



WinFrog

Integrated Navigation System

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Table of Contents

1	Introduction
2	Configuration Overview
3	Configuring Geodetics & Units
4	Working Directories
5	Working Files
6	Vehicles
7	Peripheral (I/O) Devices
8	Operator Display Windows
9	Vehicle Data Source
10	Eventing
11	Utilities
12	Simulator
13	Positioning Using Range/Range Devices
14	GPS Calculations
15	Multi-Vehicle Positioning and Telemetry
16	Controlled Remote Tug Telemetry
17	LBL Acoustics
18	USBL Acoustics
19	Special Applications
20	LBL & USBL Calibrations
21	Basic Ribbit
Tutorial	Simulated Bathymetric Survey
Appendix A	Useful Geodetic/DGPS Reference Station Information
Appendix B	WinFrog Raw File Formats

Chapter 1: Introduction

Conventions Used in this Manual	1-1
Files	1-1
Common Reference Point (CRP)	1-2
Direction and Orientation	1-2
Abbreviations	1-2
Documentation Feedback	1-2
WinFrog Applications	1-3
WinFrog Features	1-3
Core Package	1-3
Extension Modules	1-4
WinFrog Licensing and Security	1-6
Enabling CrypKey Security in the Event of a Dongle Failure.....	1-6
To Enable an Emergency License	1-7
Installing WinFrog	1-9
To Install WinFrog from a CD	1-9
Starting WinFrog	1-9
To Launch WinFrog	1-9
Using WinFrog.....	1-11
Menu Bars	1-11
Dialog Boxes	1-11
Speed Toolbar	1-12
Lower Status Bar	1-16
Capture Screen.....	1-16
Hotkeys	1-17
Printing Features	1-17
Saving the Current System Configuration	1-21
To Save a System Configuration (.cfg) file	1-22
To Load a System Configuration (.cfg) File	1-22
WinFrog_3.ini file	1-22
Exiting WinFrog.....	1-23
To Exit WinFrog	1-23

Chapter 2: Configuration Overview

New Project Wizard	2-1
To Setup a New Project	2-1

Chapter 3: Configuring Geodetics & Units

Geodetics	3-1
To Configure the Geodetic Parameters	3-1
General Projection	3-3
Map Projections	3-4
To Configure a UTM Projection.....	3-5
To Configure a State Plan Coordinate System (SPCS) Projection	3-7
User Specific Projection Configuration.....	3-7
To Configure a Lambert Projection.....	3-8
To Configure the Local Coordinate System Projection	3-9
To Configure the Mercator (Clarke 1866 or WGS 84) Projection	3-10
To Configure an Oblique Mercator Projection	3-12
To Configure a Plant Grid Coordinate System Projection.....	3-13
To Configure the Lambert Projection for a Local Coordinate System.....	3-15
To Configure the Polar Stereographic Projection	3-15
To Configure a Station/Offset Coordinate System.....	3-16
To Configure a Transverse Mercator Projection.....	3-17
Ellipsoidal Datum Parameters	3-18
To Edit the Ellipsoidal Datum Parameters	3-18
Units.....	3-20
To Configure Units	3-20
WinFrog Line Tracking Process.....	3-23

Chapter 4: Working Directories

To Configure the Working Directories	4-1
The Working Directories Tab	4-1
To Change the Filing Directory.....	4-2

Chapter 5: Working Files

Selecting Working Files	5-2
Working Files Dialog Box	5-2
To Configure a Working File Using the Working Files Dialog Box	5-3
Creating and Selecting Less Common Working Files	5-4
To Create a .XPT, .CLS, .VEL, or .CET file	5-4
To Designate an Existing File as the Working File.....	5-5

To Create a .MKI file	5-5
Working Survey Lines (.PTS) File	5-6
To Create or Select the Working Survey Lines File	5-7
To Select a Track Route (.TRK) as the Survey Line	5-7
Editing the Contents of the Working Survey Lines File	5-7
To Edit the Working Survey Lines File	5-7
Creating a New Survey Line	5-8
To Create a New Survey Line	5-8
Overage Loop Option	5-10
To Apply an Overage Loop.....	5-10
Defining Curves in a Survey Line	5-12
Creating New Survey Lines Parallel to Existing Survey Lines	5-13
To Create Survey Lines Parallel to Existing Survey Lines.....	5-13
Creating a Grid of Survey Lines Around a Point	5-14
To Create a Grid of Survey Lines	5-14
Using the Kilometer Post Control in the Survey Line Dialog	5-16
Line Information	5-18
Event Control - SOL Event.....	5-18
Vessel Approach Alarm	5-18
Editing the Working Survey Lines File.....	5-19
To Edit the Working Survey Lines File	5-19
To Edit a Survey Line.....	5-19
Deleting a Survey Line	5-19
To Delete a Survey Line	5-19
Creating a Survey Line from the Working Waypts File	5-20
To Create a Survey Line from Waypoints in the Working Waypoints File	5-20
Creating a Survey Line from the Working Logs File	5-20
Tracking a Survey Line From the Working Survey Lines File	5-23
To Enable Survey Line Tracking.....	5-23
Working Waypoints (.WPT) File	5-23
Adding a Waypoint to the Working Waypoints (.WPT) File.....	5-24
To Create or Select the Working Waypoints File.....	5-24
Creating New Waypoints	5-24
To Create a New Waypoint from Within the Working Waypoints File	5-24
To Create a Waypoint Using the Graphics Window Shortcut.....	5-26
Editing the Contents of the Working Waypoints File.....	5-27
To Edit a Waypoint in the Working Waypoints File.....	5-27

Removing Waypoints from the Working Waypoints File.....	5-27
To Remove Waypoints from the Working Waypoints File.....	5-27
Tracking a Waypoint Contained in the Working Waypoints File.....	5-27
To Enable Waypoint Tracking	5-28
Working Data (.ALG) File	5-28
Creating or Selecting the Working Data (.ALG) File	5-29
To Create a New Working Data (.ALG) File	5-29
Adding a Data (.DAT) File to the Working Data (.ALG) File.....	5-30
To Add Existing Data (.DAT) Files to the Working Data (.ALG) File.....	5-30
Editing the Working Data (.ALG) File.....	5-32
To Edit Data Contained in the Working Data (.ALG) File	5-32
To Add data to the Working Data (.ALG) File	5-34
To Delete data from the Working Data (.ALG) File	5-34
Creating a Histogram of Data (.DAT) File Events	5-34
To Generate a Histogram of Offtrack Data from a Data (.DAT) File.....	5-34
Working Seismic Sources (.ASC) File.....	5-35
Creating the Working Seismic Sources (.ASC) File	5-35
To Create the Working Seismic Sources File.....	5-36
Adding Source Files to the Working Seismic Sources (.ASC) File	5-37
To Add Existing Source Files to the Working Seismic Sources File.....	5-37
To Configure WinFrog to Create Source (.SRC) Files.....	5-37
Editing the Working Seismic Sources (.ASC) File	5-38
To Edit Data Contained in the Working Seismic Sources (.ASC) File.....	5-39
To Add Data to the Working Seismic Sources (.ASC) File.....	5-40
To Delete Data from the Working Seismic Sources (.ASC) File	5-40
Creating a Histogram of the Source File Data	5-41
To Generate a Histogram of Offtrack Data in a Source (.SRC) File.....	5-41
Working Seismic Receivers (.ALL) File.....	5-41
Creating a New Working Seismic Receivers (.ALL) File.....	5-42
To Create a New Working Seismic Receivers (.ALL) File	5-42
Adding a .RCV File to the Working Seismic Receivers (.ALL) File	5-43
To Add Existing (.RCV) Files to the Working Seismic Receivers (.ALL) File	5-43
To Configure WinFrog to Create Receiver (.RCV) Files	5-44
Editing the Working Seismic Receivers (.ALL) File	5-46
Creating a Histogram of the Seismic Receivers (.ALL) File	5-49
To Generate a Histogram of Offtrack Data in a Receiver (.RCV) File	5-49

Working Logs File.....	5-49
To Create or Select the Working Logs (.LOG) File	5-49
Editing the Contents of the Working Logs File.....	5-50
To Edit the Contents of the Working Logs File	5-50
Deleting a Manual Event from the Working Logs File.....	5-51
To Remove a Manual Event.....	5-51
Working Picture (.PIC) File	5-51
To Create or Select the Working Picture File.....	5-52
Creating a Line in the Working Picture File	5-52
Creating a Circle in the Working Picture File.....	5-55
Importing Files.....	5-57
To import drawing files into WinFrog:	5-57
Editing the Working Picture File	5-58
To Edit the Working Picture File	5-58
Removing an Item from the Working Picture File.....	5-58
To Remove a Picture Point from the Working Picture File	5-58
Working Charts (.RML) File	5-59
To Load a New Working Chart (.RML/.BSB/.HDR) File	5-59
Working CRDD Database (.MDB) File	5-60
To Load a New CRDD Database (.MDB) File	5-60
To Edit the Working CRDD (.MDB) File	5-60
Working Transponders (.XPT) File	5-61
Overview of the Working Xponders Types	5-62
Working with Xponders Files (*.XPT).....	5-65
Editing the Working Xponders File	5-67
To Open the Working Xponders File.....	5-67
To Add a Transponder to the Working Xponders File.....	5-67
To Delete a Transponder from the Working Xponders File.....	5-68
To Edit a Transponder in the Working Xponders File.....	5-68
Special Case: Double Occupancy	5-69
To Configure the Fixed Transponder Networks.....	5-69
To Print the Transponder File	5-71
To View the Transponder File Summary.....	5-72
Editing Xponders.....	5-74
Editing Standard Xponders	5-75
Processing the Inclinator Data	5-87
To Print The Transponder Configuration	5-90

Editing Non-Standard Xponders	5-91
Working Control Stations (.CLS).....	5-99
Creating a Working Control Station (.CLS) File.....	5-99
To Create a New Working Control Stations File	5-99
To Add a Control Station to the Working Control Stations File.....	5-99
Editing the Working Control Stations File.....	5-101
To Edit Parameters in the Working Control Stations File	5-101
Removing a Control Station from the Working File.....	5-101
To Remove a Control Station from the Working Control Station File	5-101
Working Velocities (.VEL) File	5-101
Creating and Opening the Working Velocities File	5-102
To Create a New Velocity File.....	5-102
To Open a Velocities File	5-103
To Designate a Velocities File to be the Working Velocities File	5-103
Editing the Working Velocities File	5-103
To Open the Working Velocities File	5-103
To Add a Velocity Record to the Working Velocities File.	5-103
To Edit a Velocity Record in the Working Velocities File	5-104
To Delete a Velocity Record in the Working Velocities File.....	5-105
Printing a Working Velocities File.....	5-105
Viewing a Velocities File Graphically	5-105
Working Cable Events (.CET) File.....	5-107
Creating the Working Cable Events File	5-107
To Create a New Working Cable Events File	5-107
Editing the Working Cable Events File	5-107
To Edit the Contents of the Working Cable Events File.....	5-108
Deleting a Cable Event.....	5-110
To Remove a Cable Event	5-110
To Add a Cable Event to the Working Cable Events File.	5-110

Chapter 6: Vehicles

Adding a Vehicle	6-1
To Add a Vehicle to WinFrog.....	6-1
Configuring a Vehicle	6-2
Vehicle Presentation	6-3
To Display the Vehicle Presentation Window	6-3
Configure Vehicle Outline	6-7
To Configure a Vehicle's Outline.....	6-7

To Define a Vehicle's Dimensions	6-9
To Define a Moonpool.....	6-9
To Define a Vehicle's Outline using the Outline Entry Method	6-9
To Define a Vehicle's Outline using the Graphical Entry Method	6-11
MSEditor	6-13
Configure Vehicle-Devices	6-16
To Configure a Vehicle's Devices	6-17
Configure Tracking Offsets	6-22
To Configure Tracking Offsets	6-22
Configure Fairleads/Anchors.....	6-23
To Configure Fairleads and Anchors	6-24
Setup Vehicle Rings.....	6-25
To Setup Vehicle Rings.....	6-25
Setup Waypoint Tracking.....	6-26
To Setup Waypoint Tracking	6-26
Setup Line Tracking.....	6-29
To Configure a Vehicle to Track a Survey Line	6-29
Setup Dynamic Tracking.....	6-31
To Setup Dynamic Tracking Vehicles and Tracking Points	6-31
To View the Dynamic Tracking Information	6-35
Acoustic Calibration.....	6-37
Setup Data Events	6-37
Deleting a Vehicle	6-37
To Delete a Vehicle	6-37

Chapter 7: Peripheral (I/O) Devices

Adding a Device	7-1
To Add a Device to WinFrog	7-2
Device I/O Parameters Dialog Box	7-4
NovAtel PC Card	7-6
Editing Device Input/Output Parameters	7-7
To Edit WinFrog's Input/Output Parameters for a Device	7-8
Configuring Generic Device Parameters	7-8
To Configure Generic Device Parameters	7-9
Enabling the Timeout Warning.....	7-9
To Enable or Disable the Timeout Warning for a Device	7-9
Deleting a Device	7-10
To Delete a Device	7-10

Time Synchronization.....	7-11
Adding I/O Socket Devices.....	7-13
Configuring Socket Devices	7-13
To Configure the I/O device "WriteToSocket"	7-13
To Configure the I/O device "ReadSocket"	7-14

Chapter 8: Operator Display Windows

Maximizing Available Monitor Space.....	8-2
To Maximize Available Monitor Space.....	8-2
Virtual Screen Configuration	8-2
To Configure Virtual Screens	8-3
I/O Devices Window	8-5
To Display the I/O Devices Window.....	8-5
Graphics Window.....	8-6
To Display a Graphics Window	8-7
To Configure the Graphics Window.....	8-7
Charts	8-21
To Display a Raster Chart - Method 1	8-21
To Display a Raster Chart - Method 2	8-23
Raster Chart Viewing Tips/Hints.....	8-23
To Center the Graphics Display at the Middle of the Chart.....	8-25
ARCS Charts.....	8-26
To Display an ARCS Chart Using 2 CD-ROM Drives	8-26
To Display an ARCS Chart by Copying the Chart CD to the Hard Drive.....	8-28
To Display an ARCS Chart by Copying Update Directories to the Hard Drive	8-29
Troubleshooting Chart Problems.....	8-32
Blue Marble Map File Support.....	8-33
To Display a Blue Marble Map File	8-33
User Drawing Support	8-35
To Draw Graphic Objects When a Blue Marble Map (BMM) File is Displayed	8-35
To Draw Graphic Objects on an Existing Blue Marble Layer File (BML)	8-36
To Draw Graphic Objects on an Empty Background	8-37
To Save Graphic Objects to a Blue Marble Layer File	8-39
To Append Graphic Objects to a Blue Marble Layer (BML) File	8-40
To Edit User-Drawn Graphic Objects.....	8-40
Displaying a C-Map Vector Chart in WinFrog	8-41
To Display a C-Map Vector Chart.....	8-41
C-Map Vector Chart Feature Levels	8-43

To Bypass the Default Precision Value Associated with an Entered Scale	8-44
To Use WinFrog's Map Projection	8-44
To Indicate Illumination	8-45
Profile Window.....	8-45
To Display the Profile Window	8-45
To Configure the Profile Window	8-46
Profile Window Toolbar.....	8-53
Vehicle Text Window.....	8-55
To View the Vehicle Text Window	8-56
To Configure the Vehicle Text Window.....	8-56
To Remove a Vehicle's Data from Display in the Vehicle Text Window	8-60
Acoustics Window	8-60
To Display the Acoustics Window.....	8-60
Anchor Handling Window	8-82
To Configure a Vehicle as a Barge Vehicle	8-82
To Display and Configure the Anchor Handling Window.....	8-84
To Configure the Anchor Event Printing	8-89
Alarms Window	8-90
To Display the Alarms Window	8-90
To Configure Alarms.....	8-90
Attitude Window	8-92
To Display the Attitude Window	8-92
Auditor Window	8-94
To Display the Auditor Window	8-94
To Re-Open the Auditor Window	8-95
Bird's Eye Window	8-96
To Display the Bird's Eye Window	8-96
To Configure the Bird's Eye Window	8-97
Calculations Window	8-97
To Display a Calculations Window.....	8-98
To Configure the Calculations Window	8-98
To Perform a Position Comparison	8-100
To Configure a Position Comparison Histogram.....	8-102
To Configure the Time Series Graph	8-103
Controlled Remote Window	8-105
Distance Counter Window	8-106
To Display the Distance Counter Window	8-106

Dynamic Tracking Window	8-107
To Display the Dynamic Tracking Window.....	8-107
Helmsman Display	8-108
To View the Helmsman Display.....	8-108
To Configure the Helmsman Display	8-109
Level Bubble Window	8-110
To Display a Level Bubble Window.....	8-110
To Configure the Level Bubble Window	8-111
Numerics Display.....	8-112
To View the Numerics Display.....	8-112
To Configure the Numerics Display	8-112
To Add an Item to the Numerics Display	8-114
Smart Remote Control.....	8-115
Network Communications.....	8-115
Remote Position Data Reception	8-116
Remote Configuration	8-117
Master WinFrog Operation.....	8-118
Tracking Offsets Window.....	8-121
To Display the Tracking Offsets Window	8-122
Cable Model Windows	8-122

Chapter 9: Vehicle Data Source

To Configure a Vehicle's Data Source.....	9-2
Simulated Data Source Configuration.....	9-3
Network Data Source Configuration	9-4
To Manually Configure a Smart Remote.....	9-5
To Configure the Primary System for Network Data Output	9-7
Controlled Remote Data Configuration	9-8
Real-Time Data Source Configuration.....	9-8
Adding a Peripheral Device to a WinFrog Vehicle.....	9-8
To Add Data Generated by Peripheral Devices to a WinFrog Vehicle.....	9-9
Editing a Vehicle's Peripheral Devices.....	9-9
To Edit the Configuration of an I/O Device Once Added to a Vehicle.....	9-10
Deleting a Vehicle's Peripheral Device.....	9-10
To Remove a Device from a Vehicle's Calculations	9-10
File Data Source Configuration	9-11
To Use .raw File Data as a Position Source	9-11

Pipe Track Data Source Configuration	9-14
To Configure Touchdown Point Positioning Based on a Layback From a Reference Vehicle	9-15

Chapter 10: Eventing

Types of WinFrog Events	10-1
Automatic Events	10-1
Manual Event	10-2
Cable Events.....	10-3
Configuring Vehicles for Automatic Events	10-4
To Configure a Vehicle as Event Primary	10-4
To Configure a Vehicle as Event Secondary.....	10-5
Enabling and Activating Automatic Events.....	10-5
To Enable Automatic Event Recording	10-5
To Configure the Event Secondary Configuration Dialog Box.....	10-15
To Configure the Distance Fixing Dialog Box.....	10-17
To Activate Data Recording	10-19
To Stop Recording Data	10-20
Manual Events	10-20
To Record a Manual Event	10-21
To Edit a Manual Event After it has been Recorded.....	10-22
Cable Events.....	10-22
To Record a Cable Event	10-22
To Edit a Cable Event After it has been Recorded	10-24

Chapter 11: Utilities

Geo/Grid Conversion.....	11-3
To Convert Geographic Coordinates to Grid Coordinates	11-3
To Convert from Grid Coordinates to Geographic Coordinates	11-4
KP/Coordinate Conversion	11-4
To Convert KP Values to Geographical/Grid Coordinates	11-4
To Convert Geographical/Grid Coordinates to KP Values	11-6
Datum Transformations	11-7
To Convert Coordinates from WGS84 to the Working Datum	11-7
To Convert Working Geodetic Datum Coordinates to WGS84	11-8
Forward/Inverse Calculations	11-8
To Calculate the Range and Bearing from One Known Point to Another Known Point	11-9
To Calculate the Coordinates of a Point by Entering a Range and Bearing from a Known Coordinate	11-10

LOP/Position Calculation	11-11
To Access LOP/Position Calculation	11-11
Acoustic Utilities	11-19
Map Wizard.....	11-20
To Create a BMM map file.....	11-20
Plotter Base Map Wizard	11-25
To Add The Plotter to WinFrog.....	11-25
To Generate a New Base Map	11-25
To Register an Existing Map and Plot to it in Real Time.....	11-30
Generate DXF Map.....	11-34
To Create a .DXF Format Map	11-34
Map Parameters Dialog Box	11-36
Select Grids Dialog Box	11-37
Select Data Dialog Box	11-39
Select RAW Data Dialog Box	11-42
To Plot Raw Positional Data in the DXF Map	11-42
Generate MGD77 File	11-44
File Formats	11-44
Header Page Buttons	11-47
Time Period Data.....	11-50
Time Conversion	11-50
To Convert DOS Time to ASCII Time.....	11-50
To Convert ASCII Time to DOS Time:.....	11-51
Position Averaging.....	11-51
To Record Vehicle Positions into an .aep File	11-52
To Record an .aep File.....	11-52
To Load and View Average Position Data	11-53
To Edit and Re-Calculate Average Position Data	11-55
To Print and Save Average Position Data	11-56
Import Bathymetry	11-56

Chapter 12: Simulator

Simulated Devices.....	12-2
To Set the Vehicle Data Source to Simulated	12-2
To Add a Simulated Real-Time Device	12-2
To “Generically” Configure a Simulated Device.....	12-3
To Configure the Simulated GPS Device	12-3
To Configure the Simulated USBL Device	12-4

To Configure the Plow Simulator.....	12-5
To Configure the Simulated Counter	12-6
To Configure the Simulated Attitude Sensor	12-7
To Add a Simulated Real-time Device to a Vehicle.....	12-8
To Configure a Simulated Real-time Device for a Specific Vehicle	12-8
Controlling Simulated Devices	12-9
Controlling the Simulated Devices Via The Toolbar Buttons.....	12-9
To Configure the Toolbar Button Controls	12-9
Toolbar Simulator Controls	12-11
To Use the Toolbar Simulator Control Buttons	12-11
Chapter 13: Positioning Using Range/Range Devices	
Working Control Station File	13-1
Range/Range Devices	13-2
To Add a Range/Range Peripheral I/O Device	13-2
To Add a Range/Range I/O Device to a Vehicle.....	13-2
Configuration of a Range/Range Device	13-3
To Configure the Range/Range Device	13-3
To Add a Station to the Solution.....	13-5
To Remove a Station from the Solution	13-6
Editing Range Use in the Solution.....	13-6
To Monitor Range/Range Data in the Calculations Window	13-7
Chapter 14: GPS Calculations Extension Module	
Pseudorange Positioning.....	14-1
Differential GPS (DGPS)	14-3
RTCM Data.....	14-4
DGPS Solutions in WinFrog.....	14-4
To Configure GPS Calculations	14-5
To Add a GPS Device to WinFrog	14-5
To Generically Configure a GPS Device.....	14-6
To Add a GPS Device's Data Items to a WinFrog Vehicle's Devices List	14-7
To Configure a GPS Device for a Vehicle Using GPS Calcs Module	14-8
To Configure the Phase Smoothing Filter	14-13
Applying RTCM Corrections to WinFrog Pseudorange Position	
Calculations	14-14
To Add RTCM Device(s) to WinFrog.....	14-15
To Add an RTCM Device to a Vehicle's Device List	14-16

To Configure an RTCM Device in a Vehicle's Device List for use with the GPS Calcs Module	14-16
To Enable/Remove an RTCM Source in WinFrog's Pseudorange Calculations	14-18
Alarms.....	14-19
To Configure Alarms	14-21
UKOOA Statistical Testing	14-23
w-Test	14-23
F-Test	14-23
To Configure Statistical Tests	14-24
Monitoring of Statistical Tests	14-25
To Display the Results of the Statistical Testing.....	14-25
GPS Pod Positioning	14-25
To Track a GPS Pod in WinFrog.....	14-25
GPS Calculation Displays	14-27
To View Pseudorange Calculation Data	14-27
Multi-Ref Summary Page	14-29
Individual Reference Station Display Page(s)	14-30
To Display Pseudorange Calculation Results in the Calculations Dialog Box.....	14-30
To Display Pseudorange Calculation Data in the Calculations Dialog Box.....	14-33
To Display Pseudorange Calculation Statistics in the Calculations Dialog Box.....	14-36
Reference Station Integrity Monitoring (RSIM) Features.....	14-39
Reference Station Configurations	14-39
Single Reference Station Component Configuration	14-41
To Configure a GPS Receiver for DGPS Positioning.....	14-42
Use of RSIM at the Remote Station.....	14-46
To Configure a Remote Station to Use RTCM/ RSIM Data	14-48
To Turn on the Audible and Visual Alarms.	14-49

Chapter 15: Multi-Vehicle Positioning and Telemetry Extension Module

Network Functionality	15-2
Token Ring Network	15-2
Point-to-Point Network	15-3
Data Packet Types	15-4
Telemetry Setup	15-5
To Add the Telemetry Device	15-5
To Configure the Telemetry Device.....	15-6
I/O Devices Dialog Box.....	15-15

To Toggle Between Standard Telemetry and RTCM Displays	15-16
Transmitting/Receiving Positions	15-18
To Configure WinFrog to Transmit Position Information	15-18
To Configure WinFrog to Receive a Position.....	15-19
Transmitting/Receiving Targets.....	15-20
To Configure WinFrog to Transmit a Target Position	15-21
To Configure WinFrog to Receive a Target Position	15-22
Transmitting/Receiving RTCM Corrections	15-22
To Configure WinFrog to Transmit RTCM Corrections	15-22
To Configure a WinFrog Station to Receive and Apply RTCM Corrections.....	15-24
File Transfer	15-24
To Send a File via Telemetry	15-24
Receiving a File	15-28
To Change the WinFrog Telemetry Directory.....	15-28

Chapter 16: Controlled Remote Tug Telemetry

Overview	16-1
Security.....	16-4
Remote Sites.....	16-4
WinFrog with the Controlled Remote Tug Telemetry Module versus the WinFrog Remote Package	16-4
Remote Control with Telemetry versus TCP/IP Network	16-5
Configuring a Remote Site	16-5
To Configure a Remote Site	16-5
Remote Site Operation	16-8
Control Sites	16-9
Operation Overview	16-9
The Controlled Remote Window	16-10
To Add and Configure a Controlled Remote in the Controller's Vehicle List.....	16-11
To Connect to a Remote	16-13
To Disconnect from a Remote	16-17
To Configure the Vehicle List for the Remote	16-17
To Display the Remote Graphics at the Controller	16-19
To Send a Working File to the Remote.....	16-20
To Force an Update of the Configuration of the Vehicles on the Remote's Vehicle List	16-21
To Interrogate the Remote Vehicle Data Type List and Configuration.....	16-22
To Query the Remote Vehicle and System for Configurations	16-22

To Set the Remote's Data Transmission Rate	16-23
Monitoring and Configuring the Remote Vehicle and Graphics.....	16-24
To Configure the Remote from the Controlled Remote Window	16-24
To Interrogate the Remote from the Controlled Remote Window	16-25
Remote Control and Anchor Handling Operations	16-40
Operating Restrictions	16-40

Chapter 17: LBL Acoustics

Overview	17-1
Components	17-2
The Data	17-2
Fixed Transponder Arrays and the Working Xponder File.....	17-3
Non-Fixed Transponders and the Working Xponder File	17-4
Inverted LBL and the Working Xponder File.....	17-4
Velocity Files	17-4
Operational Modes.....	17-5
Data Items	17-6
Standard LBL Setup	17-8
To Add the LBL Device to WinFrog.....	17-8
To Configure the LBL Device	17-9
To Attach and Configure the LBL TRANSCEIVER Data Item.....	17-9
To Attach and Configure the XPONDER Data Item	17-18
To Attach and Configure the FIXED XPONDER Data Item.....	17-31
To Attach and Configure the ELEVATION Data Item	17-34
To Attach and Configure the ATTITUDE Data Item	17-36
Differential Depth Operation.....	17-37
To Implement the Differential Depth for Standard Simultaneous Positioning Operations.....	17-38
To Implement the Differential Depth for CRP Depth from Other Source Positioning Operations.....	17-38
To Implement the Differential Depth for Monitoring Depth/Attitude Operations.....	17-40
Monitoring the Standard LBL and Differential Depth Operations	17-41
To Monitor LBL Operations in the Calculation Window.....	17-41
Using the LBL Data Items Calculation Window for XPONDER and LBL TRANSCEIVER.....	17-42
Using the LBL Data Items Calculation Window for XPONDER, Depth and Attitude Only	17-47

Using the LBL Data Items Calculation Window for FIXED XPONDER	17-50
Inverted LBL Application	17-51
Overview.....	17-51
Adding the INVERTED LBL Device	17-52
Attaching Data items to the Vehicle.....	17-54
To Monitor INVERTED LBL Operations in the Calculation Window	17-65
Understanding and Using the INVERTED LBL Data Items Calculation Window.....	17-66
Editing an LBL LOP	17-75
Edit LBL Range	17-75
 Chapter 18: USBL Acoustics	
Overview	18-2
Components.....	18-2
The Data	18-2
Application.....	18-3
Attitude Data and Offsets for the Hydrophone	18-3
Attitude Data and Offsets for the Beacon	18-4
USBL Data Types.....	18-4
General USBL Setup	18-5
To Add the USBL Device to WinFrog.....	18-5
To Generically Configure a USBL Device in WinFrog	18-7
To Attach and Configure the USBL HYDROPHONE Data Type	18-7
To Attach and Configure the BEACON Data Type.....	18-13
To Attach and Configure the ATTITUDE Data Type.....	18-17
To Attach and Configure the HEADING Data Type	18-19
To Monitor the HYDROPHONE Data Type.....	18-20
To Monitor the BEACON Data Type.....	18-21
Specific USBL Setups	18-23
To Configure for Positioning the Hydrophone Vehicle	18-23
To Configure for Only Tracking the Beacon Vehicle.....	18-24
To Configure for Relative USBL Beacon Positioning for a Vehicle	18-26
To Configure for Ray Bending	18-26
 Chapter 19: Special Applications	
Doppler Speed Log.....	19-1
General Kalman Filtering	19-1

Gyro Requirements	19-2
Adding the Speed Log to WinFrog and the Vehicle	19-2
To Add the Speed Log Device	19-2
Configuring the SPEED LOG Data Type.....	19-3
Associated Configurations	19-4
Monitoring the Application of the Speed Log	19-7
To Monitor Use of the Speed Log Data Type as Attached to the Vehicle	19-7
To Monitor the Impact of the SPEED LOG Data Type	19-9
To Reset the Vehicle's Position	19-9
Calibrating the SPEED LOG Data Type	19-10
Pipe Bundle Tow Monitoring	19-14
The Pipe Bundle Traverse	19-14
Adding and Configuring the Device.....	19-15
Configuring the Pipe Bundle Vehicle	19-17
Viewing the Pipe Bundle Vehicle	19-22

Chapter 20: LBL & USBL Calibration

LBL Calibrations	20-1
LBL Transponder Array Design	20-2
LBL Transponder Deployment.....	20-3
LBL Calibration Preparation.....	20-3
LBL Calibration Data Collection.....	20-5
To Access the Acoustic Calibration Dialog	20-5
To Initiate Data Collection of Surface Range Data.....	20-16
LBL Calibration Data Editing.....	20-21
To evaluate the residuals to detect bad data	20-46
How WinFrog Bins the Data	20-47
LBL Calibration Calculations.....	20-50
To Setup the LBL Calibration Solution	20-51
To Enter Constraints for the Least Squares Adjustment.....	20-55
To Calculate the LBL Calibration Solution	20-58
Viewing the LBL Solution Statistics	20-65
Editing Calibration Station Information.....	20-68
To Edit a Calibration Base Station	20-69
To Remove a Calibration Base Station	20-71
To Edit a Working Xponder File Station	20-71
To Add a Working Xponder File Station	20-72

To Update a Calibration Base Station	20-72
To Complete the Base Station Editing	20-73
LBL Calibration Report.....	20-73
To Print an LBL Calibration Report	20-73
Recalculate LBL Data.....	20-80
Summary of the LBL Calibration Process	20-83
USBL Calibrations.....	20-84
USBL Calibration Preparation	20-85
Key Points to Review Prior to USBL Calibration	20-85
The Acoustic Calibration Dialog for Data Collection.....	20-87
To Access the Acoustic Calibration Dialog	20-87
USBL Calibration Data Collection.....	20-92
To Configure the Transducer Settings	20-98
To Collect USBL Calibration Data	20-100
To Save Calibration Data to File.....	20-101
USBL Calibration Data Editing.....	20-102
To View USBL Calibration Data for Editing	20-102
USBL Calibration Processing.....	20-115
To Setup for the Determination of the Beacon Position	20-117
To Perform the Adjustment.....	20-124
USBL Calibration Reporting.....	20-134
Recalculation of the USBL Data	20-139
Reset the USBL Calibration Data	20-140
Updating the USBL Calibration.....	20-141
To Update the USBL Calibration Data in WinFrog	20-142
Confirmation Tests	20-142
To Confirm the USBL Calibration Results	20-142
Summary of the USBL Calibration Process	20-143

Chapter 21: Basic Ribbit

Introduction.....	21-1
An Overview of Ribbit	21-2
Start Up.....	21-2
Status Window	21-2
Audit Trail “Notepad”	21-3
Menu Items	21-4

Data Input	21-6
Raw (.Raw) Files	21-6
Loading Raw (.Raw) Data Files.....	21-7
To Load WinFrog Raw (.raw) Files	21-7
To Manually Select .Raw Files	21-8
To Select .Raw Files by Time	21-9
Data (.Dat, .Rcv, .Src) Files	21-10
To Load .Dat, .Rcv and .Src Data Files	21-11
Manual Event (.Log) Files	21-11
To Load Manual Event (.Log) Files.....	21-11
XYZ Data.....	21-11
Loading Tide Files	21-13
ASCII Files	21-13
To Load an ASCII Tide File	21-14
World Tide (.Tab) Files	21-14
To Load a World Tide (.Tab) File	21-14
NOAA Tide Files	21-15
To Load a NOAA (.Tid) Tide File	21-15
MS Access (.Mdb) Data.....	21-16
To Load an MS Access (.Mdb) File.....	21-16
Tools.....	21-17
Data Operations	21-17
To Perform Data Operations	21-17
Merging / Deskewing.....	21-19
To Merge Data Items.....	21-19
Interpolation	21-21
To Interpolate Data	21-21
Apply Corrections	21-22
To Apply a Correction to a Data Item.....	21-22
Filtering & Thinning.....	21-24
To Thin Out a Data Item.....	21-24
To Filter a Data Item.....	21-26
To Apply a Gate Filter to a Data Item	21-26
To Apply a Mean Filter to a Data Item	21-27
To Apply a Median Filter to a Data Item.....	21-27
To Apply a Central Tendency Filter	21-28
Configure/Transform Geodetics	21-29

To Change a Data Item's Geodetics.....	21-29
Apply Offsets	21-30
To Apply a Horizontal Offset to a Positional Data Item.....	21-30
Overplot Removal	21-31
To Apply Overplot Removal to a Three Dimensional Data Item	21-32
Interactive Data Editor	21-33
To Edit a Data Item using the Interactive Data Editor	21-33
Spreadsheet Editor	21-35
To Edit a Data Item Using the Spreadsheet Editor	21-35
Data Output	21-36
ASCII File Output	21-37
To Output Data as ASCII Text	21-37
DXF File Output	21-38
To Create a DXF Chart	21-39
DXF File Output Font Options	21-46
MS Access™ .MDB File Output	21-47
To Output Data to a .MDB File	21-47

Tutorial: Simulated Bathymetric Survey

Procedural Steps.....	T-1
Sample Project.....	T-2
First Steps.....	T-3
Geodetics	T-3
To Configure Geodetics	T-4
Units of Measure	T-6
To Configure Units of Measure	T-6
Working Directories.....	T-8
Working Files	T-9
To Define the Working Files	T-9
I/O Devices (Peripheral Devices)	T-11
To Add Peripheral Devices to WinFrog	T-11
Viewing the I/O Device Data.....	T-13
To View the I/O Devices Window.....	T-14
Configure the Vehicle.....	T-15
To Configure a Vehicle.....	T-15
Vehicle Dimensions	T-17
To Configure a Vehicle's Dimensions	T-17

Defining the Vehicle's Data Source and Devices	T-18
To Define the Vehicle's Data Source.....	T-19
Vehicle Tracking Offsets	T-23
Vehicle Text Window	T-25
To Display the Vehicle Text window	T-25
To Configure the Vehicle Text Window	T-26
Graphics Window/Display	T-27
To Display the Graphics Window	T-27
To Configure a Graphics Window	T-28
Graphics Display Zooming.....	T-29
To Zoom Out.....	T-30
To Zoom In.....	T-30
Vehicle Navigation in Simulation Mode	T-30
To Change the Position of the Vehicle.....	T-30
To Change a Vehicle's Position Using the Display Position Feature	T-31
Driving the Vehicle in Simulation Mode.....	T-31
To Configure the Simulator	T-31
To Drive the Vehicle in Simulation Mode.....	T-32
Survey Lines and Waypoints	T-32
Survey Lines	T-33
To Create New Survey Lines.....	T-34
To Create Survey Lines Parallel to an Existing Survey Line	T-36
Waypoints.....	T-37
To Create New Waypoints	T-37
Tracking a Waypoint.....	T-39
To Track a Waypoint	T-39
Collecting Data: Events.....	T-40
Automatic Eventing.....	T-40
Raw Data.....	T-41
Manual Fixing	T-42
Configuring a Vehicle for Automatic Events	T-43
To Define the Event Primary Vehicle.....	T-44
Configuring Automatic Events	T-45
To Configure Automatic Events	T-45
Eventing is Active	T-48
Tracking up the Screen	T-49
To Change the Rotation of the Graphics Display.....	T-49

Attitude	T-49
To View the Attitude Display	T-49
Starting to Record Automatic Events with Autostart	T-50
To Record Automatic Events with Autostart Activated	T-50
Stopping/Re-starting Eventing	T-51
To Stop Eventing	T-51
To Re-start Eventing	T-51
Checking the Survey Data	T-51
To Check the Recorded (.DAT) Data	T-52
To Check the Raw (.RAW) Data	T-52
Completing the Survey	T-52

Chapter 1: Introduction

This User's Guide is written with the assumption that users are familiar with the operation of Microsoft Windows™ and have some familiarity with the use and purpose of integrated navigation systems. If you are unfamiliar with the Windows environment, you should spend some time reading Windows documentation prior to operating WinFrog as this will explain some of the basic features and concepts of the Windows operating system.

Of critical importance is the ability to navigate through the various windows of the program. WinFrog allows you to open dialog boxes and select various options by using a mouse or by the use of "**shortcut keys**" (i.e. File > Open = Ctrl + O). A WinFrog function can be enabled by simultaneously holding the ALT key and selecting the desired underlined control letter. In WinFrog, it is much more efficient to use the mouse to highlight, copy, and paste variables. Most WinFrog windows also have a configuration shortcut that is accessed by clicking the right mouse button when the mouse pointer is within the border of the desired window.

The use of a file management program such as **Windows Explorer™** is required to support WinFrog. In particular, you should be proficient in the creation of new folders and copying and moving existing files.

You should also know how to edit the contents of a file. All of WinFrog's files are written as simple ASCII text, so standard Windows™ editing programs such as **WordPad™** and **NotePad™** can be used to display the contents.

This document is written in reference to WinFrog version 3.4 (released January 2004). You can determine which version of WinFrog you are using by selecting **Help > About WinFrog** from the menu bar.

Conventions Used in this Manual

Files

All files used and created by WinFrog have unique three letter file extensions. As these extensions are unique to WinFrog, they are not automatically associated with any type of Windows™ program. See **Appendix B: WinFrog File Formats** for more detailed information concerning the structure and contents of individual WinFrog files.

Common Reference Point (CRP)

All locations on a vehicle are defined in relation to a reference position on that vehicle. This reference position is called either the **Common Reference Point (CRP)** or the **origin**. Typically, this is the position of the GPS antenna, but it can be any point on the vehicle, i.e., the point of the bow, the mount of the sounder transducer, the main mast, the center of the stern, the center of mass, etc. Once the location of the **CRP** has been determined, all **offset** measurements must be made from that location in order to obtain accurate results.

Direction and Orientation

Offsets **forward** and **starboard** from the **CRP** are **positive** values.

Offsets **aft** and **port** from the **CRP** are **negative** values.

Abbreviations

CRP	common reference point
comm	communications
COG/CMG	Course Over Ground/Course Made Good
I/O	input/output
QC	quality control
config	configuration

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WinFrog Applications

The WinFrog integrated navigation and data management software is suitable for a wide variety of applications in marine, land, and air environments and is now being used for numerous applications on over 400 vehicles worldwide:

- Fleet Monitoring
- Remote Vehicle Tracking
- Cable and Pipelaying Operations
- Bathymetric Surveys
- Geophysical Surveys
- Seismic Surveys
- Drill Ship/Rig Positioning
- Land Surveying
- Real-Time Aeronautical Vectoring

Though these are some of the more common applications, the potential use of WinFrog in any environment is unlimited. The WinFrog suite of programs continues to evolve and develop as users find new applications for the system and as new computer, data acquisition, and data processing systems come onto the market.

WinFrog Features

The WinFrog integrated navigation software consists of a “core” package with several add-on modules that allow the choice of a final system configuration best suited to the particular positioning and processing requirements. The core WinFrog package contains features that are beneficial to all uses; while the features provided in additional modules typically apply to specific applications.

Core Package

Graphics

Separate windows are provided for graphics, vehicle control, device control, track following, and quality control. Multiple windows may be opened and controlled independently. It is also possible to have multiple instances of the same window for use on different workstations.

WinFrog supports the display of vector and raster data, i.e. shorelines, hazards, and navigation charts. Vector data can be imported in a variety of formats including DXF, DWG and DGN files or electronic charts, while raster data is imported in a number of common graphics formats or as electronic charts and can be used to provide a level of visual detail not obtainable with vector charts alone. Several different layers of chart and graphics can be displayed

simultaneously in the **Graphics** window and can be toggled on and off with a button click. The chart, like the vector display, can be scaled, panned, and rotated. In some cases, the chart color scheme can be changed to provide optimal contrast between the chart and the vector display or to enhance visibility at night.

Devices

WinFrog supports over 300 different peripheral devices, with the capability to simultaneously use over 30 devices, including multiple copies of the same device. Device data can be received in either industry-standard **NMEA** or customized formats. Alphanumeric windows display the raw data for each device configured in WinFrog. WinFrog serves as a data management system by collecting and distributing data for an entire project. Raw data for each device can be logged for future calculations, processing, and playback.

Vehicles

WinFrog supports the configuration of multiple vehicles, each using different peripheral devices. The calculation of each vehicle's position can be independently defined. Each vehicle can have its own shape and offsets, track its own waypoints, and line track. Events can be generated by any one of the multiple vehicles and raw device data for each vehicle can be logged for future use. Alphanumeric windows for each vehicle are user-configurable to display various parameters, such as position, speed, heading, course of advance, waypoint and line track, and crosstrack error.

Extension Modules

In addition to the Core WinFrog package, there are several extension modules to augment WinFrog's capabilities.

GPS Calculations Extension Module (GPS Calcs)

The GPS Calculations Extension Module of WinFrog provides multiple reference station DGPS positioning by combining raw pseudoranges and RTCM differential corrections in a weighted position solution. Kalman filtering and user-defined DOP gates can be selected to smooth data and reject spikes inherent in the GPS measurement system.

Extensive quality assurance of the DGPS position is achieved through the use of UKOOA standard statistical testing. The **Calculations** window can be used as a real-time display of various statistical testing and GPS calculation results, including vessel position, statistical position error and residuals, satellites used with their elevations, signal to noise ratio, differential corrections, age of differential corrections, and dilution of precision values.

WinFrog has the capability to perform visual quality control checks on some of its functions. In the **Calculations** window, which was designed for QA/QC purposes, you have the ability to view time series plots for all input and output data types and to monitor the data quality. The type of data viewed in a window, the scale of the data being displayed, and the width of the display window are all user-definable.

Multiple Vehicle Positioning and Telemetry Extension Module (MVP&T)

The WinFrog integrated navigation system supports a sophisticated, wireless, inter-vehicle telemetry network that enables position information from remote vehicles to be transmitted to other vehicles in the network. This ability is available in the Multiple Vehicle Positioning and Telemetry Extension Module. Each vehicle has the capability to transmit its own position as well as receive and display the positions of other vehicles in the network, all in real-time. Position information for each vehicle can be recorded at any one vehicle or at all of the other vehicles. Vehicle positions can also be monitored by transmitting observed raw pseudorange data to another vehicle. The remote WinFrog system will then calculate that vessel's position from the pseudorange data and available RTCM information. In addition to transmitting position information, files and RTCM corrections can be transmitted between vehicles in the network.

Controlled Remote, LBL Acoustics, and Cable Management

WinFrog supports the use of one site controlling the operation of a remote site. The WinFrog Controlled Remote Tug Telemetry Extension Module enables one central WinFrog system to control a series of remote WinFrog systems. This is useful for a project utilizing a barge with several anchor handling tugs.

WinFrog supports the use of long baseline (LBL) acoustic technology. The WinFrog LBL Acoustics Extension Module provides the ability to calibrate and utilize LBL systems to enable accurate real-time positioning of a vehicle far below the ocean surface.

The WinFrog Cable Management Extension Module, in conjunction with the Cable Route Design Database, enables modeling and monitoring of submarine cables during cable lay operations. This software assists cable lay personnel with decisions regarding ship speed, cable tension, and cable payout speed to reach design goals.

WinFrog Licensing and Security

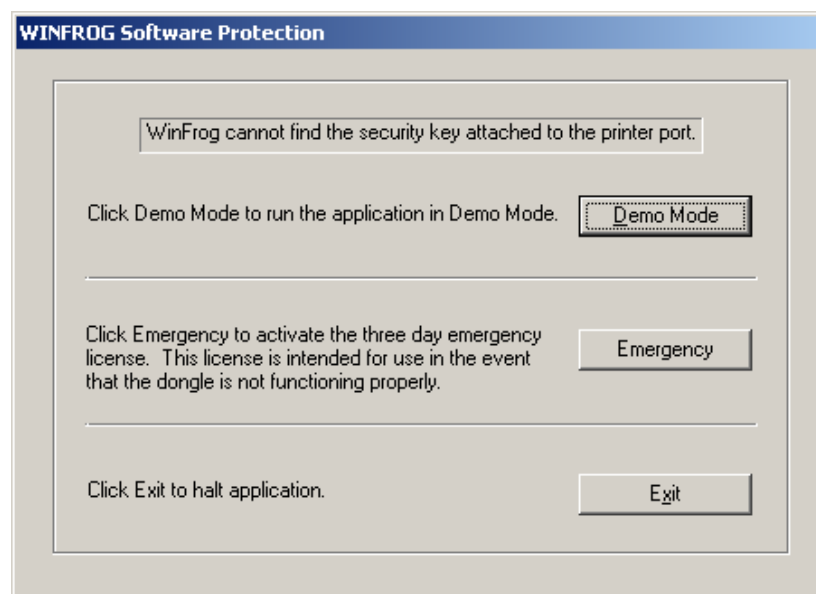
Fugro Pelagos, Inc. provides a hardware licensing security system (dongle) and an emergency license for our software programs. The primary system uses a **DESkey™ dongle** that you attach to the computer's parallel printer port. This dongle is issued to you at the time of purchase and represents your software license. The backup emergency system uses **CrypKey™**, a system that uses a licensing feature coded into the software program.

WinFrog requires security approval in order to have all of WinFrog's capabilities made available. When you run WinFrog for the first time you will be prompted for the licensing method to use – either a DESkey dongle or a CrypKey license. Ensure that the default option of **DESkey dongle security** is selected. (See **Starting WinFrog** later in this chapter.)

Without the security approval, WinFrog will only run in **Demonstration Mode (Demo)**. In Demo mode, real-time peripheral devices can be added to and are decoded by WinFrog, with the data visible in the **I/O Devices** window, but the data generated by these peripheral devices cannot be added to a vehicle. Only data generated by simulated peripheral devices can be added to a vehicle while WinFrog is running in **Demo** mode.

Enabling CrypKey Security in the Event of a Dongle Failure

In the event that the DESkey dongle fails during a survey operation, the Emergency License can be activated to allow continued WinFrog operation until a replacement DESkey dongle is obtained. If WinFrog is started and the dongle is not detected, the following dialog will be displayed.



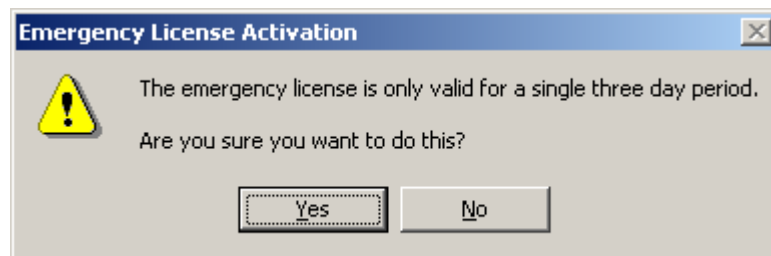
The Emergency License will allow WinFrog to be used for three days, allowing time to contact Fugro Pelagos to resolve your WinFrog licensing problem.

Note: The emergency license can only be used for a single 3-day period, starting from the time the emergency license is first activated, unless an extended emergency license is obtained from Fugro Pelagos.

Before enabling an emergency license, first check the printer port to ensure that the dongle is correctly attached. If it is attached correctly, but still fails, follow the steps below.

To Enable an Emergency License

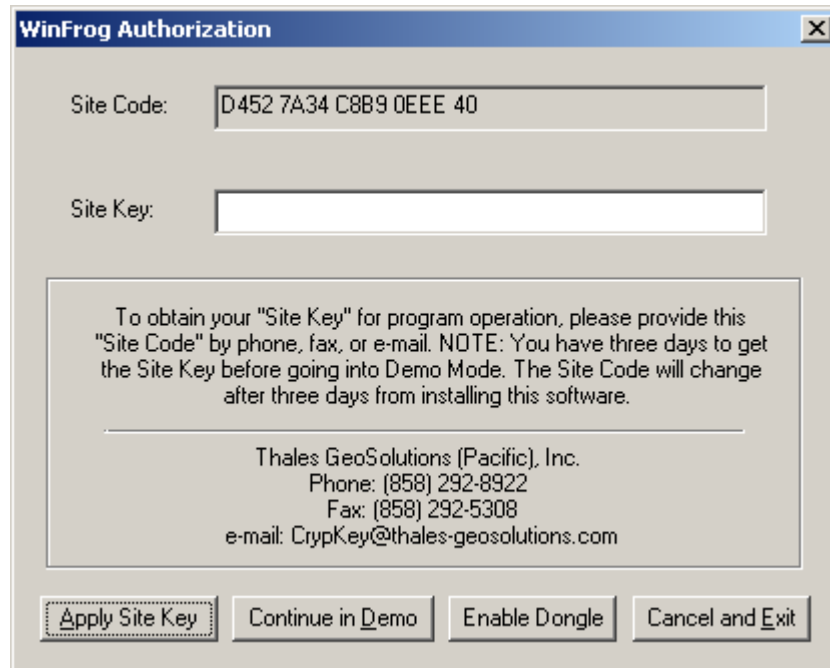
- 1 Click the **Emergency** button in the **WinFrog Software Protection** dialog. The following dialog displays.



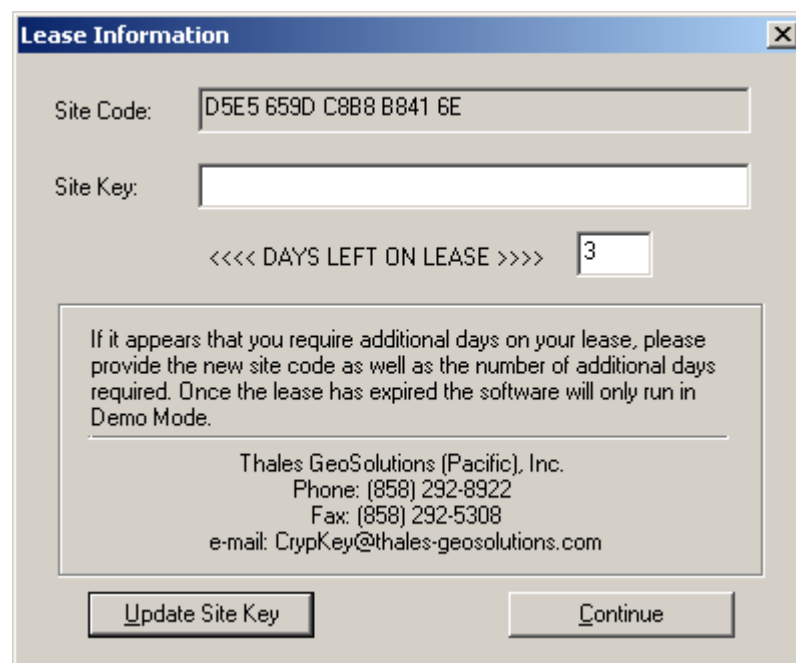
- 2 Click **Yes** to activate the emergency license. The following dialog displays.



- 3 Click **OK**. WinFrog will shut down.
- 4 Restart WinFrog. The **WinFrog Authorization** dialog displays.



- 5 Click the **Continue in Demo** button. The **Lease Information** dialog displays.



- 6 Click **Continue** to start WinFrog in the Emergency License Mode.
- 7 Contact Fugro Pelagos as soon as possible with the Site Code displayed in the Lease Information dialog to obtain an extended emergency license and/or a replacement DESkey dongle.

Installing WinFrog

Close all applications and ensure that you have **Administrator** privileges before beginning the install. WinFrog should be installed on the same drive as the Windows system directory. For example, if the Windows system directory is installed in **D:\Winnt**, then WinFrog should be installed somewhere on the **D drive**.

To Install WinFrog from a CD

The CD you receive has an auto-start feature which means that a menu screen with several options will appear when you insert the CD. This screen gives you the ability to install the software, copy documentation to your hard disk, browse the CD and visit our website. To install WinFrog, click the Install Software button and simply follow the steps through the installation program.

If for some reason the CD does not start, please follow the steps below.

- 1 Run **Windows Explorer™** and navigate to the CD.
- 2 Double-click the **autorun.exe** icon.
- 3 The menu screen described above will appear. After choosing to install the software, the **Setup** window will appear followed shortly by the **Welcome** window. Follow the instructions on screen.
- 4 **Restart** the computer. (**Note:** Once the software is installed, it is no longer necessary to have administrator privileges.)

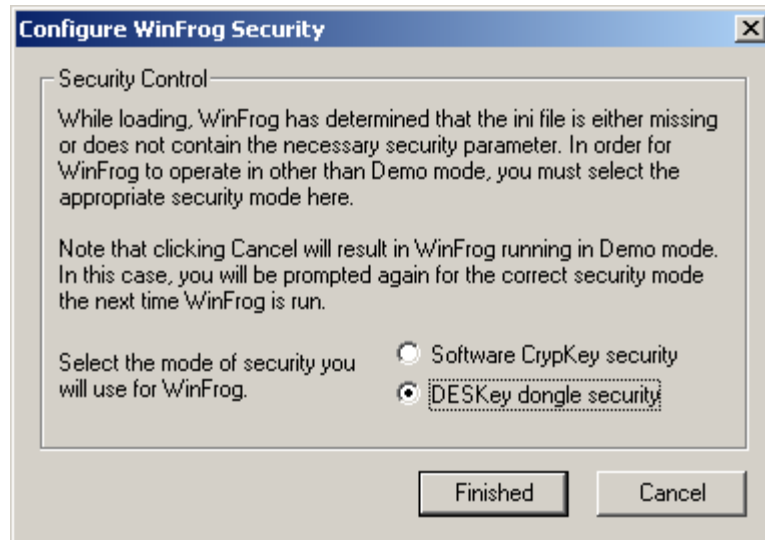
Starting WinFrog

To Launch WinFrog

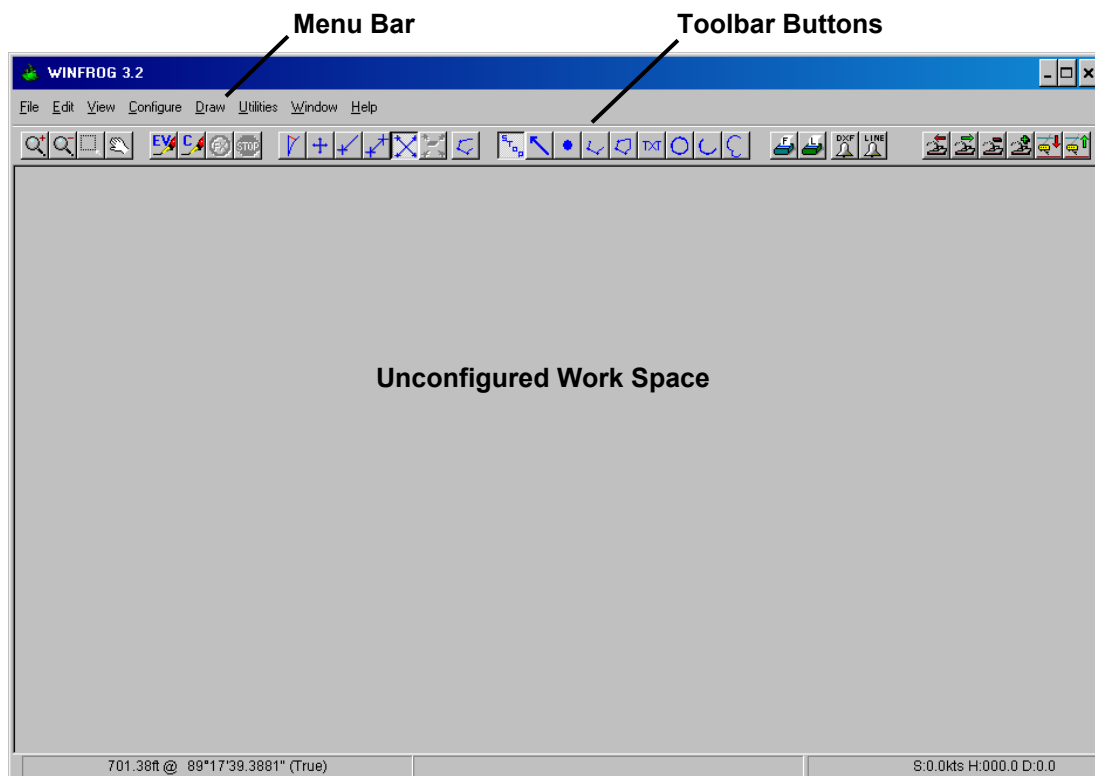
- 1 Either double-click the **WinFrog** shortcut on the desktop (if there is one) or click **Start > Programs > Fugro Pelagos > WinFrog**.

Be careful not to start more than one version of WinFrog at a time. This will cause problems with real-time operations, as well as the potential loss or overwriting of various data files.

When you run WinFrog for the first time you will be prompted for the licensing method to use – either a hardware dongle attached to a parallel port on your PC, or a CrypKey license.



- 2 Ensure that the default option of **DESkey dongle security** is selected and click the **Finished** button. WinFrog fills the screen, displaying a window containing the **Menu bar**, a **toolbar with buttons**, and an unconfigured WinFrog **workspace**.



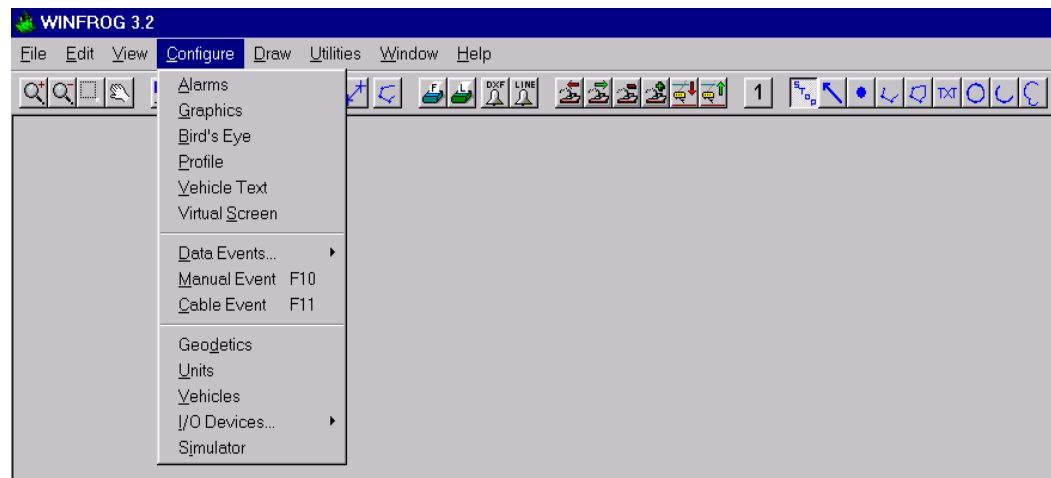
Using WinFrog

WinFrog uses standard **Windows** menus, dialog boxes, and windows. This section provides a quick introduction to using WinFrog.

Menu Bars

At the top of the WinFrog window is the **Menu** bar. This bar contains eight categories of WinFrog items, each of which contains numerous sub-options.

The **Configure** menu (shown in the next figure) is a typical WinFrog menu and provides numerous configuration options in a dropdown list. The Configuration menu is used as an example below.

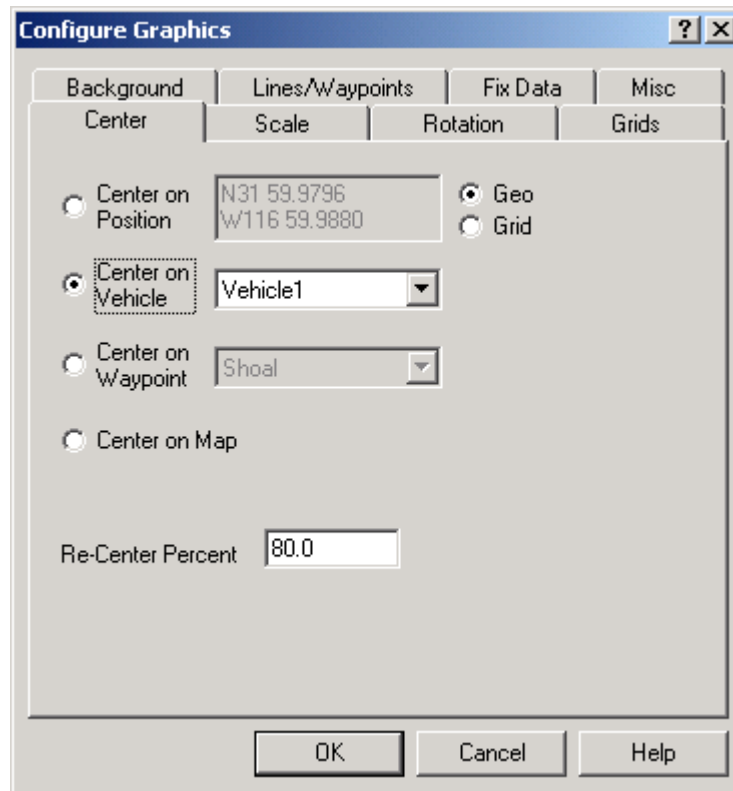


When you select the main menu item **Configure**, you will see that **F10** and **F11** appear to the right of the **Manual Event** and **Cable Event** choices. These are **hotkeys** that allow you to quickly choose a menu item without using the mouse. In this example, pressing the **F10** function button along the top of a standard keyboard would open the dialog box associated with the **Manual Event** menu choice. For more information on hotkeys, see the **Hotkeys** section later in this chapter.

Also in the main menu item **Configure** option list, note that there is an arrow to the right of the **I/O Devices** menu choice. This arrow indicates that if you select this menu item WinFrog will open a cascading sub-menu with more choices.

Dialog Boxes

Dialog boxes allow the user to communicate with WinFrog. WinFrog's parameters and options are set using these dialog boxes and they can also provide access to other dialog boxes and windows. Standard Windows conventions are used to select items and open and close dialog boxes. The **Configure Graphics** dialog box, seen below, is a typical WinFrog dialog box.



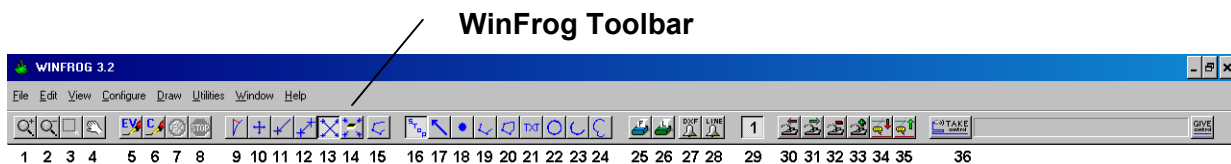
The title of each dialog box appears flush left at the top of the box. In this case, the dialog box is entitled **Configure Graphics**.

Clicking the **OK** button accepts the changes that have been made in a specific dialog box and closes that box. Clicking the **Cancel** or **Close** button or clicking the **X** in the top right corner of the dialog box closes the dialog box **without** accepting the changes made.

All WinFrog dialog boxes can be repositioned by clicking on the blue section at the top of the box and holding the left mouse button down to drag the dialog box to a new location. In addition, dialog boxes and windows can be resized. Move the mouse pointer to the edge or corner of the dialog box or window. When the pointer reaches the edge or corner, it will change to one of four double-headed arrows. Click and drag the edge or corner to the desired size.

Speed Toolbar

WinFrog's default configuration has a toolbar that is located below the menu bar. The toolbar contains 36 buttons that provide shortcuts for performing often used functions. This toolbar is actually made up of 8 individual "dockable" sections that can be moved to anywhere in the WinFrog workspace by clicking near a button in the section and dragging to the new location. The complete WinFrog toolbar is shown below.



As found from the left, the buttons on the Speed Toolbar do the following:

1 Zoom In	Zooms in a Graphics or a Bird's Eye window.
2 Zoom Out	Zooms out a Graphics or a Bird's Eye window.
3 Zoom Window	Allows you to window the area that you want to see on a Graphics or a Bird's Eye window.
4 Pan	Centers the current Graphics or a Bird's Eye window on the crosshairs.
5 Manual Event	Click this to quickly add a Manual Event to the Working .Log File . This is the same as choosing Configure > Manual Event or pressing the F10 function key.
6 Cable Event	Click this to quickly add a Cable Event to the Working.CET File . This is the same as choosing Configure > Cable Event or pressing the F11 function key.
7 Event Start	Click this to manually Activate Automatic Eventing , (once events are enabled).
8 Event Stop	Manually stops Automatic Eventing .
9 Convergence Display	Sets the Displays Position or Range/Bearing section of the display bar to display the Map Convergence and Scale Factor of the position the cursor is clicked on in the Graphics and Bird's Eye window(s).
10 Display Position	Sets the Coordinate Readout to display latitude and longitude or grid northing and easting of the position the cursor is clicked on in the Graphics and Bird's Eye window(s). The coordinate format for this feature and all associated buttons (Range/Bearing , Quick Range/Bearing and Multiple Quick Range/Bearing) is dependent upon the configuration for Units\Coordinates .
11 Range/Bearing	Sets the Displays Position or Range/Bearing to display bearing and distance from main crosshairs to secondary crosshairs. The main crosshair is set when the Display Position button is active, the secondary crosshair is set when the Range/Bearing button is active. The secondary crosshair can be reset repeatedly while maintaining the original main crosshair. Each time the left mouse button is clicked, the secondary crosshair is reset to that point. The previous measurement line is removed and a new line is drawn. This measurement can be made between different Graphics and/or Bird's Eye windows.

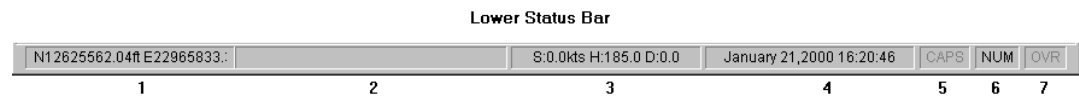
12 Quick Range/Bearing	Sets the Displays Position or Range/Bearing to actively display the changing bearing and distance from main crosshairs to secondary crosshairs as the cursor is moved. The main crosshair is set when the left mouse button is clicked, the secondary is set wherever the cursor is as the left button is kept depressed and dragged around the Graphics or Bird's Eye window. When the left mouse button is released, the line is drawn on the screen in the same manner as for the Range/Bearing option. Each measurement cycle of clicking and holding the left mouse button causes the previous measurement line to be removed. This measurement cannot be made between different Graphics and/or Bird's Eye windows.
13 Multiple Range/Bearing	This performs the same as the Quick Range/Bearing option except that subsequent measurements do not cause the previous measurement line to be removed, thus any number of measurement lines can be displayed simultaneously. The information for the current measurement is displayed in the Coordinate Readout area. This measurement cannot be made between different Graphics and/or Bird's Eye windows.
14 Clear Range/Bearing	This button is only active when the Multiple Range/Bearing option is active and there is at least 1 measurement line in existence. Clicking this button when there is more than 1 measurement line causes all but the last measurement line to be removed. Clicking this when there is only 1 measurement line causes this line to be removed (and the button to be disabled).
15 Graphical Route Design	Used to enter survey line segment coordinates by clicking on the Graphics or Bird's Eye window with Display Position enabled.
16 Stop Drawing	Stops drawing the currently selected graphic object in the Graphics window.
17 Select Object	Click this to select a user-drawn graphic object in the Graphics window.
18 Draw Point	Click this to draw a point in the Graphics window.
19 Draw Polyline	Click this to draw a polyline in the Graphics window.
20 Draw Polygon	Click this to draw a polygon in the Graphics window.
21 Draw Text	Click this to draw text in the Graphics window.
22 Draw Circle	Click this to draw a circle in the Graphics window.
23 Draw Arc	Click this to draw an arc in the Graphics window.
24 Draw Polyarc	Click this to draw a polyarc in the Graphics window.
25 Form Feed	Sends a form feed command to the Windows default printer.
26 Line Feed	Sends a line feed command to the Windows default printer.

27 Hazard Alarm	Select this option and then click within five meters of a map object displayed in the Graphics window to identify that item as a hazard. The map object could be a point, line, polyline, arc, polyarc or text on a BMM map with a DXF, DWG or SHP map layer. An alert box appears on screen when a vehicle comes within 100 meters of an identified hazard. Note: A polygon and DGN map layer cannot be selected as a hazard. Note: the Hazard Alarm checkbox must be selected in the Vehicle Presentation dialog box to enable this feature.
28 Line Alarm	Click this button to enable line alarms. If any vessel comes within the specified distance to a line that has been enabled for the vessel approach alarm and this button is down, WinFrog will beep at 2 Hz. See the section on Working Survey Lines (.PTS) File.
29 Virtual Screen	Allows you to select the virtual screen to be active. Up to 24 virtual screens can be configured, each with their own toolbar button.
30 Turn Left	Click this button to turn the ship to the left by .1, 1, or 5 degrees, as configured in the Configure Simulator dialog box. The default is 5 degrees. This button only works with simulated devices.
31 Turn Right	Click this button to turn the ship to the right by .1, 1, or 5 degrees, as configured in the Configure Simulator dialog box. The default is 5 degrees. This button only works with simulated devices.
32 Decrease Speed	Decreases the vehicle's speed by the value entered in the Interval (kts) field of the Configure Simulator dialog box. The default is 0.25 knots. This button only works with simulated devices.
33 Increase Speed	Increases the vehicle's speed by the value entered in the Interval (kts) field of the Configure Simulator dialog box. The default is 0.25 knots. This button only works with simulated devices.
34 Increase Depth	Click this button to increase the vehicle depth. This button only works with simulated devices.
35 Decrease Depth	Click this button to decrease the vehicle depth. This button only works with simulated devices.
36 System Control tools	These tool bar items are only used with three cable machinery devices: DW System, SMD System, and Tycom Systems. If using one of these devices and there are two WinFrog computers, primary and secondary, only one can actually transmit data on the network. These tool bar items facilitate the transfer of output control between the primary and secondary computers. WinFrog boots up according to their previous settings (broadcasting or not) as stored in the

WinFrog_3.ini file. You may then relinquish control, which will stop WinFrog from broadcasting on the network and will allow the other computer to take control and begin transmitting on the network. A computer cannot take control unless the other computer has given it. The present state of each computer is indicated between the buttons.

Lower Status Bar

At the bottom of the WinFrog window is an information bar that displays a variety of current WinFrog data. The status bar is divided into seven sections.



1 Displays Position or Range/Bearing 2 Toolbar Information 3 Speed/Heading/Depth 4 Date/Time 5 CAPS 6 NUM 7 OVR	Depending on which option is enabled in the upper toolbar, this section of the Status Bar displays either coordinates (Latitude/Longitude or Grid Northing/Easting), range and bearing or the Map Convergence and Scale Factor for the point as defined by the respective cursor action. As the mouse pointer is moved from one menu bar item to another, a brief message about that menu bar function displays. Displays the speed, heading, and water depth of the vehicle displayed in the Vehicle window. Displays WinFrog date and time information. Note: this may be different from the computer system's date and time. Displays if the keyboard's Caps Lock function has been enabled. If CAPS is grayed out, the function is not enabled. Displays if the keyboard's Num Lock function has been enabled. If NUM is grayed out, the function is not enabled. Displays if the keyboard's Overwrite (Insert key) function has been enabled. If OVR is grayed out, the function is not enabled.

Capture Screen

To capture the whole screen, choose **File > Capture Screen**. The whole screen will be captured and a dialog will open asking for a file name to store the bitmap in. WinFrog stores the bitmap in BMP format.

Hotkeys

In addition to the toolbar shortcuts, the following function keys can be used to quickly display certain dialog boxes in WinFrog:

F8 = Print **Active Graphics Window** (**File** > **Print...Active Graphics Window**)

F9 = Print **Active Profile Window** (**File** > **Print...Active Profile Window**)

F10 = **Manual Event** (**Configure** > **Manual Event** or select the **Manual Event** button in the toolbar)

F11 = **Cable Event** dialog box (**Configure** > **Cable Event** or select the **Cable Event** button in the toolbar).

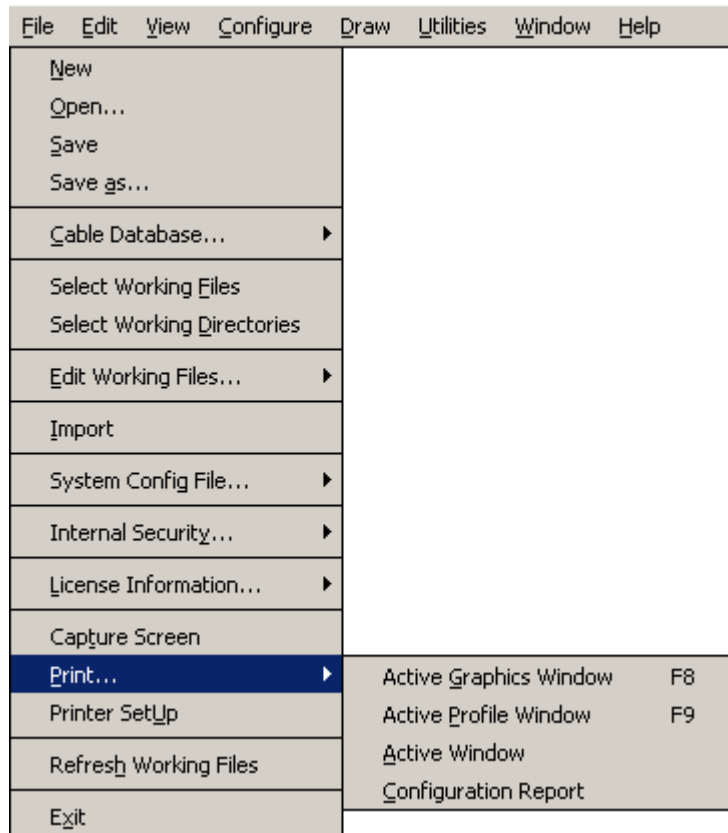
Printing Features

In addition to the report printing options provided by WinFrog, such as the LBL Calibration report or the Position Average report, and the automated printing features, such as event printing, WinFrog also supports the following printing features:

- Printing of the Graphics window
- Printing of the Profile window
- Printing of the Active window
- Printing of the Data configuration
- Printer setup, including...
 - Header information
 - Lines per page

Printing is output to the Windows default printer. This must be setup and configured as part of your Windows configuration and setup.

Print options are accessed via the main menu item **File**.



To Print the Graphics Window

From the **File** menu, choose **Print > Active Graphics Window**, or **F8**, to print the graphics window that currently has the focus. If no graphics window has the focus, the first graphics window is defaulted to and printed. If no graphics windows are open, nothing is printed. You will be prompted to select the printer to use (default is the Windows default printer). Note: if no graphic windows are open, this option is disabled.

To Print the Profile Window

From the **File** menu, choose **Print > Active Profile Window**, or **F9**, to print the Profile window that currently has the focus. If no Profile window has the focus, the first Profile window is defaulted to and printed. You will be prompted to select the printer to use (default is the Windows default printer). Note: if no Profile windows are open, this option is disabled.

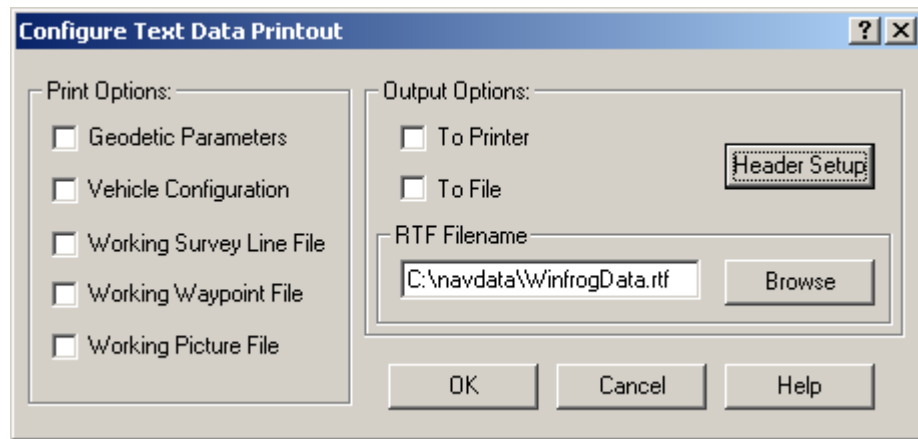
To Print the Active Window

From the **File** menu, choose **Print > Active Window**, to print the WinFrog window that currently has the focus. You will be prompted to select the printer to use (default is the Windows default printer). The windows supported for this feature are as follows:

- Anchor Handling
- Vehicle Text
- I/O Devices
- Helmsman
- Attitude
- Offset
- Dynamic Target
- Bird's Eye Graphics
- Calculation

To Print the Data Configuration

From the **File** menu, choose **Print > Configuration Report** to open the **Configure Text Data Printout** dialog where you can configure what WinFrog configuration data is to be printed and where is it to be printed.



Print Options

These allow the selection of the different configuration data to be printed.

Geodetic Parameters

This includes the Working Datum ellipsoid parameters and Working to WGS84 transformation parameters plus the Working map Projection parameters.

Vehicle Configuration

This consists of all configuration settings for the vehicles, including shape, vehicle offsets, vehicle fairleads and vehicle device offsets.

Working Survey Line File, Working Waypoint File, Working Picture File

These options result in the tabular printout of the respective files.

Output Options

These allow the selection of where to send the report to, either directly To Printer or To File or both.

For either option, the report is prepared and printed/saved in a report ready rtf format.

Header Setup

Click this button to open the **Text Data Printout Header Setup** dialog box where you can enter text to be printed as a header at the top of each page of the report.

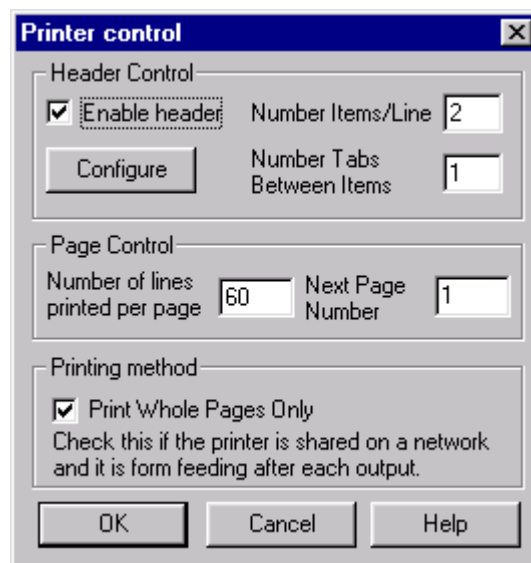
RTF Filename

In the RTF Filename section, click the Browse button to enter a filename for saving the report file in the rtf format. If the file already exists, when WinFrog is printing the report, you will be prompted to either overwrite the existing file or enter a new name.

Click **OK** to print the report.

Printer Setup

From the **File** menu, choose **Printer SetUp** to open the **Printer Control** dialog box where you can select what data to print and where to print.



Header Control

The **Header Control** section allows you to configure the header information that will be printed at the top of every page.

Enable Header	Turns the header at the top of the page on and off.
Number Items/Line	Controls how many of the selected header items will be printed per line in the header.
Number of Tabs Between Items	Allows you to control the spacing of the items on each line of the header.
Configure	Opens the Print Header Info dialog box where you select which header items are to be printed and enter the text to be printed for these. Check those items to be included in the header. The order listed here is the order that they are sent to the header.
Page Control	
Number of lines printed per page	Allows you to set the number of lines that will be printed before a form feed is sent and a new header is printed.
Next Page Number	Allows you to control the pagination by setting the page number to be printed on the next page printed.
Printing Method	
Print Whole Pages Only	When using some network printers, the driver may issue a form feed after each block of data that WinFrog sends to the printer. This allows other users on the network use of the printer without mixing different documents on the same page. By checking this box, WinFrog will avoid partial pages by saving up a whole page of data before printing it. A whole page is determined by the number of lines entered above.

Saving the Current System Configuration

WinFrog's system configuration parameters can be saved to a **System Configuration (.cfg)** file while the program is running. When a configuration file is created, WinFrog stores the following information:

- **Working Directories**
- Reference to **Working Files**

Note: **Working Files** are separate, individual files and so their contents are not saved with the .cfg file; only the reference to where the files are found is saved.

- All **I/O Devices** added to WinFrog, and their current configuration.
- Working **Units**
- Vehicle configuration parameters including dimensions, offsets, and devices
- Working **Geodetic Parameters**
- The placement and size of all open windows

Note: this same information is written to the **WinFrog_3.ini** file when WinFrog is exited properly.

To Save a System Configuration (.cfg) file

- 1 From the **File** menu, click **System Config File... > Save**.
- 2 In the **File name** entry window, type the name you wish to give to your file.
- 3 Navigate to the directory in which you wish to store the configuration file.

By default, the configuration file is stored in the directory specified as the **Filing Directory** in **Working Directories**. This defaults to **Navdata**, a directory created when WinFrog was installed.
- 4 Click the **Save** button. WinFrog creates a **.cfg** file in the designated directory.

The **.cfg** configuration file can be loaded to restore the WinFrog system configuration at any time.

To Load a System Configuration (.cfg) File

- 1 With WinFrog running, choose **File > System Config File... > Load**.
- 2 Browse to the appropriate directory and select the desired **.cfg** file.

Note: discrepancies may appear in WinFrog if a **.cfg** file from an older version of WinFrog is selected.

- 3 Click **Open**. WinFrog will re-set its configuration based on the contents of the **.cfg** file. It may take a moment for the changes to take effect.

WinFrog_3.ini file

When you first launch WinFrog, an initialization (**WinFrog_3.ini**) file is created in your system directory (i.e. the **WINNT** directory). This file contains information concerning any changes in the program's default settings, including, but not limited to, the placement of open windows, the names and placement of any defined vehicles and devices, and geodetic parameters. This file is used to configure WinFrog every time the program is started.

If a **WinFrog_3.ini** file is not found in the **WINNT** directory (the system directory), WinFrog will use its internally configured default settings upon startup.

The **WinFrog_3.ini** file is overwritten when WinFrog is **properly** exited. For this reason it is wise to create a backup copy of this initialization file (with a different name or in a different location) after you end your WinFrog session. This provides you the ability to restore WinFrog to the state recorded in the backed up **WinFrog_3.ini** file, if necessary.

A copy of the **WinFrog_3.ini** file should always be included with project data after a project is completed. This provides anyone who examines the data in the future with critical information on how WinFrog was configured during the project.

Warning: Do not attempt to use an old version of the WinFrog.ini file with a new version of WinFrog or visa versa. This may result in inexplicable operational problems or complete WinFrog failure.

Exiting WinFrog

To Exit WinFrog

- 1 **File > Exit** or click the **X** in the top right corner of the window or double-click on the WinFrog icon in the top left corner of the window.

A dialog box displays asking, “Are you sure you want to exit?”

- 2 Choose **Yes**.

WinFrog closes and overwrites the **WinFrog_3.ini** file.

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Chapter 2: Configuration Overview

It is essential that several components of the WinFrog integrated navigation software be configured properly at the beginning of each new project. Though each project and application has different requirements, some standard procedures must be followed in order for WinFrog to be used successfully. The New Project wizard guides you through the beginning steps of project configuration.

New Project Wizard

The New Project wizard automates the configuration of critical project-related parameters and data storage conventions. The wizard leads you through the steps of setting up the job details, project directory structure, project working files, survey geodesy and measurement units.

To Setup a New Project

From the **File** menu, choose **Project Configuration > New Project**.

Step 1, New Project. Enter the name of the new project to be created. The default location of the new project directory is c:\navdata and we recommend keeping the default. The name you enter in the Project Name field is used as the name of the new directory and is added to the path shown in the Project Directory field. Each project should be stored in a unique directory.

If the project name entered has the same name of an existing project in the same directory, a warning message will appear. You can choose to overwrite the existing project or go back and enter a new project name.

If the **Use Current Settings** checkbox is selected, all the current settings (those not set subsequently in the project editor) will be saved to the new project, such as windows viewed, window locations, vehicles, I/O devices, etc. If it is not selected, only the settings selected in the project editor will be saved to the new project.

Step 2, Project Details. The initial information displayed is the project details of the project currently loaded in WinFrog. (**Note:** for the remaining steps of the wizard, the settings that initially appear are those of the currently loaded project.) Double-click a Name item or select a Name item and then click the Edit Selection button to open a data entry dialog in which to enter information.

The project details can be viewed and edited later by selecting the **Configure > Project Details** menu item.

Step 3, Working Directories. The working directories are used for storage and retrieval of WinFrog data. The Filing directory field and Browse button are disabled, since this is the project directory you specified in step 1 of the wizard. Options are available to select separate directories for raw data files, processed data, telemetry data and network data output, although we recommend accepting the default setting of the Filing directory. The different file types used and created by WinFrog are easily identified by their unique names or file extensions, which allows you to locate them in a single directory without fear of overwriting files.

See chapter 4 for information on working directories.

Step 4, Working Files. WinFrog uses nine main types of files, all of which contain different information. Survey lines, waypoints, and picture files are examples of WinFrog files. As there may be more than one copy of these file types found on the computer, you must specify which particular file will be used by WinFrog. This file is identified as the working file of that type. We recommend accepting the default working files. WinFrog can access files from anywhere on the computer, but to keep projects organized, working files should be kept in the Filing (project) directory as specified in step 1.

See chapter 5 for information on working files.

Step 5, Geodesy Setup. This must be done so that all survey lines, waypoints, DXF, vector and raster chart data, and vehicle positions refer to the same (correct) reference system. While many common datums and projections are available as pre-configured options in WinFrog, the software also has the capability to utilize custom user-defined systems.

See chapter 3 for information on configuring geodetics.

Step 6, General Units. At this step you need to configure the units of measurement.

See chapter 3 for information on configuring units.

Step 7, Coordinates. At this step you need to configure the default format for coordinate display and entry.

See chapter 3 for information on configuring coordinates.

Step 8, Calculations. At this step you need to select the type of calculations that will be undertaken to derive Line Tracking values.

See chapter 3 for information on selecting calculations.

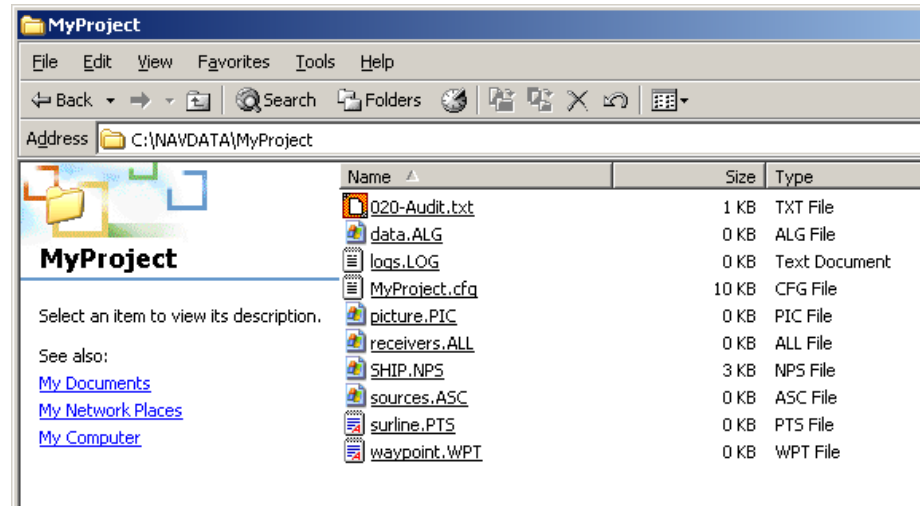
Click the **Finish** button to complete the New Project wizard. The following sequence of events will occur:

the previous project is saved,

the new settings are implemented,
the new project is saved and
the project directory and files are created.

If the **Use Current Settings** checkbox was not selected in step 1 of the wizard, all the vehicle settings, I/O devices, and window configurations will be lost. Only the settings specified in the New Project wizard will be set.

The following figure shows the files that are created in the new project directory.



Upon completion of the New Project wizard, the next step in a project configuration is to select and configure the necessary **I/O devices**. Each input and output device integrated in WinFrog must be defined before the device data can be correctly used and recorded. WinFrog has the capability to support up to fifty devices at one time, including multiple copies of the same device. When configuring a new device, essential communication information such as baud rate and com port settings must be defined to enable the device to communicate and share information with WinFrog. As each additional device is configured, you can view relevant device data in the **I/O Devices** window to verify that WinFrog is receiving the information.

See chapter 7 for information on I/O devices.

The next step is to configure the **Vehicles**. WinFrog supports up to twenty-five independent vehicles, all of which can have their own name, shape, and color. Each vehicle must also be configured with its own devices. WinFrog vehicles can obtain information from real-time devices, radio telemetry networks, computer networks, simulators, or previously recorded files. Each of the devices must then be configured for that particular vehicle and application.

See chapter 6 for information on vehicles.

Finally, you should **save** the modifications made to WinFrog's configuration. Choose **File > Project Configuration > Save Project** to save the configuration and settings for the current project. The current project name is displayed in the WinFrog title bar.

Note: to exit WinFrog correctly, be sure to use one of the following: **File > Exit** or double-click the frog icon in the upper left hand corner of the WinFrog window or click the **X** in the upper right hand corner of the window. Choose **Yes** to confirm that you wish to exit.

To open a previously saved project, choose **File > Project Configuration > Open Project** and the **Open Project** dialog box displays. Browse for the directory the project is located in, select the project from the dropdown list box and click OK. The current project is displayed in the WinFrog title bar.

The steps mentioned above are necessary for any new application, but they do not represent an all-inclusive list of procedures for setting up WinFrog. Additional steps may also be necessary depending on the application. Detailed information on the procedures mentioned above can be found in the separate chapters of this manual.

Chapter 3: Configuring Geodetics & Units

WinFrog provides you with the ability to configure the **Working Geodetics** to suit survey requirements for almost any location worldwide. The configuration of the **Working Geodetics** involves selecting which mathematical model (**ellipsoid**) will be used to estimate the shape of the earth, and which **Map Projection** will be used to convert the Latitude and Longitude values to **Grid** (Northing/Easting) coordinates. These configuration options can be chosen from several standard geodetic configurations or can be customized to suit a specific unique requirement.

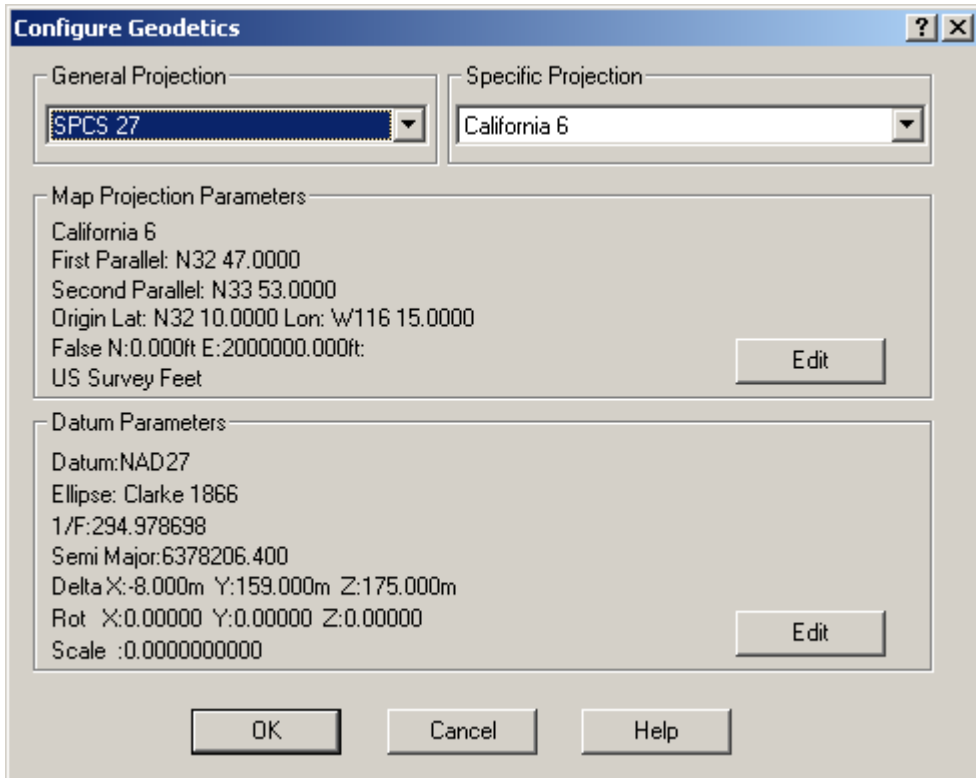
The **Units** that WinFrog uses is user-definable so that WinFrog displays coordinates, distances, and speed in the desired formats. In addition, you can select how **Geodetic Coordinates** (degrees of Latitude and Longitude) are displayed in WinFrog.

Geodetics

The configuration of **Geodetics** is one of the most important and powerful options in WinFrog. It allows you to modify the geodetic constants on which WinFrog bases its coordinate calculations. Errors made in specifying geodetic constants will be carried throughout an entire survey and may be very difficult, if not impossible, to correct. Therefore, it is imperative that you understand the implications of modifying the geodetic constants and ensure that all values are correctly set prior to entering coordinates or starting real-time operations.

To Configure the Geodetic Parameters

- 1 Select the main menu item **Configure > Geodetics** to display the **Configure Geodetics** dialog box, as shown below.



- 2 Choose one of the **General Projection** options from the dropdown list. WinFrog lists some of the more commonly found **Ellipsoid** and **Map Projection** combinations - **ED50 UTM**, **NAD27 UTM**, **SPCS27**, **SPCS83**, and **WGS84 UTM**.

Choosing any one of these options will change the options that will appear in the **Specific Projection** dropdown list.

- 3 Once the **General Projection** has been chosen, you must further define the **Projection** by selecting one of the options in the **Specific Projection** dropdown list.

For example, when using one of the common **General Projection** combinations (to which a projection has already been matched), the **Specific Projection** dropdown list is used to select the projection **zone** in which you are working.

If you have chosen **User**, you must now open the **Specific Projection** dropdown list to choose the **Projection** to be used. You must then **Edit** the **Map Projection Parameters** to suit the application.

For detailed information concerning choosing the **Specific Projection**, see the **Map Projections** section found later in this chapter.

- 4 The **Map Projection Parameters** area of the **Configure Geodetics** dialog box shows details concerning the current **General Projection** and **Specific**

Projection. These are specific pre-defined details about the projection that typically do not require modification.

For detailed information concerning the editing of map projection parameters, see the **Map Projections** section found later in this chapter.

- 5 In the **Datum Parameters** area, click **Edit**. The resulting **Datum Parameters** dialog box displays the **Working Ellipsoid** parameters and the **Datum Shifts** that are used to relate the **Working Ellipsoid** to the **WGS 84** ellipsoid. This information is required if GPS (which is referenced to the WGS84 ellipsoid) is used to provide real-time positioning data to the vehicle.

For detailed information concerning changing the **Ellipsoid/Datum shift** parameters, see **Ellipsoidal Datum** in a later section in this chapter.

General Projection

The **General Projection** dropdown list provides you with the ability to choose one of several commonly used **Datum/Projection** combinations, or a **User** option that allows for full customization of the **Datum/Projection** parameter configuration. The choices offered are as follows:

ED50 UTM	Combines the European Datum (1950) and the UTM Projection .
NAD27 UTM	Combines the North American Datum (1927) and the Universal Transverse Mercator Projection .
SPCS27	Combines the North American Datum (1927) and American State Plane Coordinate System projections.
SPCS83	Combines the North American Datum (1983) and American State Plane Coordinate System projections.
USER	Allows you to define your own Ellipsoid and Map Projection .
WGS84 UTM	Combines the World Geodetic System (1984) and the Universal Transverse Mercator Projection .

Note: the selection of a pre-configured **Datum/Projection** does not preclude the editing of the **Specific Projection**, **Map Projection**, and **Datum Parameter** configurations. The correct **Map Projection Zone** must be selected even if you decide not to configure any other items.

You should always confirm that the **Map Projection Parameters** (false northings, eastings, origin, and units) and the **Datum Parameters** (ellipse semi-major axis

and flattening, and datum shift values) are correct for the current project. WinFrog does enter default configuration values for each of the above listed “common” projections, but these may not be the exact values required for the current project.

The following sections detail the configuration of **Map Projection** and **Datum Projection** parameters. This information is useful for both “common” and “User” **General Projection** selections.

Map Projections

WinFrog allows you to choose (or custom configure) basically any **Map Projection** that is found in use anywhere in the world.

There are three basic categories of **Map Projections** found in WinFrog:

Universal Transverse Mercator (UTM)	a very common projection system. UTM is used worldwide and also in various State Plane Coordinate Systems .
Lambert	Most often used in US State Plane Coordinate Systems .
User	various customizable projections, most commonly used for Local Coordinate Systems and for configuring an Oblique Mercator projection.

For more information on (and diagrams of) **Map Projections** refer to **Appendix A: Useful Geodetic Data** at the end of this manual.

The more common pre-configured general projections typically utilize the **UTM** or **Lambert** projection, requiring only that you select the particular **zone** to be used from the **Specific Projection** dropdown list (as well as confirming the **Datum Parameters**, as detailed later in this section).

Once you have selected the **General Projection > User** option, use the **Specific Projection** dropdown list to choose the **Projection** to be used. You have the following choices:

- Lambert
- Local
- Mercator (Clarke 1866)
- Mercator (WGS84)
- Oblique Mercator
- Oblique Mercator (RSO)
- Oblique Mercator (RSO) N Borneo
- Oblique Mercator (RSO) NW Borneo

- Plant Grid
- Polar Stereographic
- StaOff (Station/Offset)
- Transverse Mercator

Each of these choices is covered in the following sections.

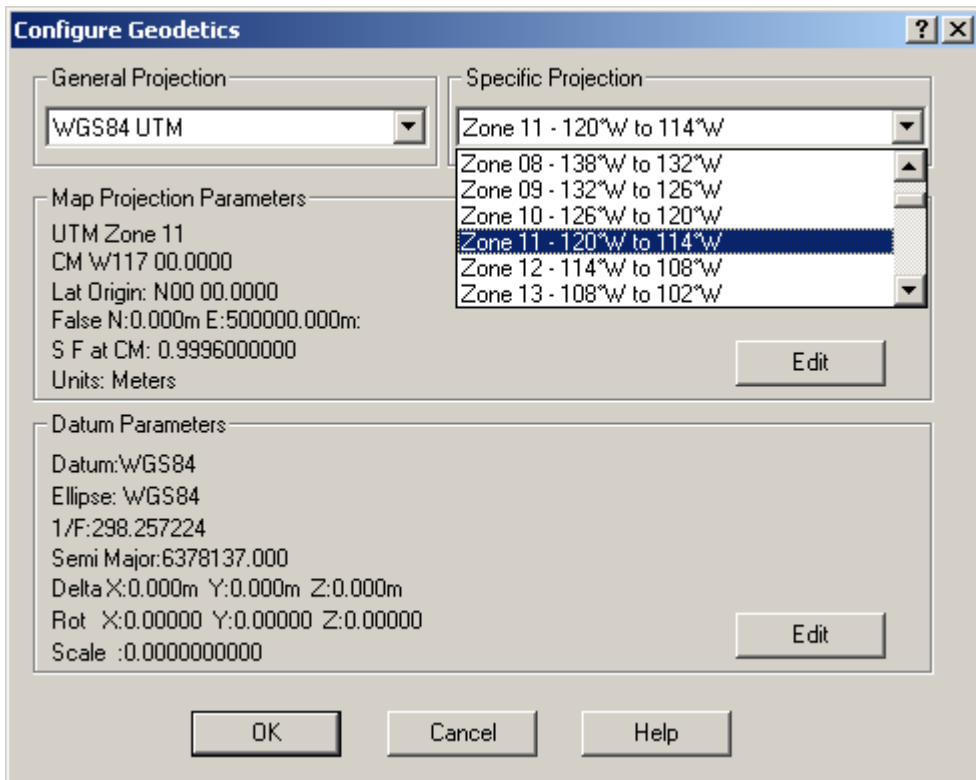
UTM and SPCS Projection Configuration

Typically, when you have chosen one of the more common general projections (which automatically combine certain ellipsoids and projections), the **UTM** or **SPCS Map Projection** parameters are fixed (except for choosing the appropriate zone) and should not be altered by the user. Generally, the only exception to this is when you are using the **UTM** projection while working South of the Equator. In this case you would have to **Edit** the **Map Projection Parameters** to change the **False Northing** to **10,000,000.00** meters.

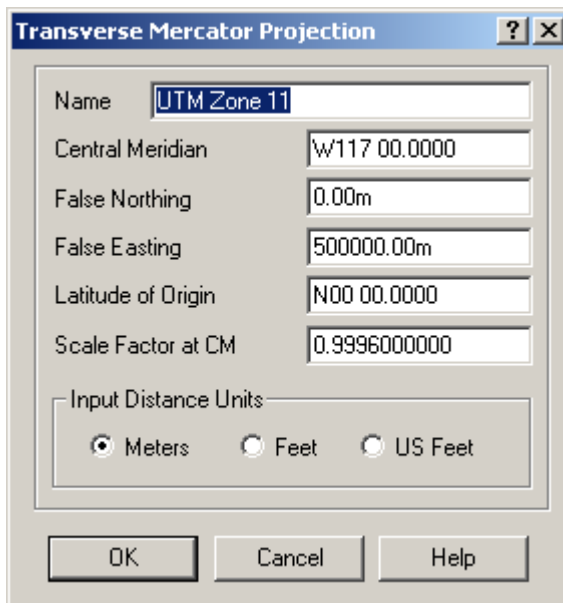
If your specified **Map Projection Parameters** require further modifications, you should choose the **General Projection** option **User**, then select and configure the appropriate **Specific Projection** parameters.

To Configure a UTM Projection

- 1 In the **Configure Geodetics** dialog box, **General Projection** dropdown list, select a **UTM** projection. (**WGS84 UTM** was selected for this example.)
- 2 In the **Specific Projection** area of the **Configure Geodetics** dialog box, use the dropdown list to select the appropriate zone. (For this example, **Zone 11** is selected to reflect the longitude of San Diego, CA - 117 West.)



- 3 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button.



The **Transverse Mercator Projection** dialog box allows for the configuration of the following parameters:

Name	Name of the Specific Projection
Central Meridian	Longitude of Central Meridian
False Northing	False Northing to be added to Northings
False Easting	False Easting to be added to Eastings
Latitude of Origin	Latitude of the Projection's Origin
Scale Factor at CM	Scale Factor at the Central Meridian
Units	Units of measure can be set to Meters, Feet, or US Survey Feet using the radio buttons. Typically, meters are used with UTM projections.

To Configure a State Plan Coordinate System (SPCS) Projection

The configuration for a **SPCS 27** or a **SPCS83 General Projection** is very similar to the procedures listed above for **UTM General Projections**.

- 1 Select either **SPCS27** or **SPCS83** from the **General Projection** dropdown list.
- 2 Select the appropriate state and zone from the **Specific Projection** dropdown list.

Some **SPCS**'s use the **Transverse Mercator** projection (which is configured the same way as shown above), while others use a **Lambert** projection. See below for more information on **Lambert** projection parameters.

User Specific Projection Configuration

As an alternative to the more common pre-configured map projection options provided, you can choose to use the **User** map projection. (Select the **User** option under **General Projection**).

The parameters that can be configured for the **User Projection** depend upon which specific projection option is chosen. This section examines the configurable parameters for each projection option listed, in the order found in the **Specific Projection** dropdown list.

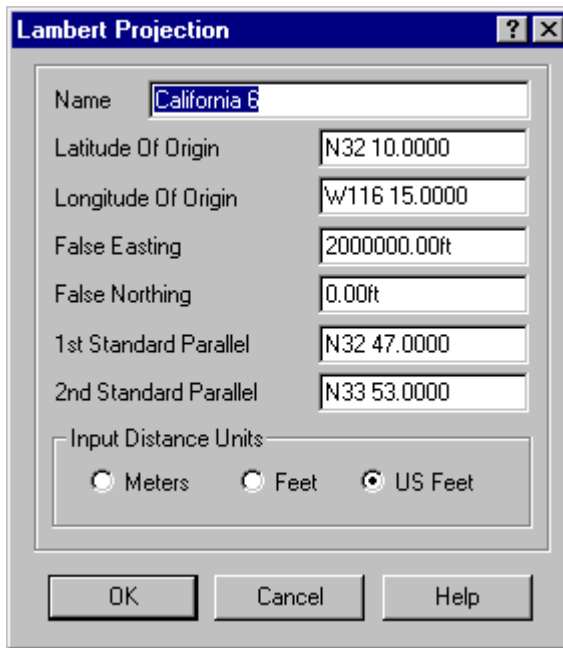
Note: It is important to remember to configure the **Datum Parameters AFTER** the **Specific Projection** parameters have been configured.

Lambert

The **Lambert Projection** is a conic conformal projection in which parallels are unequally spaced arcs of concentric circles and meridians are equally spaced radii of the same circles.

To Configure a Lambert Projection

- 1 In the **Configure Geodetics** dialog box, make sure **USER** is chosen in the **General Projection** dropdown list and **Lambert** is chosen in the **Specific Projection** dropdown list.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button.



The **Lambert Projection** dialog box allows for the configuration of the following parameters:

Name	Name of the Specific Projection
Latitude of Origin	Latitude of the Projection's Origin
Longitude of Origin	Longitude of the Projection's Origin
False Easting	False Easting to be added to Eastings
False Northing	False Northing to be added to Northings
First Standard Parallel	Latitude of First Standard Parallel
Second Standard Parallel	Latitude of Second Standard Parallel
Units	Units of measure can be set to Meters, Feet, or US Survey Feet using the radio buttons

Local

The **Local Coordinate System** is a simple projection that uses one center point as its origin and one base line or angle offset as its north axis. Northings and Eastings are calculated simply in terms of distance North/South and East/West from the center point of the local north coordinate system. Because of this, it should only be used in a limited area from the center point to prevent excessive distortion.

To Configure the Local Coordinate System Projection

- 1 In the **Configure Geodetics** dialog box, make sure **USER** is chosen from the **General Projection** dropdown and **Local** displays in the **Specific Projection** dropdown.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button. The **Local Coordinate System** dialog box will appear.

Local Coordinate System

Local System Center

Latitude: N31 50.0000

Longitude: W117 10.0000

Local System Orientation

☒ Define using baseline endpoint

☐ Define using angle offset from True North

Latitude: N33 00.0000

Longitude: W117 10.0000

Grid Coordinates at Origin

False Easting: 1000.00m

False Northing: 1000.00m

Units and Scale

☒ Meters ☐ US Feet

☐ Feet ☐ Yards

Scale Factor: 1.0000000000

OK Cancel Help

The **Local Coordinate System** dialog box allows for the configuration of the following parameters:

Local System Center	Origin of Local Coordinate System. If the baseline option is used for orientation of the system, it is also the start position of the baseline.
Latitude	Latitude of Origin / Baseline start
Longitude	Longitude of Origin / Baseline start
Local System Orientation	Select the method of determining the orientation of the local system.
Using Baseline Endpoint	The geodetic azimuth between the start and end points of this baseline will be the local grid north.

Angle from True North	An angle can be manually entered for the difference between True and grid north.
Local System Base Line End	End position of the base line for defining the North axis of the Local Coordinate system.
Latitude	Latitude of baseline end
Longitude	Longitude of baseline end
Grid Coordinates at Origin	
False Easting	Easting value of local system center
False Northing	Northing value of local system center
Units	Units of measure can be set to Meters, Feet, US Survey Feet or Yards using the radio buttons
Scale	If there is a scale difference between distances on the ground and distances in the local system, enter it here.

Note: The base line or angle offset defines the north axis of the local coordinate system.

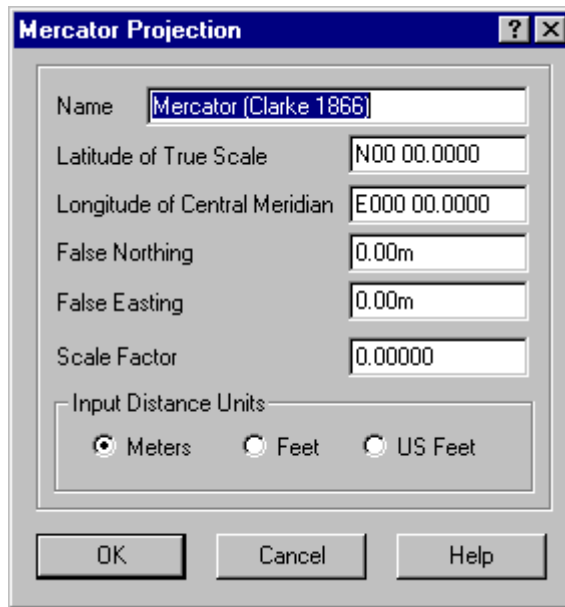
Mercator (Clark 1866 and WGS84)

The **Mercator Projection** is a cylindrical conformal map projection that is used extensively throughout the world, most commonly as the **Universal Transverse Mercator (UTM)** projection.

The user-defined options allow you to define a **Mercator** projection with custom Origin, False Easting/Northing, and scale factor values.

To Configure the Mercator (Clarke 1866 or WGS 84) Projection

- 1 In the **Configure Geodetics** dialog box, make sure **USER** displays in the **General Projection** dropdown list and **Mercator (Clarke 1866 or WGS 84)** in the **Specific Projection** dropdown list. Both options require the same configuration, differing only in the defaults that are presented in the **Datum Parameters** window.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button to see the following dialog box.

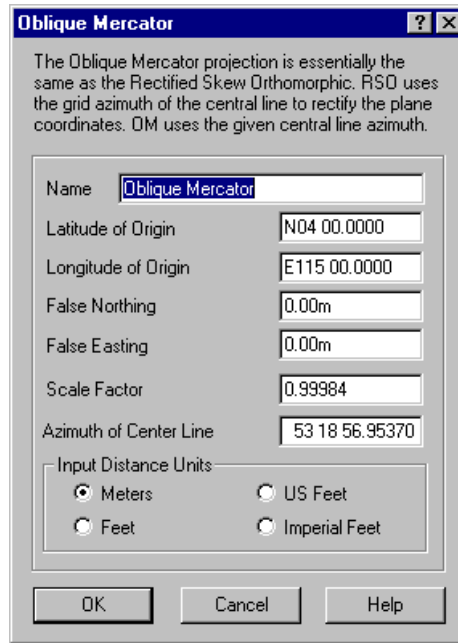


The **Mercator Projection** dialog box allows for the configuration of the following parameters:

Name	Name of the Specific Projection
Lat of True Scale	Latitude at which the map scale factor equals 1.000
Long of Central Meridian	Longitude of Central Meridian
False Northing	False Northing value to be added to Northings
False Easting	False Easting value to be added to Eastings
Scale Factor	Scale Factor at the Central Meridian
Units	Units of measure can be set to Meters, Feet, or US Survey Feet using the radio buttons.

Oblique Mercator/Oblique Mercator (RSO)

The **Oblique Mercator Projection** is a cylindrical conformal map projection that is used in various locations throughout the world. The two projections are essentially the same, as explained in the dialog box.



To Configure an Oblique Mercator Projection

- 1 In the **Configure Geodetics** dialog box, make sure **USER** displays in the **General Projection** dropdown and **Oblique Mercator** in the **Specific Projection** dropdown.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button.

The **Oblique Mercator** dialog box allows for the configuration of the following parameters:

Name	Name of the Specific Projection
Lat of Origin	Latitude of the map origin
Long of Origin	Longitude of Central Meridian
False Northing	False Northing value to be added to Northings
False Easting	False Easting value to be added to Eastings
Scale Factor	Scale Factor at the Central Line
Azimuth of Center Line	
Line	Allows you to define a rotated Central Meridian as opposed to Mercator or Transverse Mercator projections.
Units	Units of measure can be set to Meters, Feet, or US Survey Feet using the radio buttons.

Plant Grid

The **Plant Grid Coordinate System** is based on a transformation between a **Lambert** map projection plane coordinate system and a locally derived coordinate system. As a result, part of the configuration of this coordinate system involves the configuration of **Lambert** projection parameters.

The transformation between the map projection plan and the local coordinate system is based on the following equations:

$$\text{Projection} \rightarrow \text{Local Northing} \quad L_N = (C_{SN1} * S_N) + (C_{SE1} * S_E) - X_1$$

$$\text{Projection} \rightarrow \text{Local Easting} \quad L_E = (C_{SN2} * S_N) + (C_{SE2} * S_E) - X_2$$

$$\text{Local} \rightarrow \text{Projection Northing} \quad S_N = (C_{LN1} * L_N) + (C_{LE1} * L_E) + X_3$$

$$\text{Local} \rightarrow \text{Projection Easting} \quad S_E = (C_{LN2} * L_N) + (C_{LE2} * L_E) + X_4$$

where:

L_N Local Northing

L_E Local Easting

S_N Map Projection Plane Northing

S_E Map Projection Plane Easting

C_{SN1} Map Projection Northing Coefficient to transform to Local Northing

C_{SE1} Map Projection Easting Coefficient to transform to Local Northing

X_1 Constant for transformation to Local Northing

C_{SN2} Map Projection Northing Coefficient to transform to Local Easting

C_{SE2} Map Projection Easting Coefficient to transform to Local Easting

X_2 Constant for transformation to Local Easting

C_{LN1} Local Northing Coefficient to transform to Map Projection Northing

C_{LE1} Local Easting Coefficient to transform to Map Projection Northing

X_3 Constant for transformation to Map Projection Northing

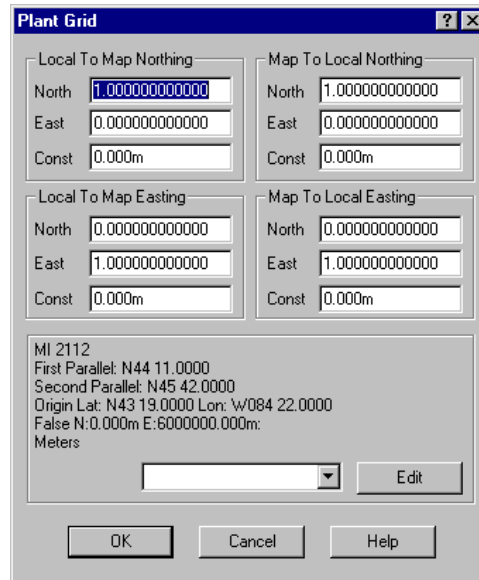
C_{LN2} Local Northing Coefficient to transform to Map Projection Easting

C_{LE2} Local Easting Coefficient to transform to Map Projection Easting

X_4 Constant for transformation to Map Projection Easting

To Configure a Plant Grid Coordinate System Projection

- 1 In the **Configure Geodetics** dialog box, make sure **USER** is chosen from the **General Projection** dropdown list and **Plant Grid** is chosen from the **Specific Projection** dropdown list.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button.



The following parameters are configurable from the **Local Coordinate System** dialog box:

Local To Map Northing

- North** Local Northing Coefficient to transform to Map Projection Northing (C_{LN1})
- East** Local Easting Coefficient to transform to Map Projection Northing (C_{LE1})
- Const** Constant for transformation to Map Projection Northing (X_3)

Local To Map Easting

- North** Local Northing Coefficient to transform to Map Projection Easting (C_{LN2})
- East** Local Easting Coefficient to transform to Map Projection Easting (C_{LE2})
- Const** Constant for transformation to Map Projection Easting (X_4)

Map To Local Northing

- North** Map Projection Northing Coefficient to transform to Local Northing (C_{SN1})
- East** Map Projection Easting Coefficient to transform to Local Northing (C_{SE1})
- Const** Constant for transformation to Local Northing (X_1)

Map To Local Easting

- North** Map Projection Northing Coefficient to transform to Local Easting (C_{SN2})

East	Map Projection Easting Coefficient to transform to Local Easting (C_{SE2})
Const	Constant for transformation to Local Easting (X_2)

In addition to the above parameters, you must configure a **Lambert** Projection for the Local Coordinate System.

To Configure the Lambert Projection for a Local Coordinate System

- 1 Click the **Edit** button at the bottom of the **Local Coordinate System** dialog box to customize the **Lambert** projection associated with the plant grid.

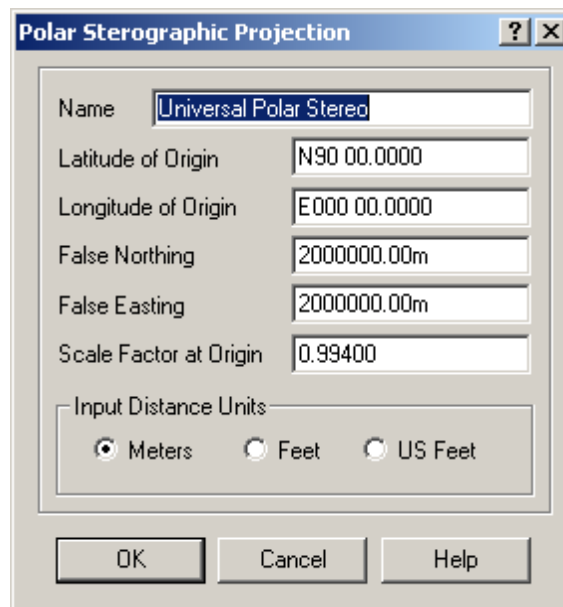
This **Edit** button produces the same dialog box as when a Lambert projection is chosen under **Specific Projections**. (See the section above for details on the various entry windows.)

Polar Stereographic

The **Polar Stereographic Projection** is an azimuthal conformal map projection. This projection is often used to map the polar regions.

To Configure the Polar Stereographic Projection

- 1 In the **Configure Geodetics** dialog box, select **USER** from the **General Projection** dropdown list and **Polar Stereographic** from the **Specific Projection** dropdown list.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button.

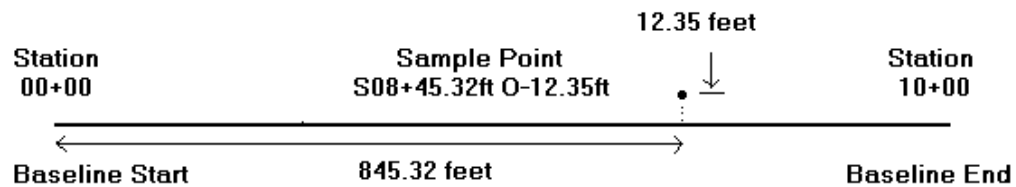


The **Polar Stereographic** dialog box allows for the configuration of the following parameters:

Name	Name of the Specific Projection
Lat of Origin	Latitude of the Projection's Origin
Long Of Origin	Longitude of the Projection's Origin
False Northing	False Northing to be added to Northings
False Easting	False Easting to be added to Eastings
Scale Factor at Orig	Scale Factor at the Origin
Units	Units of measure can be set to Meters, Feet or US Survey Feet using the radio buttons

StaOff (Station/Offset)

The **StaOff** (Station/Offset) coordinate system is often used in linear construction projects. It is a local coordinate system that is defined by a baseline. The baseline defines the origin and orientation of the coordinate system as shown in the diagram below.



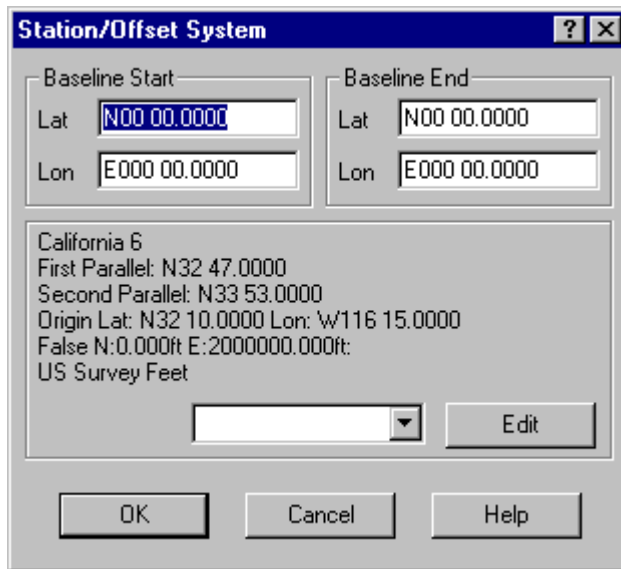
When **StaOff** is used as the map projection, coordinates previously displayed in Northings and Eastings are now displayed as **Station** and **Offset** values.

For example, an **Alongline (Sta)** distance of 845.32 ft and an **Offset** distance of -12.35 would be displayed as **S08+45.32ft O-12.35ft**.

Note: the coordinates are calculated using a **Lambert** projection.

To Configure a Station/Offset Coordinate System

- 1 In the **Configure Geodetics** dialog box, select **USER** from the **General Projection** dropdown list and **StaOff** from the **Specific Projection** dropdown.
- 2 In the **Map Projection Parameters** area of the **Configure Geodetics** dialog box, click the **Edit** button.



The following parameters are configurable from the **Station/Offset System** dialog box:

Baseline Start

Lat	Latitude of the baseline start point
Lon	Longitude of the baseline start point

Baseline End

Lat	Latitude of the baseline end point
Lon	Longitude of the baseline end point

Edit button	Opens the Lambert Projection dialog box. Its parameters are configured in the same way as described above.

To Configure a Transverse Mercator Projection

The **Transverse Mercator** projection is mathematically the same as the **UTM** projections defined above. However, this particular option allows you to define the parameters for a totally custom configuration.

The **Transverse Mercator** dialog box allows for the configuration of the following parameters:

Name	Name of the Specific Projection
Central Meridian	Longitude of Central Meridian
False Northing	False Northing to be added to Northings
False Easting	False Easting to be added to Eastings
Lat of Origin	Latitude of the Projection's Origin
Scale Factor at CM	Scale Factor at the Central Meridian
Units	Units of measure can be set to Meters, Feet, or US Survey Feet using the radio buttons.

Ellipsoidal Datum Parameters

As mentioned previously, you must always confirm that the datum parameters of the working ellipsoid have been configured correctly, including its relationship to the **WGS 84** ellipsoid.

To Edit the Ellipsoidal Datum Parameters

- In the **Datum Parameters** area of the **Configure Geodetics** dialog box, click **Edit**. In the example below, the **NAD27 SPCS General Projection** was selected.

Datum Parameters

Working Ellipsoid

Name:

Semi Major Axis:

Inverse Flattening:

Datum

Name:

Shift Method:

DX to WGS84:

DY to WGS84:

DZ to WGS84:

Scale (parts per unit length):

Rot X:

Rot Y:

Rot Z:

Rotations are from local datum to WGS84 using Bursa-Wolf sign convention (opposite from the US DOD)

NADCON Area:

OK Cancel Help

The following parameters are configurable from this dialog box:

Working Ellipsoid

Name	Reference Ellipsoid name (<i>e. g.</i> Clarke 1866)
Semi Major Axis	Ellipsoid's Semi Major Axis (in meters, regardless of the setting in the Data Units dialog box)
Inverse Flattening	Ellipsoid's Inverse Flattening (1/f)

Datum

Name	Datum name (e.g. NAD 27)
Shift Method	Choose Bursa Wolf or NADCON .
dx	X coordinate datum shift parameter (WGS 84-Local)
dy	Y coordinate datum shift parameter (WGS 84-Local)
dz	Z coordinate datum shift parameter (WGS 84-Local)
Scale	In parts per million
Rot X	X axis rotation with respect to WGS 84 (d-m-s.sssss)
Rot Y	Y axis rotation with respect to WGS 84 (d-m-s.sssss)
Rot Z	Z axis rotation with respect to WGS 84 (d-m-s.sssss)
NADCON Area	used if NADCON is the chosen Shift Method - specify the general area where the project is to take place from the dropdown window options.

Note: WinFrog utilizes the multiple regression formula provided by NIMA for the NADCON datum shifts. These formulae must be downloaded from NIMA's internet site <ftp://ftp.ngs.noaa.gov/pub/pcsoft/nadcon/>. Once the site is open, double-click the .LAS and .LOS files of the desired zone, saving them (one at a time) to your hard disk in the same directory as the currently used winfrog.exe file. For example, if you are working in the Continental U.S., select the conus.las and conus.los files and save them to the C:\Program files\Fugro Pelagos\WinFrog\ (or to the correct location and name, as required). If WinFrog can not find these files or the files are misnamed an error message displays, "Unable to Initialize the Nadcon" when you try to configure.

For more information concerning ellipsoidal datum parameters for a specific geodetic datum, refer to **Appendix A: Useful Geodetic Data**.

Units

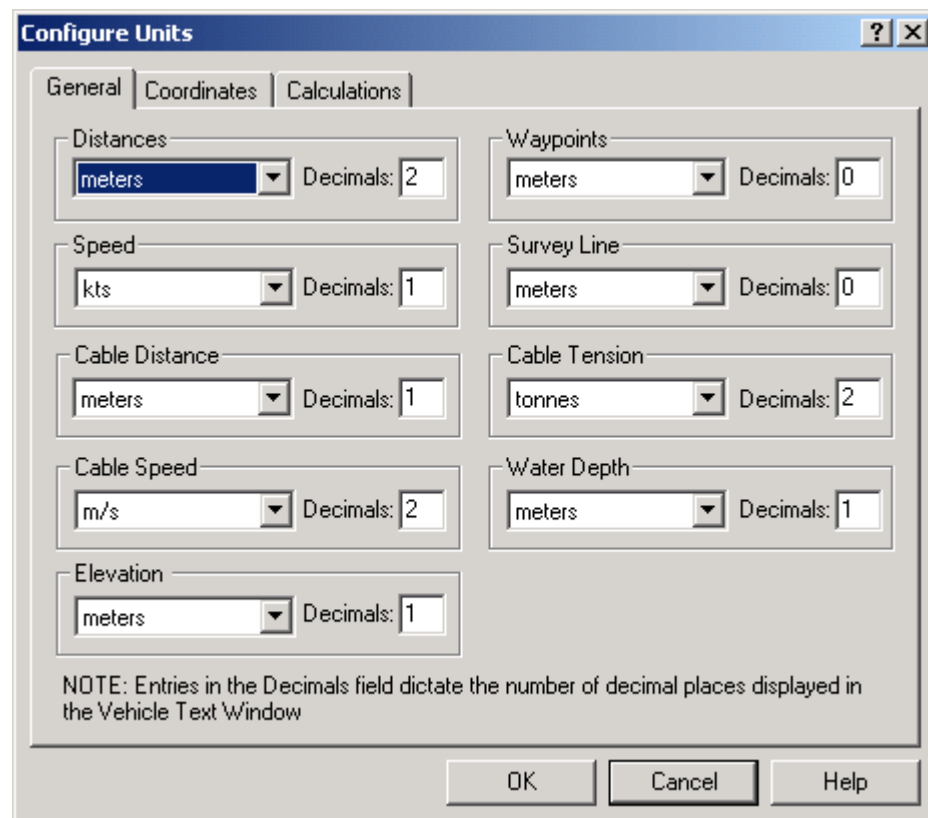
WinFrog allows you to configure the units of measurement and the types of coordinates that will appear in WinFrog's entry boxes. With these default formats pre-configured, the units will not have to be specified each time a value is entered in dialog box. These selections also affect the way these values will be seen throughout WinFrog.

Seven different units of measure are available in WinFrog:

- meters
- feet
- US survey feet
- kilometers
- nautical miles
- fathoms
- Imperial feet

To Configure Units

- From the **Configure** menu, choose **Units**.



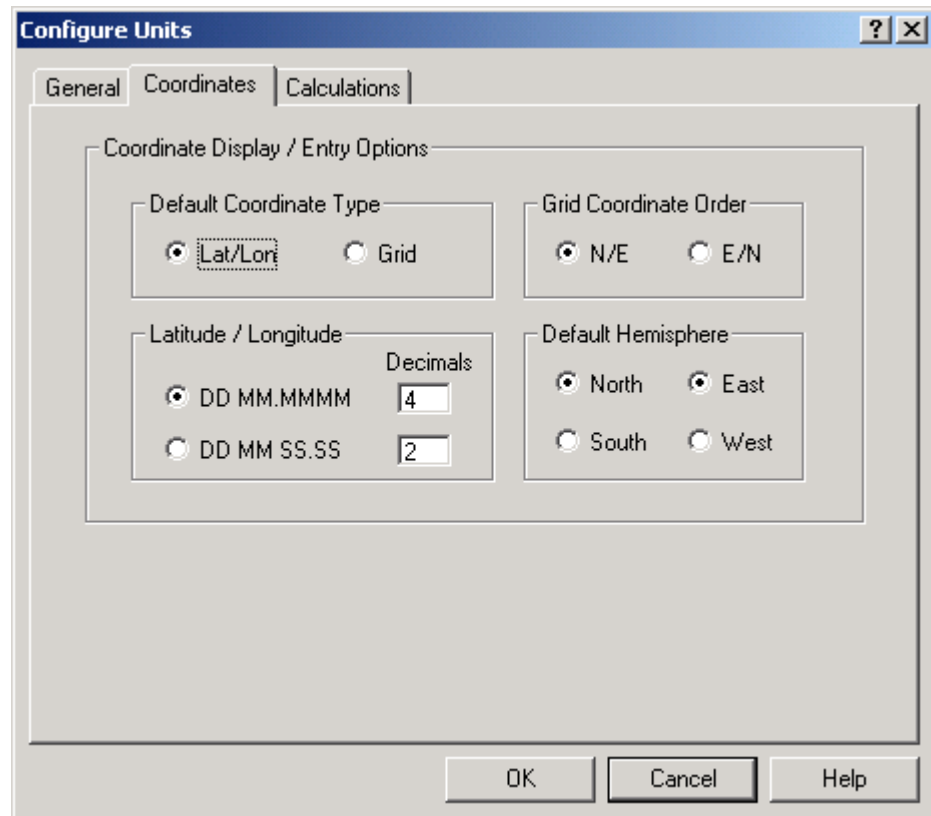
The following parameters are configurable using this dialog box:

General Tab

Distances	Units to be used for various forms of distances (ship offsets and dimensions, distance offline, etc.).
Waypoints	Units to be used when tracking Waypoints.
Speed	Units to be used to display Speed.
Survey Line	Units to be used when tracking Survey Lines.
Cable Distance	Units to be used to display laid Cable Distances.
Cable Tension	Units to be used to display Lay Cable Tensions.
Cable Speed	Units to be used to display LayCable Speed.
Water Depth	Units to be used to display Water Depth.
Elevation	Units to be used to display Elevation.

Coordinates Tab

Select the **Coordinates** tab to configure the default format for coordinate display and entry.

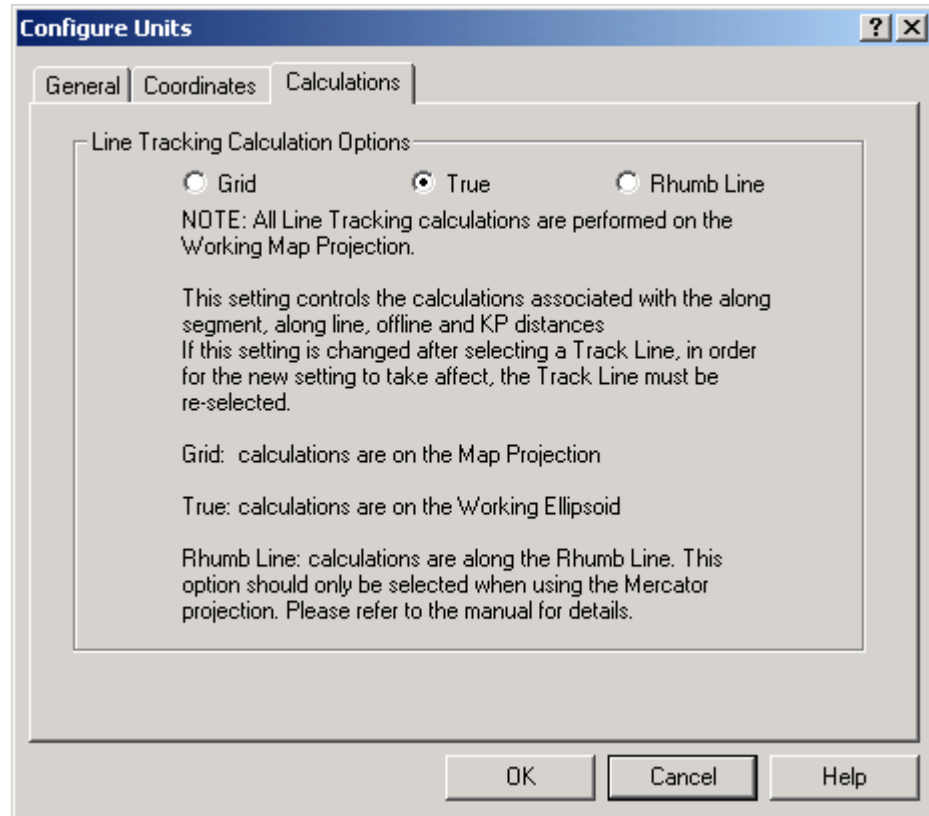


The following options are presented:

Default Coordinate Type	
Area Lat/Lon or Grid	Select the appropriate option to have coordinates displayed/entered as Geographic latitude/longitude or as Grid Northings/Eastings.
Grid Coordinate Order	
N/E or E/N	Select the appropriate option to present Grid coordinates as Northing/Easting (N,E or Y,X), or as Easting/ Northing (E,N or X,Y).
Latitude/ Longitude	Select the appropriate option to present geographical coordinates as degrees, minutes, and decimal minutes (DD MM.MMM) or degrees, minutes, seconds, and decimal seconds (DD MM SS.S). Enter the desired value to define the number of decimals for display.
Default Hemisphere	Default format for entering geographic coordinates. Both Latitude (North or South) and Longitude (East or West) can be configured.

Calculations Tab

Select the **Calculations** tab to select the type of calculations that will be undertaken to derive **Line Tracking** values.



WinFrog Line Tracking Process

When utilizing the Line Tracking feature in WinFrog, it is critical that the methodology applied by WinFrog is understood. This is especially true when the lines involved are very long, such as transoceanic RPLs.

The Relationship of the Vessel to the Line

The most important point to remember about line tracking is that the relationship of the vessel with the line being tracked is determined on the Working Map Projection Grid, not the Working Ellipsoid, i.e. WinFrog compares a vehicle position to the line on the map. This involves determining the intersection point of a line passing through the vessel's tracking point and perpendicular to the respective segment of the tracked line. This intersection point is determined using plane geometry based on the Working Map Projection. Essentially there are then three points to consider: 1) the reference point on the vehicle, 2) the point on the segment perpendicular to the reference point and 3) the coordinate of the start of the segment.

Representation of the Line Tracking Information

Once the intersection point is determined, the line tracking information must be calculated and presented. It is at this stage that the selection of the **Calculations** options, from the **Configure Units** dialog affects the line tracking calculations. The calculations involve the calculating of the cumulative along line distance, the along segment distance, the offline distance and the KP, as well as other less used values. These calculations involve the use of inverse algorithms between the three points plus the length of all the segments up to the segment in question.

Grid

When **Grid** is selected, the inverse calculations used apply plane geometry on the Map Projection to determine Map Projection grid distances. The above intersection point was determined on the Map Projection and is therefore left in that coordinate system.

True

When **True** is selected, the inverse calculations used are geodetic on the Working Ellipsoid. The three points are converted to geodetic coordinates then the geodetic inverses, on the working ellipsoid, are computed. The along segment distance is added to the sum of the geodetic distances along all the preceding segments.

Rhumb Line

When **Rhumb Line** is selected, the inverse calculations used are Rhumb Line using Working Ellipsoid geographic coordinates. The three points are converted to geodetic coordinates then the rhumb line distances, computed on the working ellipsoid, are calculated. The along segment distance is added to the sum of the rhumb line distances along all the preceding segments.

Associated Issues

The following are general and specific points that are important in understanding the WinFrog Line Tracking.

Geodetic Issues

- Technically speaking, the shortest distance between any two points on any particular surface is called a geodesic. On a sphere this line is usually called a great circle and on a plane it's always referred to as a straight line. On a reference ellipsoid it usually referred to as a geodesic.
- Except for special cases, a Great Circle and a geodesic cut meridians of longitude at constantly changing angles.

- A Rhumb Line (or loxodrome) may be considerably longer than either a Great Circle or geodesic and is affected by its location with respect to the equator and the separation of the end points.
- A Rhumb Line cuts all meridians of longitude at the same angle.

WinFrog Specific Issues

- WinFrog's geographic inverse and direct calculations utilize Puissant's short line formula for distances under 40km, and Sodano's for distances over 40km.
- The geographic inverse calculated with WinFrog over a sample 4000km line on WGS84 compares to GeoCalc (Blue Marble Geographics) to the hundredths of seconds in azimuth and to 15cm in distance.
- The setting of **Grid**, **True** or **Rhumb Line** affects the line tracking data displayed and the eventing, if based upon along line distance traveled.
- In the line dialog, the button **Insert POL's** allows you to have WinFrog calculate additional points on line at a specified interval using either Map Projection, geographic or Rhumb Line inverse and direct algorithms. For long lines this allows WinFrog to approximate a geodesic for geographic line tracking. Even though WinFrog is in fact still performing the line tracking calculations on the map projection, because several more points were added this new "path" better approximates the geodesic. The accuracy of the approximation of the geodesic depends upon the interval used to add the new nodes - the more points the better the approximation.

Map Projections

- When using the Mercator Projection, a straight line on the map is a Rhumb Line. Since WinFrog performs the line tracking calculations on the map projection, when using the Mercator Projection, WinFrog is performing Rhumb Line tracking. Combining this with the setting of Line Calculations to **Rhumb Line** results in Rhumb Line navigation with the graphical and alphanumerical data agreeing. If Rhumb Line tracking is desired then the map projection selected should be the Mercator.
- On all of the other WinFrog projections, except in special cases, a straight line on the map is neither a Rhumb Line nor a geodesic. Essentially a straight line on one of these projections is the chord of the geodesic between the same two points on the ellipsoid. A geodesic projected onto a map will appear as a section of an ellipse, circle or hyperbola depending upon the map projection.

Usage

- If the planned route was created on a Mercator projection and the desire is to track these same straight lines, then the Mercator projection must be selected with the same projection parameters as the map used for the design. Select the Rhumb Line calculation in the **Configure Units** dialog.
- If Rhumb Line tracking is desired then a Mercator projection is required with the Rhumb Line calculation selected in the **Configure Units** dialog.
- If the desire is to track a geodesic, then the length of the line segments need to be made short in order to approximate the geodesic on the map. To determine how short is required:
 1. Setup a line in WinFrog
 2. Find the center point coordinates
 3. Using the POL, divide the line exactly in half
 4. Compare the mid point in 3 with the point in 2
- Then select the calculation to either Grid or True in the **Configure Units** dialog. The choice here usually depends upon the KP values from the plan. If these were grid distance KP's then select Grid in the **Configure Units** dialog. If the plan KP's were true then select True in the **Configure Units** dialog.

For information on configuring a vehicle to track a survey line, see the Setup Line Tracking section in Chapter 6: Vehicles.

Chapter 4: Working Directories

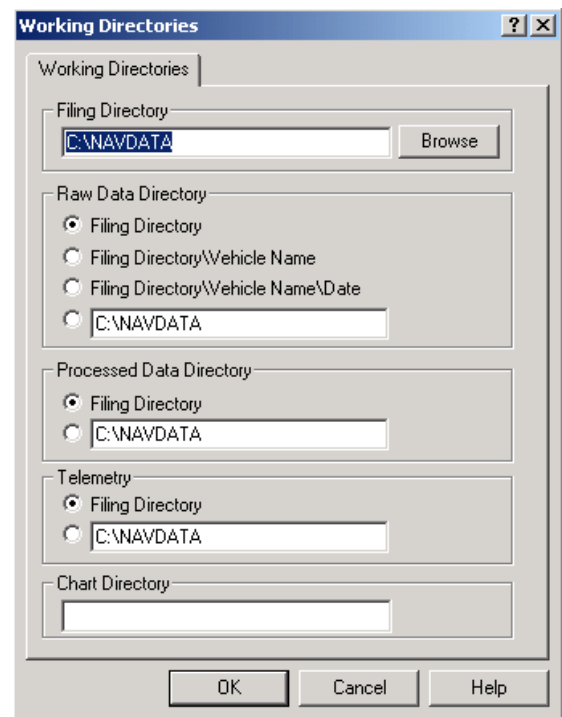
Before a project starts, it is prudent to organize the various files used by WinFrog in easily found, project-specific directories. This includes files that WinFrog receives, such as those received through a telemetry network and also files created by WinFrog for output, such as raw and network data files.

The specific folders where these files are placed are called the **Working Directories**. **Working Directories** can exist or be created here. For the sake of organization, it is recommended that each project's files be contained in its own dedicated directory.

To Configure the Working Directories

- From the **File** menu, choose **Select Working Directories**. The **Working Directories** dialog box displays.

The **Working Directories** dialog box is used to assign locations for data storage. There is a default directory setup for data storage, **C:\NAVDATA**, in the **Filing Directory** field. Since the **Filing Directory** radio button is selected in each data area listed, by default *all* of the data will be stored in this directory. You can change each one and assign other directories, as desired, or leave them to be stored in the default location.



The Working Directories Tab

Filing Directory

The folder specified in the **Filing Directory** window can be selected as the main storage location for all data so that all data received or output is placed in this directory.

To Change the Filing Directory

- 1 Type the desired path in the **Filing Directory** field. Or, click the **Browse** button, navigate to the desired directory, and click **OK**.

Note: even when you have the **Filing Directory** option chosen, the name of the directory shown in the various entry windows below will not immediately change to reflect the new directory selection. The change will not occur until the **OK** button is selected.

Raw Data Directory

The **Raw Data Directory** is where WinFrog raw (**.raw**) data files are stored. WinFrog can be configured to automatically create subdirectories for raw file storage in order to create a more efficient data path structure for large projects. The **Raw Data Directory** can be set to one of four different data path hierarchies using the radio buttons:

- Filing Directory
- The Filing Directory followed by the Vehicle Name.
- The Filing Directory followed by the Vehicle Name and then the Date.
- Any other directory entered into the input box or selected using the
- Browse button.

Note: the “Date” directory uses the Julian day to identify that day.

Processed Data Directory

The **Processed Data Directory** is reserved for future development.

Telemetry

The **Telemetry** area is where WinFrog stores files received via an interfaced radio telemetry network. This directory can be set to the **Filing Directory**, or any directory entered in the user entry field or selected via the **Browse** button. For more information about WinFrog file transfer via telemetry, see the telemetry chapter.

Chart Directory

This window was used on previous WinFrog versions to specify the **Working Chart** for display on the **Graphics** and **Bird’s Eye** windows. Entries made here will be superseded by choices made when configuring the **Graphics** display using **Configure Graphics > Background > Plot Charts**.

See the **Operator Display Windows** chapter for more details on using charts.

Chapter 5: Working Files

This chapter discusses the creation, selection, and use of **Working Files**.

Designating a file as a **Working File** instructs WinFrog to use that particular file for data retrieval or storage. There may be several different files of the same type on the computer's hard drive. Designating a file as the **Working File** specifies that all entry and/or editing of that type of data will occur in that specific file.

WinFrog's **Working Files** are not different in content than any other **non-working** file. All WinFrog generated files contain text-based, comma separated ASCII format data. WinFrog can also utilize some other files whose formats are specified by their third party creators. WinFrog utilizes these various files for different purposes; some are used to store data while WinFrog uses others in graphic presentations, etc.

Each WinFrog file has a unique three-letter file extension and contains different types of information. (See **Appendix B: WinFrog File Formats** for detailed information concerning the structure and contents of individual file types.)

Some **Working Files** contain coordinate data. For example, a **Working Survey Line** file contains a list of individual lines that can be displayed on screen and tracked by the helmsman. Each line is independent of the others in terms of name, coordinates, color, etc. A **Working Waypoints** file contains a list of individual target points that can be displayed and tracked. Each waypoint is independent of the others in terms of name, coordinates, etc.

Other **Working Files** are used only to refer to other WinFrog files that contain coordinate data. For example, the **Working Data (.ALG) file** simply contains a list of **data (.DAT)** files that have been created. These individual **.DAT** files contain the actual data fix information.

WinFrog can access **Working Files** from anywhere on the computer, but to keep projects organized it is recommended that the **Working Files** be kept in a single **Working Directory** on the computer's hard drive. When WinFrog was installed, default **Working Files** were created and stored in the default **Working Directory** named **Navdata**. You can use these default files for a project or create new files, as required.

Each of the different types of files used by WinFrog are easily identified by their three letter file extensions:

File name	Extension	Contents
Survey line	.PTS	node coordinates and attributes of each survey line
Waypoint	.WPT	list of individual waypoints and their associated attributes
Data	.ALG	list of individual data files
Data	.DAT	contains automatic event information
Seismic Sources	.ASC	list of individual Source files
Source	.SRC	contains automatic event information
Seismic Receivers	.ALL	list of individual Receiver files
Receiver	.RCV	contains automatic event information
Logs	.LOG	manual event information
Picture	.PIC	list of entities comprising a picture
Charts	.***	various 3rd party file types (.RML, .BSB, .HDR)
CRDD Database	.MDB	Cable Route Design Database
Xponders	.XPT	list of subsea transponders and their attributes
Control Stations	.CLS	list of individual control stations and their associated attributes
Velocities	.VEL	profile of velocities at different depths
Cable Events	.CET	manual event information
Passwords	.PWD	security password information

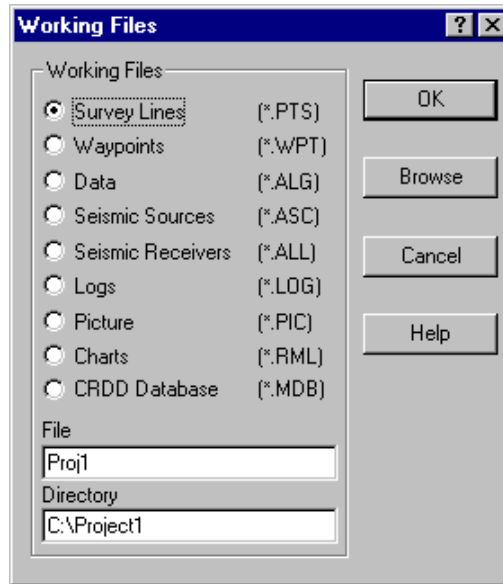
Selecting Working Files

Working files are selected (or created) in two different ways, depending on which type is needed. The first (and quickest) way is by opening the **Select Working Files** dialog box. Use this method to select the more commonly used file types, i.e.: those files required in a typical hydrographic survey.

Other, less commonly used, WinFrog files must be created by selecting the main menu item **File**, then **New**. The following sections detail both of these methods.

Working Files Dialog Box

The **Working Files** dialog box allows you to quickly select or create those working files most commonly used by WinFrog.



To Configure a Working File Using the Working Files Dialog Box

- 1 From the **File** menu, choose **Select Working Files**.
- 2 Select the working file type by selecting the corresponding radio button.
- 3 Type the path of the desired directory into the **Directory** input field and the file name into the **File** input field. **Note:** the directory must already exist in order to use it, since WinFrog will not create a new directory. If a file name that does not already exist is entered, a new file will be created with the specified name.

Or, alternatively

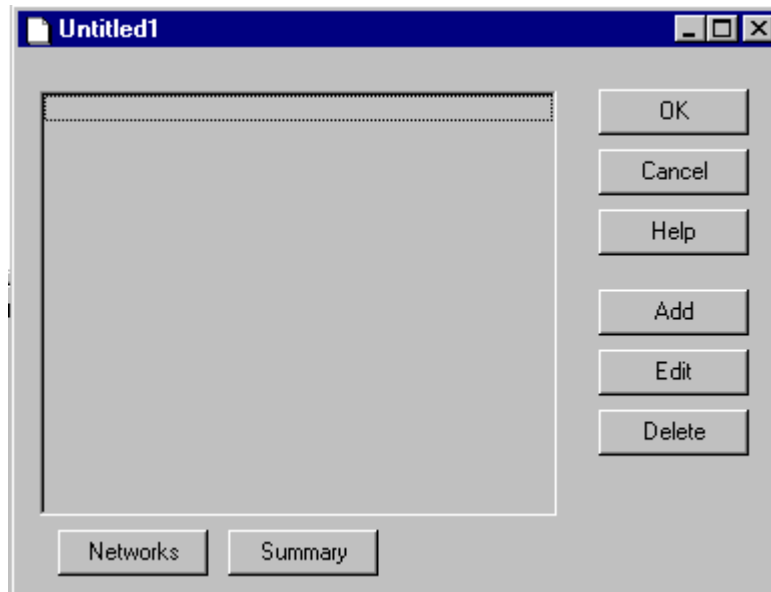
- 3a Click the **Browse** button.
- 3b Navigate to the desired directory.
- 3c In the **File name:** field, type the desired name.
- 3d Click **Open**.
- 4 Repeat the above steps for all required file types. Once all the required **Working Files** have been specified, click **OK**.

Creating and Selecting Less Common Working Files

Transponder (Xponder) files, **Control Station (CtrlStation)** files, **Velocities** files, and **Cable Event** files are required only on certain specific projects such as those involved with subsurface positioning and cable installation projects. These file types are configured and selected differently from other WinFrog files.

To Create a .XPT, .CLS, .VEL, or .CET file

- 1 From the **File** menu, choose **New**



- 2 From the list of available file types, choose the desired option.
For example, choosing the **.XPT** type brings up the following window:
- 3 Click the **Add** button.
- 4 Highlight the **Comment/Name** entry window and enter a temporary name. (You will delete this later). Click **OK** to close this and return to the previous dialog. You will see your entry reflected in the window.
- 5 Click **OK**. A message will appear asking you if you want to save the changes. Select **Yes**.
- 6 Once you select **Yes**, the **Save As** dialog box opens. Use the **Save as type** dropdown box to select the appropriate file type (.XPT for this example). Enter the name of the file, then click the **Save** button.
You have now created a file of that specific type.
- 7 Now, open this file in order to designate it as the **Working File** for files of that type.

To Designate an Existing File as the Working File

- 1 From the **File** menu, choose **Open...**

At the bottom of the **Open** dialog box is a **Files of type:** dropdown menu listing all 11 types of WinFrog files.

- 2 From the **Files of type:** dropdown menu, select the file type you wish to open.

- 3 Navigate to the directory containing the file to be opened.

- 4 Select the desired file.

- 5 Click **Open**.

- 6 At the upper left of the dialog box, check the **Working** box.

This designates the file as the current **Working File**. Once a file is selected as the current **Working File**, WinFrog de-selects the previously selected **Working File** of the same type.

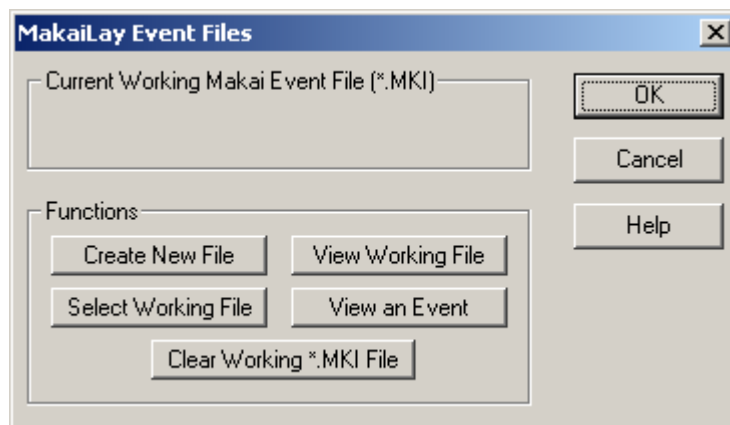
You can now edit or delete the “false” entry made when the file was created.

- 7 Click **OK**.

You can now access the contents of the file in the same way as you access the more common **Working Files**. (Select **File > Working Files...**)

To Create a .MKI file

MakaiLay event files are used in conjunction with the MakaiLay interface drivers ‘Tycom System’ and ‘DW System’. The MakaiLay operator may download a selection of events as recorded by WinFrog during the cable laying. This may be done periodically, say every six or twelve hours. To enable recording of these events by WinFrog, the WinFrog operator must set up a working *.MKI file. This is done by selecting **File > Edit Working Files > Makai Cable Event**. The **MakaiLay Event Files** dialog appears.



Use this dialog to first create a MKI file, then to select it as the working MKI file. **View Working File** provides a drop down list of the events in the file, one of which may be selected to view. **View an Event** allows you to select any MKI file and then view an event in that file.

If a file is not set up, events from MakaiLay will not be stored. Ribbit can read these MKI files.

Working Survey Lines (.PTS) File

A **Survey Line** is a series of points (at least 2) joined together in consecutive order to create a line. All **Survey Lines** are accessed via the **Working Survey Lines (.PTS) File**. Each line in the **Working Survey Lines File** is treated independently of the others.

A **Survey Line** is made up of the following components:

- The **Start of Line**, also referred to as the **SOL**.
- Points where the line direction changes, referred to as **Alter Courses** or **A/C's**. **A/C's** are also referred to as **Segments** in the survey line coordinate entry window.
- The **End of Line** , also referred to as the **EOL**.

A **Survey Line's** length can be as long as required, with as many **A/C's** as needed. All **Survey Line** records are regarded as multi-segmented lines. (A simple point-to-point line is treated as a multi-segmented line with only one segment). Each line record contains the name, start of segment coordinates, and end of segment coordinates for each segment (the end of segment coordinates of each segment are the start of segment coordinates for the next segment).

Once a **Survey Line** has been defined in the **Working Survey Lines** file, it can be displayed in the **Graphics** and **Birds Eye** windows and a vehicle can be made to track the **Survey Line**. Once you have selected which line to track, WinFrog calculates such information as along-track distances from the **SOL** and **EOL**, as well as the cross-track distance perpendicular to the **Survey Line**. This information can then be displayed in one or more windows to assist the helmsman in keeping the vessel on course.

Other survey line features allow you to add a radius to a point to create a curved line, and change the line color to help differentiate one line from another. You can also have WinFrog automatically generate **Points on Line** between two existing points and you can create lines parallel to an existing line or automatically generate a series of lines in a grid pattern about a fixed point.

To Create or Select the Working Survey Lines File

- 1 Select the main menu item **File > Select Working Files**.
- 2 Click the radio button beside **Survey Lines (.PTS)**.
- 3 In the **File** field, enter the name of an existing **.PTS** file or a new name for the **Survey Line** file.
- 4 In the **Directory** field, enter the location and name of an *existing* directory where the file is (will be) located. (Alternatively, use the **Browse** button to select the appropriate directory.)
- 5 Click **OK** to complete the designation of the file as the **Working Survey Lines** file.

To Select a Track Route (.TRK) as the Survey Line

- 1 Select the main menu item **File > Select Working Files**.
- 2 Click the radio button beside **Survey Lines (.PTS)**.
- 3 In the **File** field, enter the name of an existing **.TRK**
- 4 In the **Directory** field, enter the location and name of an *existing* directory where the file is located. (Alternatively, use the **Browse** button to select the appropriate directory.)
- 5 Click **OK** to load the Track Route file as the **Working Survey Lines** file.

The Track Route file will be read when you click OK and you will be notified of any anomalous data that is found. Once the file has been read, a **.PTS** file will be created in the same directory as the original **.TRK** file with the same name. If a file of that name already exists, you will be prompted to choose to overwrite the existing file, enter a new name for the file or cancel opening the new file.

Editing the Contents of the Working Survey Lines File

WinFrog stores **Survey Line** information in the **Survey Lines (.PTS)** file. This file contains all information pertinent to survey lines, including the line name(s) and all the coordinate points that define each of the line segments.

To Edit the Working Survey Lines File

- 1 From the **File** menu, choose **Edit Working Files... > Survey Lines**.

WinFrog opens a dialog box whose title bar reflects the name of the **Working Survey Lines File**.

This dialog window allows you to **Add**, **Edit**, and **Delete** survey lines. You can also create new survey lines parallel to an existing survey line, and create a grid of survey lines around a specific coordinate.

Creating a New Survey Line

A **Survey Line** is created by defining the coordinates of two or more points. These coordinates define the end points of each segment of the line.

To Create a New Survey Line

- 1 Click the **Add** button to open the **Survey Line** dialog box, as seen below.

- 2 In the **Name** field at the top of the **Survey Line** dialog box, enter a unique name for the line.

Note: problems will arise if two lines have the same name; specifically, if you try to track a survey line that is listed twice in the same file, WinFrog will select the first line found in the file.

- 3 Highlight **Segment0** in the **Line Segments** area, indicating that you will be entering the coordinates for the **Start of Line (SOL)**.
- 4 Enter the coordinates in the coordinate field.

This sets the coordinates of the first point of the new line. Determining which point is the **Start of Line** is significant because it determines the direction of the line, as well as which side of the line will be deemed the starboard or port side of the line.

- 5 Select **Segment1** in the **Line Segments** list.

- 6 Enter the coordinates of the end of the first segment of the line.

You can also define this point by selecting the **R/B** checkbox to enter the **Range** and **Bearing** from the previous point. Ensure the distance units are correct and note that the bearing **must be** entered in **degrees and decimal degrees (dd.dddd)** format. If the point is below vertical datum (i.e. a depth) enter the elevation value as negative.

- 7 To **Add** another point to the end of the survey line, click the **Add Segment** button.

Enter the coordinates of the additional points.

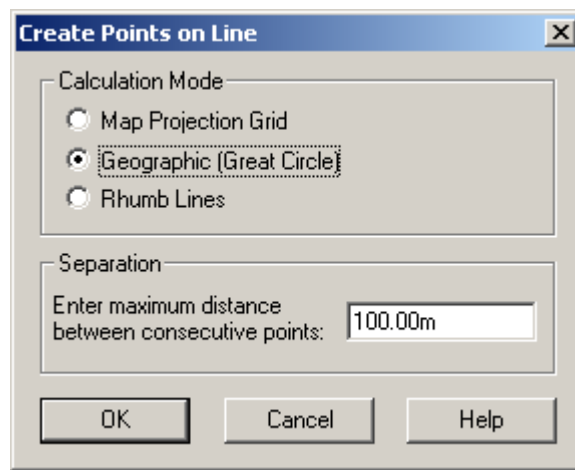
- 8 To **Insert** a point between two previously entered points, first highlight the **Segment** that you want the new point to **precede**, then click the **Insert Segment** button. **Note:** a new point is inserted in the coordinate listing just above the point that was highlighted.

The coordinates of the newly added point must be edited to the desired value.

- 9 Highlight the newly created **Segment**, then highlight and edit the coordinates as required.

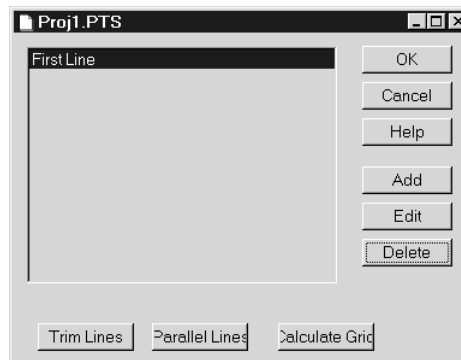
- 10 To **Delete** a point, highlight the appropriate segment and select **Delete Segment**.

- 11 You can use WinFrog to generate “points on line” between two previously entered points, based on a defined maximum distance from a selected segment. First, highlight the segment that you want the new points to **follow**, then select the **Insert POL's** button. The **Create Points on Line** dialog box appears, as seen below.



WinFrog will generate points on the selected segment using the inverse and direct algorithms for the selected Calculation Mode based on the entered Separation value. Note that the distance from the last new POL to the following original node may be less than the entered separation.

- 12 Highlight the value in the entry window and type in the desired interval between points. Click **OK**. WinFrog will create as many points that will evenly fit between the existing points.
- 13 **Note:** the **Line Information** section of the survey line dialog box. The three windows in this section will update as you click on any of the segments of the line. **KP at Segment** refers to the **Kilometer Post** value at that segment.
- 14 Click on **OK** to close this window and save the changes.
- 15 The line is added to the list of Survey Lines in the Working Survey Lines file, as shown below.



To create additional **Survey Lines**, repeat this process giving the new **Survey Lines** unique names.

Overage Loop Option

WinFrog supports the capability to generate the necessary alteration in the design route to allow for the laying of excess flexible pipe. This is referred to as an Overage Loop. This option is accessed via the Overage Loop button in the Line Segment panel and includes the option to preview the loop in the Graphics Window.

To Apply an Overage Loop

- 1 Select the appropriate line in the **Survey Line** dialog box and click the **Edit** button.
- 2 Select the segment the overage loop is to be located on and click the **Overage Loop** button.

Route Modification Configuration

Parameters

Excess
Enter length of excess to adjust for.

TP1 Coordinate
☒ Geo ☐ Grid

☐ Range from Node 0
 Segment: 0 Azimuth: 51 15 55.0Grid

Maximum heading Deviation
Enter the maximum deviation from the original segment

Route Modification Type
☐ Off
☐ Half Wave - Clockwise
☐ Half Wave - Counter Clockwise
☒ Full wave - Clockwise
☐ Full Wave - Counter Clockwise

Options

Calculated Points

IP1	N33 43.1827 E139 57.6958	70.19mGeo
IP2	N33 43.1774 E139 57.7597	70.19mGeo
IP3	N33 43.2842 E139 57.7725	70.19mGeo
IP4	N33 43.2789 E139 57.8364	70.19mGeo

- 3 In the **Excess** panel, enter the actual (true geographic) length of excess flexible pipe that is to be laid in the overage loop.
- 4 In the **TP1** panel, select the coordinate type (Geo or Grid) and enter the coordinate that the loop is to start at. This can be either manually entered or copied from the last position a Graphics Window cursor was positioned (clicked) using the **Copy** button. In either case, WinFrog calculates the point on the segment that is closest to the entered coordinate. Alternatively, the range from the node that defines the start of the selected segment can be entered by selecting the **Range from Node n** checkbox. This distance is entered in grid if the Grid radio button is selected and actual (true) if the Geo radio button is selected.
- 5 In the **Maximum heading Deviation** panel, enter the maximum deflection angle allowed for any tangent defining the overage loop components.
- 6 In the **Route Modification Type** panel, select the type of overage loop to use.
- 7 Click the **Calculate/Preview Line** button to calculate the overage loop and preview it any Graphics or Bird's Eye window that is open. The previewed line is displayed in white. The calculated nodes are displayed in the **Calculated Points** panel.

- 8 To clear existing overage loop nodes, click the **Clear Current Modified Points** button.
- 9 To accept the overage loop, exit the dialog with **OK**.
- 10 During the process, if at any time WinFrog determines that a problem exists, you are alerted. WinFrog will not let the overage loop calculation proceed if a problem exists. An example of this is if based upon the selected starting point and length of excess flexible pipe to lay results in an end of the overage loop that extends beyond the following node.

It is important to note the following with respect to the overage loop option:

- Only one overage loop can be added to a survey line.
- The Overage Loop button is only active if the selected segment can support a loop. Thus when the last segment is selected, this button is disabled.
- WinFrog keeps track of the overage loop nodes, including when saving to and loading from a survey line file. In the **Survey Line** dialog in the **Line Segment** panel, if an overage loop has been added to a line, the segment the loop was added to is indicated with an asterisk.
- If a loop has already been added to a line, the Overage Loop button is only active when that segment is disabled. If another loop is to be added to the line, the existing loop must be cleared first.
- The nodes associated with the overage loop become actual nodes in the survey line and thus are incorporated in line tracking calculations, including alongline, offline and KP.

Defining Curves in a Survey Line

As previously mentioned, **Survey Lines** are created by entering the coordinates of a series of points in consecutive order. The line that results simply joins those points together directly. However, some **Survey Lines** are defined with a certain curvature at these changes of direction. Pipe laying, for example, requires curves of a specific minimum radius at direction changes to accommodate for the rigidity of the pipe.

You can enter a radius in the **Radius Grid Distance** field for any line points except the **Start of Line** and **End of Line**, since the curve radius must be applied to a segment that is between two other segments. The radius is used to describe an arc between the two line segments at the point selected in the **Line Segments** list. The point to which the radius is applied is understood by WinFrog to be the **point of intersection (PI)** of the two tangents between which the curve is applied. If mathematically possible, WinFrog inserts the curve tangentially into the

survey line. A message will appear if the operation is not mathematically possible.

To enter a radius, simply highlight the designated **PI** segment, then enter a radius value in the **Radius Grid Distance** window. Click in any other window to make the values in the **Line Information** windows change to reflect the changes. Now the **KP at Segment** and **Total Length** values are now calculated using the curve information, not the tangent information.

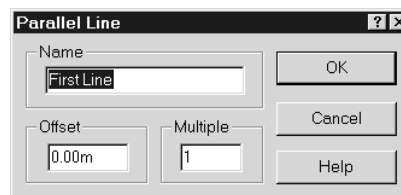
Note: If you select the **Scalable KP** radio button, any radii entered for any line segment is ignored. Scalable kilometer post calculations are based on a line segment-to-line segment basis. (For more details see the **Using the Kilometer Post Control** section later in this chapter.)

Creating New Survey Lines Parallel to Existing Survey Lines

You can use WinFrog to generate new survey lines that are parallel to an existing survey line. This saves time that would otherwise be spent calculating Start of Line and End of Line coordinates and also ensures that the parallel line coordinates are correct.

To Create Survey Lines Parallel to Existing Survey Lines

- 1 Choose **File > Edit Working Files... > Survey Lines** to display the contents of the **Working Survey Lines** file.
- 2 Click on the name of the existing **Survey Line** to which the new parallel lines will be created.
- 3 Click the **Parallel Lines** button at the bottom of the dialog box. The **Parallel Line** dialog box appears, as seen below.

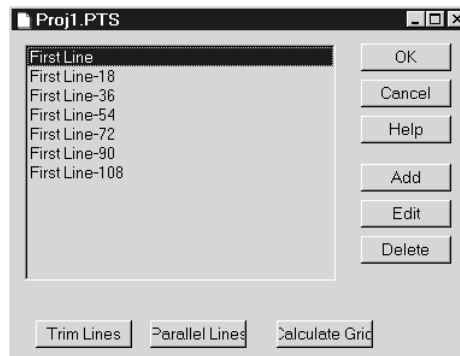


- 4 Highlight the **Offset** field. This value defines the distance that the new lines will be offset from the chosen line.
- 5 Enter the offset value. (Remember, in WinFrog, **starboard** offsets are entered as **positive** values and **port** offsets are entered as **negative** values.)

Note: The **port** and **starboard** sides of the line are designated as viewed from the start of the line towards the end of line.

If the original survey line contains a curve, the new parallel lines' curve radii will be increased or reduced by the offset value. This may result in incorrect line segment calculations if the radius is reduced to zero (or less).

- 6 Highlight the **Multiple** field.
- 7 Enter the desired number of survey lines to be created parallel to the selected line.
- 8 Click **OK** to close this window and initiate the creation of the new survey lines.



The **Survey Lines** dialog box now lists the newly created survey lines. The names of the new lines are based on the original line - appended with the offset value. You can highlight and edit any of these lines as described above.

- 9 Click **OK** to close the **Survey Lines** dialog box and save the new lines.

See the **Operator Display Windows** chapter for information about configuring the **Graphics** window to display the survey lines.

Creating a Grid of Survey Lines Around a Point

Some projects require a grid pattern of survey lines centered around a single point. WinFrog has the capability to automatically generate a grid of survey lines, based on user-entered values such as Center Position, the Number of Lines, Line Offset, Line Length, and Orientation.

To Create a Grid of Survey Lines

- 1 With the **Working Survey Lines** dialog box open, click the **Calculate Grid** button to display the **PrePlot Grid** dialog box, as seen below.

Preplot Grid

Grid Center/Orientation

N32 00.2359
W117 01.0439

☒ Geo
☐ Grid

Azimuth 45.0

OK
Cancel
Help

N-S Line

Number of Lines 6
Length of Lines 1000.00m
Spacing of Lines 50.00m
Name Prefix NS

E-W Line

Number of Lines 4
Length of Lines 300.00m
Spacing of Lines 250.00m
Name Prefix EW

- 2 In the **Grid Center/Orientation** field, enter the coordinates of the center point of the grid.
- 3 In the **Azimuth** field, enter the rotation of the grid in **degrees - decimal degrees (dd.dddd)**. The rotation refers to the bearing of the N/S lines, as measured clockwise from North.
- 4 In the **N/S Line** area, enter the **Number of Lines** that are required in the **North/South** direction.

If an even number of lines is to be created, half the number of lines are created to the left of the center point and half the number of lines are created to the right of the center point. If an odd number of lines are to be created, one line will be created directly over the center point.

- 5 In the **N/S Line** area, enter the length required for the lines in the **Length of Lines** field.

The lines are created so that the center point coordinates will be perpendicular to the mid-point of each line.

- 6 Enter a value in the **Spacing of Lines** area that reflects the required spacing between lines in the North/South direction. This entry is always a positive value.
- 7 In the **Name Prefix** field, enter the label you would like to precede each line name. For example, enter **NS** to indicate that these lines are North/South lines. WinFrog will add a numerical offset value to this prefix so that each line created will have a unique line name.
- 8 To create the lines in the East/West direction, repeat Steps 4–7 for the fields in the **E/W Line** area.
- 9 Once the parameters of the survey grid have been configured, click **OK**.

WinFrog will generate the new lines and present them in the **Working Survey Lines** file. The newly created lines are completely independent and no different than any other lines contained in the **Working Survey Lines** file. You can edit each of the lines to change the name, color, etc. as required.

Note: If the grid was generated incorrectly, all of the newly created lines must be deleted and the new lines re-generated following the same procedures as there is no single “re-calculate grid” option.

- 10 Click **OK** to save the changes to the **Working Survey Lines** file. The new survey lines are now also visible in the **Graphics** window, if configured to display them.

Using the Kilometer Post Control in the Survey Line Dialog

The **KP (Kilometer Post) Control** section of the **Survey Line** dialog box (as seen below) enables you to alter a **Survey Line's KP** value by selecting either **Scalable KP** or **Design KP**.

The screenshot shows the 'Survey Line' dialog box with the following sections and controls:

- Line Name:** A text field containing 'ACsOnly'.
- Node Data:**
 - Position:** Radio buttons for 'Geo' (selected), 'Grid', and 'R/B'. A 'Copy' button is next to it.
 - Elevation:** A text field containing '-850.00m'.
 - Radius (Grid Distance):** A text field containing '0.00m'.
- Event Control - SOL Event:**
 - Number:** A text field containing '0'.
 - Downline Distance:** A text field containing '0.00m'.
- KP Control:**
 - Scalable KP:** A radio button (unselected).
 - Design KP:** A radio button (selected).
 - Segment:** A text field containing '0.000'.
 - Starting:** A text field containing '0.00000'.
 - Segment Scale Factor:** A text field containing 'N/A'.
 - Scale Limit (% of 1.0):** A text field containing '20.00%'.
 - Buttons:** 'Increase' (selected), 'Decrease', and 'Use FP'.
- Line Segments:**
 - A list box showing 'Segment0' through 'Segment7'.
 - Buttons: 'Add Segment', 'Insert Segment', 'Delete Segment', 'Insert POL's', and 'Overage Loop'.
- Line Information:**
 - Distance:** A text field containing '0.0'.
 - Segment Length - to -:** A text field containing '0.00000'.
 - KP at Segment:** A text field containing '0'.
 - Total Length:** A text field containing '185391.71m'.
- Graphic Control:**
 - Plot On:** A checkbox (unchecked).
 - Line Colour:** A green color swatch with an 'Edit' button.
- Vessel Approach Alarm:**
 - Enable:** A checkbox (unchecked).
 - Approach Distance:** A text field containing '1.00m'.
 - Note:** 'Line alarm toolbar button must be pressed for alarm to be active'.
- Buttons:** 'OK', 'Cancel', and 'Help' at the bottom.

The two **KP Control** options are discussed in detail below.

Design KP

Selecting the **Design KP** radio button in the **KP Control** area of the **Survey Line** dialog box results in kilometer post calculations executed based on a specified **Starting KP** user entry and increment selection (**Increase** or **Decrease** radio button). The value entered in the **Starting KP** field under the **Design KP** radio button always refers to **Segment 0** (i.e. SOL) of a **Survey Line**. The selection of

the **Increase** or **Decrease** radio buttons indicates whether the kilometer post value increases or decreases downline. **Note:** if curves are present in the survey line, the curves are included in the kilometer post calculations.

Scalable KP

Selecting the **Scalable KP** radio button in the **KP Control** area of the **Survey Line** dialog box allows you to input specific kilometer post values for each line segment. This entry then defines a scale factor used for that segment. This is often required when performing pipeline inspection surveys when, for example, a previous survey has assigned KP values for specific points along the structure. These assigned KP values do not necessarily match the actual calculated distance between the respective points, but a KP value is entered so that subsequent surveys and inspections will be scaled to relate all information to the original KP data.

To accomplish this, specific KP values (as calculated by the initial survey) are entered in the **Segment** field under the **Scalable KP** radio button for each line segment selected from the **Line Segment** list. WinFrog then calculates a scale factor for that segment and applies the factor to the actual (new) KP distances to determine a scaled segment KP value for any point along the route.

Note: using the **Scalable KP** option requires a scale factor to be entered for every entered line segment.

The respective calculated **Segment Scale Factor** value is displayed below the **Segment** field as data are entered for each line segment highlighted in the **Line Segments** list. (You must click in any other entry window in this dialog box to update the value to reflect a new KP entry). For example, if **Segment2** is selected from the **Line Segment** list, the scale factor displayed is that for the first line segment (from **Segment1** to **Segment2**).

You can also enter a **KP Scale Limit**, which is used to test the calculated scale factor for each segment. The default value is 20 percent. When the line is assigned to a vehicle, WinFrog performs this test after the **Survey Line** dialog box is exited. If the test detects a violation after exiting the dialog box, a message box appears detailing the violation and requiring you to return immediately to the **Survey Line** dialog box to review and make adjustments as required. If the test detects a violation when the line is assigned to a vehicle, a message box displays detailing the violation, but the line is still assigned and operation continues. The onus is on you to review the line data and make the appropriate modifications. This test is applied at both points in the WinFrog operation to cover the case of reading a line file into WinFrog without actually reviewing the data from the **Survey Line** dialog box.

Use FP/KP

If you require the stationing of points to be displayed in foot units instead of

kilometers, click on the **Use FP** button. Observe the change in the KP values to the standard equivalent. The button also changes to now display **Use KP** should you want to switch back in the other direction.

Line Information

The **Line Information** area on the lower right side of the **Survey Line** dialog box is intended to assist you in ensuring the correctness of the survey line data as it is entered.

The **Segment Length - to -** displays the calculated line segment length for the line segment immediately before the highlighted point, as selected from the **Line Segments** list.

The **KP at SegmentX/MidCurveX** displays the KP associated with the selected segment. If **Design KP** is selected, the KP is calculated, and in the case of a curve, the KP for the midpoint of the associated curve is shown; otherwise, the KP displayed is for the selected segment itself. If **Scalable KP** is selected, the KP is that entered for the selected segment.

The **Total Length** field displays the total line length. If curves are present and the KP mode is **Design**, the length is calculated including the curves rather than just directly point to point.

It is important to note that these calculations and all real-time line tracking calculations are performed either on the map projection or the working ellipsoid, depending on the user selection in the **Line Distance Calc** area of the **Units** dialog box (**Configure > Units**).

Event Control - SOL Event

The **SOL Event** area in the **Survey Line** dialog box is used to assist the configuration of events. For more information, see the **Eventing** chapter.

- 1 In the **Number** field under the **SOL Event** area, enter the event number to be used at the **Start of Line**. This number will be recalled as the default **SOL event number** when eventing is configured.
- 2 In the **Downline Distance** field under the **SOL Event** area, enter the downline distance from the **Start of Line** to record the first event. This is usually left as **0.00**.

Vessel Approach Alarm

If an alarm is desired when a vessel approaches a certain location, you can create a line then enable the Vessel Approach Alarm and enter a distance. When one of the points describing the vessel shape comes within the specified distance, the

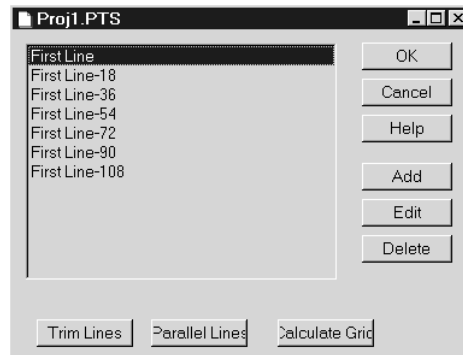
computer will beep at 2 Hz. Several lines can be enabled. To toggle the beeping on/off, click the “Line” button on the WinFrog tool bar (see the Speed Toolbar section in chapter 1).

Editing the Working Survey Lines File

For a variety of reasons, it may be necessary to modify one or more of the survey lines contained in the **Working Survey Lines** file.

To Edit the Working Survey Lines File

- 1 From the **File** menu, choose **Edit Working Files... > Survey Lines**.



To Edit a Survey Line

- 1 Select the survey line to be edited.
- 2 Click the **Edit** button.

The **Survey Line** dialog box opened is identical to the dialog box that was used to create the survey line.

- 3 Change any of the available survey line parameters desired.
- 4 Click **OK** to save the changes when finished.

Deleting a Survey Line

Any existing survey line can be removed from the **Working Survey Lines** file.

To Delete a Survey Line

- 1 From the **File** menu, choose **Edit Working Files... > Survey Lines**.
- 2 Select the survey line to be removed.
- 3 Click the **Delete** button.
- 4 Click **OK** to confirm the changes.

Creating a Survey Line from the Working Waypts File

WinFrog can create a survey line using information already entered into the **Working Waypoints** file. This saves time and increases the accuracy of the entries, especially when entering coordinates of long survey lines with many segment entries.

To Create a Survey Line from Waypoints in the Working Waypoints File

- 1 From the **File** menu, choose **Edit Working Files... > Waypoints**.
- 2 Select the desired waypoints .

Multiple waypoints can be selected by holding the **Ctrl** key on the keyboard and clicking the desired waypoints. You can also use the **shift** key with the mouse to highlight multiple waypoints listed in continuous order.

- 3 Simultaneously press the **Ctrl+Insert** keys on the keyboard. This copies the coordinates of the waypoints to the computer's "clipboard" memory. Click **OK** to close the **Working Waypoints** file.
- 4 From WinFrog's **File** menu, choose **Edit Working Files... > Survey Lines**.
- 5 Simultaneously press the **Shift+Insert** keys on the keyboard.

WinFrog creates a new survey line with the coordinates of the waypoints used as the coordinates of the survey line points (segments), in the same order that they were found in the **Working Waypoints** file. The name of the new survey line will default to the name of the first waypoint that was copied. You can now highlight and edit this survey line just like any other line in the **Working Survey Lines** file.

Creating a Survey Line from the Working Logs File

WinFrog can create a survey line using information already entered into the **Working Logs (.log)** file. The **Working Logs** file contains event data collected manually by the user. Note that the manual events can contain one or multiple vehicle's positions. If multiple positions are recorded, WinFrog uses all positions (in the order found) to create the new survey line.

To Create a Survey Line from Events in the Working Logs File

- 1 From the **File** menu, choose **Edit Working Files... > Logs**.

- Multiple events can be selected by holding the **Ctrl** key on the keyboard and clicking the desired events. You can also use the **shift** key with the mouse to highlight multiple events listed in continuous order.

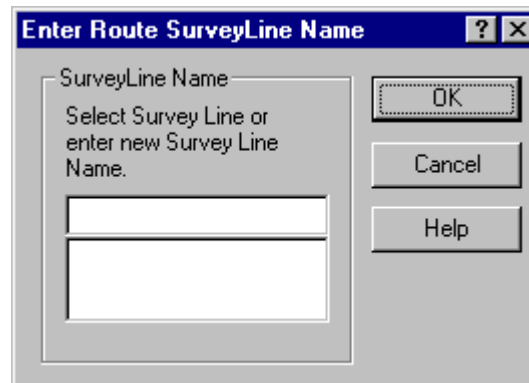
- From WinFrog's **File** menu, choose **Edit Working Files... > Survey Lines**.

- WinFrog creates a new survey line with the coordinates of the events used as the coordinates of the survey line points (segments), in the same order that they were found in the **Working Logs** file. The name of the new survey line will default to the name of the first event that was copied. You can now highlight and edit this survey line just like any other line in the **Working Survey Lines** file.

WinFrog's **Graphical Route Design** tool can be used to create a survey line using coordinates obtained by simply clicking a series of points on the **Graphics** or **Bird's Eye** displays. This tool provides a quick and easy way to create (or edit) survey lines whose coordinates need not be exact. (The accuracy depends on the Graphics display scale and the user's ability to move the mouse to the exact coordinates required). The **Graphical Route Design** tool is found in the Speed Tool bar, as is the **Display Position** button.

-
- WINFROG 3.2**
- File Edit View Configure Draw Utilities Window Help
- Display Position Graphical Route Design tool

- 2 Click on the **Graphical Route Design** icon. The **Enter Route SurveyLine Name** dialog box appears as seen below.



- 3 Click in the top entry window and type in the name of the survey line to be created. WinFrog lists the names of the existing survey lines found in the **Working Survey Lines** file. You could also select and edit one of these lines instead of creating a new line. For this example we will create a new line.
- 4 Click **OK** to close this window. Note that WinFrog now creates a new display (as shown below) that shows the coordinates of the mouse pointer as it moves about the limits of the **Graphics** display space.



As line points are specified on the **Graphics** display, this display will update to include the newly created line's **Total distance**, and the last segment's **Distance** and **Azimuth**.

- 5 With the mouse pointer located at the desired location within the limits of the **Graphics** display, click the left mouse button. A red circle symbol is plotted at the selected location.
- 6 Repeat step 5 to create new points on the survey line.
- 7 New points on line can be created between two existing points. Move the mouse pointer to the desired location for the new point on line. Once the pointer is close enough to the line segment, it changes its appearance from a straight cross to a circular design. Once the pointer has changed in appearance, you can click the left mouse button to create a new point on line.

- 8 Any point on line can be moved or deleted. To move a point, move the mouse pointer over the desired point. When the mouse pointer is close enough to the point, it changes its appearance from a straight cross to a more ornate cross design. To move the point, simply hold down the left mouse button as you drag the point to its new location.

To delete a point, move the mouse pointer over the desired point. When the mouse pointer is close enough to the point, it changes its appearance from a straight cross to a more ornate cross design. To now delete the point, click the right mouse button and select **Delete Point** from the presented options.

- 9 Once all line editing has been completed, you can save this line to the **Working Survey Line** file. Click the **Graphical Route Design** tool icon. A confirmation message appears asking “Do you want to save this route to the surveyline file?” Click the **Yes** button to save the line to the **Working Survey Line** file.

This line can now be found and edited in the **Working Survey Line** file.

Tracking a Survey Line From the Working Survey Lines File

Any vehicle in WinFrog can track any survey line contained in the **Working Survey Lines** file. When **Survey Line Tracking** is enabled, WinFrog constantly calculates the downline distance and perpendicular offline distance of the vehicle’s current tracking point. This information is displayed in the **Vehicle Text Window**, **Helmsman Display**, and **Attitude Display**.

To Enable Survey Line Tracking

- 1 Move the mouse point to within the limits of the **Vehicle Text** window and click the right mouse button.
- 2 Select the **Setup Line Tracking** option. For more information on enabling **Survey Line Tracking**, refer to the Vehicles chapter.

Working Waypoints (.WPT) File

A “**waypoint**” is a singular target or destination point. For example, a waypoint could be the target position for a rig move, a rock, or even the pier. Once a **Working Waypoints (.WPT)** file is defined in WinFrog, waypoints can be added and edited. Once a waypoint has been added to the **Working Waypoints** file, it can be displayed on the **Graphics** and **Bird’s Eye** displays. Also, any of the points contained within the **Working Waypoints** file can be tracked. Tracking involves the calculation and display of the range and bearing from a vehicle to a waypoint. As the vehicle moves, WinFrog re-calculates and displays the range and bearing automatically in the **Vehicle** window. You can also configure

WinFrog to sound an alarm when the vehicle crosses the boundary of a certain radius around a waypoint.

Adding a Waypoint to the Working Waypoints (.WPT) File

To Create or Select the Working Waypoints File

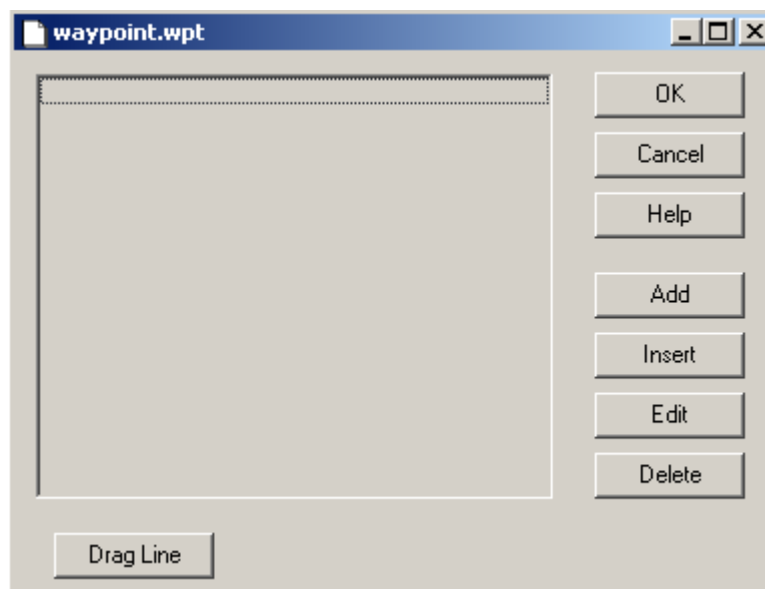
- 1 Select the main menu item **File > Select Working Files...**
- 2 Click the radio button beside **Waypoint (.WPT)**.
- 3 In the **File** field, enter the name of an existing waypoint file or the name of new **Working Waypoints** file.
- 4 Under **Directory**, type in the location and name of an *existing* directory.
- 5 Click **OK** to complete the selection of the file as the **Working Waypoints** file.

Creating New Waypoints

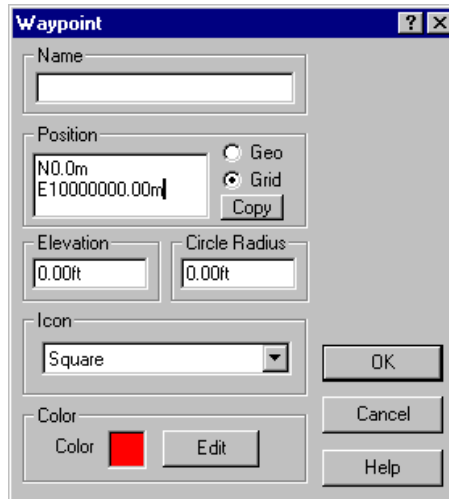
There are two ways to add a waypoint to the **Working Waypoints** file. You can edit the contents of the **Working Waypoints** file and adding a new waypoint from that location or use the **Add Waypoint** shortcut in WinFrog's **Graphics** and **Bird's Eye** displays. Both methods are detailed below.

To Create a New Waypoint from Within the Working Waypoints File

- 1 From the **File** menu, choose **Edit Working Files... > Waypoints**. WinFrog opens the **Working Waypoints** file, shown below.



- 2 Click the **Add** button.



- 3 In the **Name** field, type a unique name for the waypoint.
- 4 Highlight the coordinate value in the **Position** entry window.
- 5 Enter the coordinates of the waypoint.

The coordinates can be either entered in geographic latitude and longitude (if the **Geo** radio button is selected) or in grid Northing and Easting (if the **Grid** radio button is selected).

- 6 Type in a elevation for the waypoint in the **Elevation** field.

Note: depths are negative values in this case. The elevation is used when viewing the waypoints in the **Profile** window and for **dZ** (delta depth) **waypoint** tracking calculations.

- 7 Using the dropdown menu under the **Icon** area, select the icon to be used when displaying the waypoint in the **Graphics** and **Bird's Eye** windows.

The following choices are available:

- Square
- Circle
- Triangle
- Point
- Wreck
- Sewer/Pipeline
- Beacon - Triangular, Square, or Radio/Radar
- Post/Pile
- Rock
- Light - Directional or General
- Marker - General Buoy, Barrel Buoy, or Spherical Buoy
- Marker - Bicolor
- Bullseye
- Anchor
- Mine

- 8 Enter a value in the **Circle Radius** field, if desired.

This configures WinFrog to display a circle around the waypoint. This feature is useful when you want to stay a specified distance from a waypoint.

Note: This does not automatically enable WinFrog's audio alarm feature. That feature is enabled when you configure the tracking of a waypoint. (See the **Waypoint Tracking** section of **Chapter 6** for more details.)

- 9 In the **Color** area, click the **Edit** button to change the color of the waypoint.
- 10 Click **OK**.

Repeat steps **2** through **10** to add more waypoints.

For information about displaying waypoints in the **Graphics** window, see the **Operator Display Windows** chapter.

To Create a Waypoint Using the Graphics Window Shortcut

While this method of adding **waypoints** ultimately offers you more speed and convenience than the above mentioned “in file” method, it does initially require the configuration of various other WinFrog options, as detailed below.

- 1 From the **View** menu, choose **Graphics**. (**Note:** the WinFrog's **Bird's Eye** display can also be used).
- 2 Select the **Display Position** button in the toolbar.
- 3 Move the mouse pointer to the desired location within the limits of the **Graphics** display, then press the left mouse button. A “cross” is now drawn at that location.
- 4 Click the right mouse button and select **Add Waypoint** from the presented list of options.
- 5 The **Waypoint** configuration window displays. (See the previous section for details about the contents of this window.)

Note: the coordinates shown in the **Position** entry window are automatically updated with the coordinates of the “cross” in the **Graphics** display.

- 6 Select **OK** to close this window and add this entry to the **Working Waypoints** file.

For information about displaying waypoints in the **Graphics** window, see the **Operator Display Windows** chapter.

Editing the Contents of the Working Waypoints File

At some point during the project it may be necessary to modify one or more of the waypoints contained in the **Working Waypoints** file.

To Edit a Waypoint in the Working Waypoints File

- 1 From the **File** menu, choose **Edit Working Files > Waypoints**

WinFrog lists all the previously created waypoints contained in the **Working Waypoints** file.

- 2 Select the **waypoint** to be edited and click the **Edit** button.
- 3 Make the desired changes.
- 4 Click **OK**.

WinFrog returns to the dialog box that displays all available waypoints. Repeat as required, then select **OK** to exit this window and save the changes.

Removing Waypoints from the Working Waypoints File

Previously created waypoints can be removed from the **Working Waypoint** file.

To Remove Waypoints from the Working Waypoints File

- 1 From the **File** menu, choose **Edit Working Files... > Waypoints**

WinFrog lists all the previously created waypoints contained in the **Working Waypoints** file.

- 2 Highlight the waypoint(s) to be removed. (Use the **Shift** or **Ctrl** key to select multiple waypoints.)
- 3 Click the **Delete** button. The selected waypoints are now removed from the **Working Waypoints** file.
- 4 Select **OK** to close this window and save the changes.

Tracking a Waypoint Contained in the Working Waypoints File

Any vehicle in WinFrog can be configured to track a **Waypoint** contained in the **Working Waypoints** file. When **Waypoint Tracking** is turned on, WinFrog calculates and displays real-time range and bearing information from the vehicle's current tracking point to the waypoint. This information can then be displayed in the **Vehicle Text** window.

To Enable Waypoint Tracking

- 1 Move the mouse pointer within the limits of the **Vehicle Text** window and click the right mouse button.
- 2 Configure the presented options as desired.
- 3 Click **OK**.

For more details about enabling **Waypoint Tracking**, see the **To Track a Waypoint** section in the **Vehicles** chapter.

Working Data (.ALG) File

The **Working Data (.ALG) File** is used to reference related **Data (.DAT)** files. A **.DAT** data file contains data automatically collected during real time navigation. See **Appendix B: WinFrog File Formats** for detailed information concerning the structure and contents of data files.

The size of the **Working Data (.ALG) File** is typically quite small because this file simply consists of the names (and locations) of **.DAT** data files. For example, in a hydrographic survey application you may wish to group all **.DAT** data files under a file name corresponding to the name of the project or survey area. For example, a working data file named **Bay.ALG** may contain a listing of data files, **line1.DAT**, **line2.DAT**, etc., corresponding to the data lines associated with that area.

Unlike a working survey line, waypoint or picture file, which typically contain design data, the **Working Data (.ALG)** file references **data (.DAT)** files that contain event data collected during a survey. The format and content of a **Data (.DAT)** file is identical to that used in a **receiver (.RCV)** file and a **source (.SRC)** file. These file types are different only in their extensions and the applications in which they are used. The use of these three different file extensions for identical types of files is to improve file organization and permit you to quickly ascertain the nature of the data stored in a working file.

The contents of the **Working Data (.ALG)** file can be displayed in the WinFrog **Graphics** window. You can change the amount of **.DAT** data seen on the **Graphics** display by simply adding or deleting **.DAT** files from the **Working Data (.ALG)** file as you wish. Again, since the **.ALG** file only records the reference to the **.DAT** files, you are not actually adding or deleting the **.DAT** files, but instead simply adding or removing the reference to that file.

The **.DAT** files are generated through automatic eventing based on time, distance, or an external trigger. Each **.DAT** file consists of the actual navigation event information recorded at those pre-configured intervals. You can edit the **Working Data (.ALG)** file to access the **.DAT** data files, then edit the **.DAT** files to

read the individual event information. This editing can be done as the data are being collected or after eventing is finished, as desired.

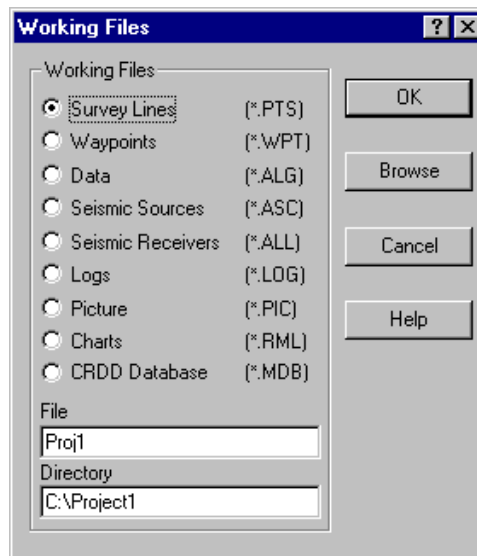
For more details about event generation, see the **Eventing** chapter.

Creating or Selecting the Working Data (.ALG) File

WinFrog stores the name and location of data (.DAT) files in the **Working Data** (.ALG) data file.

To Create a New Working Data (.ALG) File

- 1 From the **File** menu, choose **Select Working Files**.



- 2 Select the radio button to the left of **Data (*.ALG)**.

At the bottom of the **Working Files** dialog box, WinFrog displays the name of the current **Working Data (.ALG)** file in the **File** field and the file's path in the **Directory** field.

- 3 Enter the desired directory path into the **Directory** input field and the desired .ALG file name into the **File** input field. The directory must already exist since WinFrog will not create a new directory.

Note: if you enter a file name that does not already exist, a new working file will be created. The directory must already exist since WinFrog will not create a new directory.

Or

- 3a Click the **Browse** button.
- 3b Navigate to the desired directory.

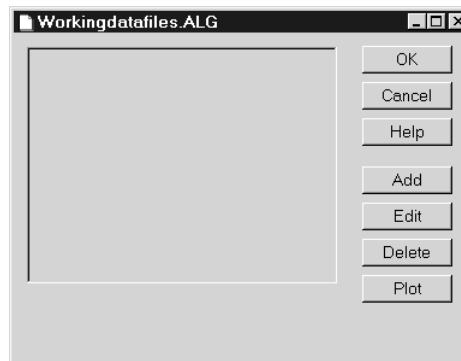
- 3c Select the desired file from the list of **.ALG** files in the **Working File** box.
- 3d Click **Open**.
- 4 Click **OK**.

Adding a Data (.DAT) File to the Working Data (.ALG) File

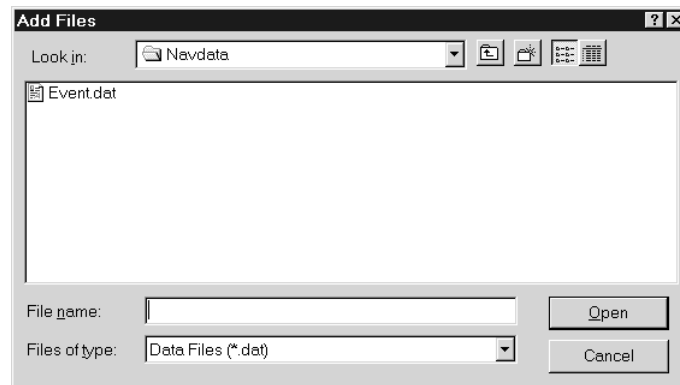
After the **Working Data (.ALG)** file has been defined, you can then specify which **Data (.DAT)** files are to be referenced by that particular **Data (.ALG)** file.

To Add Existing Data (.DAT) Files to the Working Data (.ALG) File

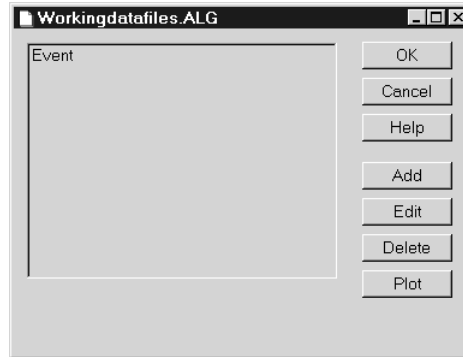
- 1 From the **File** menu, choose **Edit Working Files... > Data**.



- 2 Click **Add**.



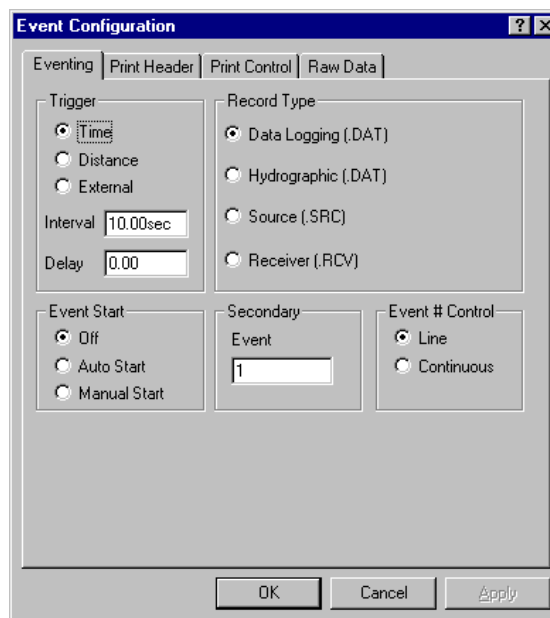
- 3 Navigate to the directory containing the **.DAT** data files to be added.
- 4 Select the file to be added.
- 5 Click **Open**
- 6 Click **OK**. WinFrog returns you to the **.ALG** contents dialog window, now listing the newly added file.



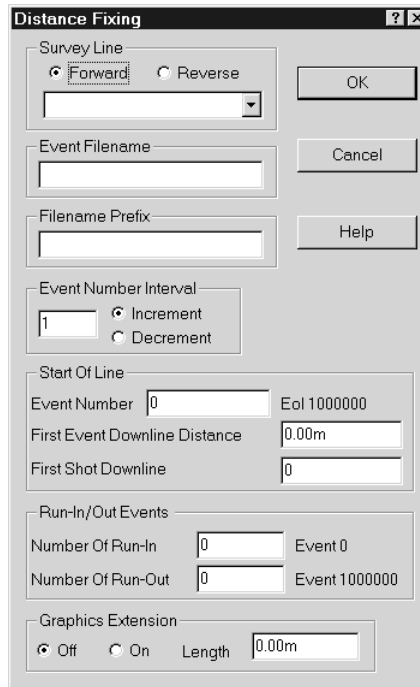
Creating Data (.DAT) Files

WinFrog's data (.DAT) files can only be created by configuring **Automatic Eventing**. The following is a brief explanation of how to start automatic eventing. See the **Eventing** chapter for more information on generating **Automatic Events**.

- 1 From the **Configure** menu, choose **Data Events > Setup**.



- 2 In the **Trigger** area, select the desired interval radio button and enter the desired event interval.
- 3 In the **Record Type** area, select the **Data Logging (.DAT)** radio button or the **Hydrographic (.DAT)** radio button, as required. Select **Hydrographic** to make WinFrog display the **Distance Fixing** dialog box, as seen in the next figure.
- 4 In the **Event Start** area at the bottom of the **Event Generation** dialog box, select either **Auto Start** or **Manual Start**.
- 5 Click **OK**.



- 6 In the **Distance Fixing** dialog box **Event Filename** field, enter the name of the **.DAT** file that is to be created. WinFrog appends the appropriate three letter file extension, **.DAT**, when the file is created.
- 7 Configure the remaining parameters.
- 8 Click **OK** to close this window and create a **.DAT** file.

Editing the Working Data (.ALG) File

You can easily modify any parameter of the **.DAT** data contained in the **Working Data (.ALG)** file.

To Edit Data Contained in the Working Data (.ALG) File

- 1 From the **File** menu, click **Edit Working Files... > Data**.
- 2 Select the **.DAT** file to be edited.
- 3 Click **Edit**.

The **.DAT** dialog box opens, listing all of the events within that data file.

The event (fix) numbers correspond to the numbers generated during automatic eventing.

- 4 Select the desired event.
- 5 Click **Edit**.

The Event dialog box contains the following fields and values:

- Number:** 9
- Vehicle:** First VEHICLE
- Position:** N3615862.54m, E485001.36m (Geo/Grid buttons are present)
- Time:** 12-22-98 12:10:47.5
- Height:** 0.00m
- Depth:** 0.00m
- Layback:** 0.00m
- Speed:** 0.00
- Heading:** 000.0
- CMG:** 0.00
- Offset:** (empty)
- QC:** 0.00
- Line Data:**
 - AlongLine: -20.68m
 - OffLine: -58.38m
 - KP: -0.021

The **Event** dialog box displays the following data:

Number	event number
Vehicle	the vehicle for which data are displayed
Position	the coordinates of the vehicle are shown either in geographic longitude and latitude (if the Geo radio button is selected) or in projection grid Northing and Easting (if the Grid radio button is selected)
Time	the date and time of that event
Height	the calculated height
Depth	water depth
Layback	the calculated layback
Speed	vehicle speed in knots
Heading	vehicle heading in degrees
CMG	course made good
Offset	name of vehicle offset point being tracked
QC	reserved for future development.
AlongLine	distance along current survey line being tracked
OffLine	distance off the current survey line being tracked
KP	kilometer post, distance downline

- 6 Edit the desired parameters.
- 7 Click **OK** to save the changes and close this dialog box.

To Add data to the Working Data (.ALG) File

- 1 From the **File** menu, click **Edit Working Files... > Data**.
- 2 Select the **.DAT** file to be edited.
- 3 Click **Edit**.

The **.DAT** dialog box opens, listing all of the events within that data file.

The event (fix) numbers correspond to the numbers generated during automatic eventing.

- 4 Click **Add**.
- 5 The **Event** dialog box displays (detailed above) with empty parameter fields. Enter the desired parameters.
- 6 Click **OK** to save the changes and close this dialog box.

To Delete data from the Working Data (.ALG) File

- 1 From the **File** menu, click **Edit Working Files... > Data**.
- 2 Select the **.DAT** file to be edited.
- 3 Click **Edit**.

The **.DAT** dialog box opens, listing all of the events within that data file.

The event (fix) numbers correspond to the numbers generated during automatic eventing.

- 4 Select the desired event.
- 5 Click **Delete**.

Creating a Histogram of Data (.DAT) File Events

If the **.DAT** file fix data were acquired while line tracking was enabled, the crosstrack error data (in a **.DAT** file contained in the **Working Data .ALG** file) may be viewed as a histogram. A histogram for an entire line can be viewed to quickly ascertain the general accuracy, in terms of line tracking, at which the line was run.

To Generate a Histogram of Offtrack Data from a Data (.DAT) File

- 1 From the **File** menu, choose **Edit Working Files... > Data**.
- 2 Select the **.DAT** file for which the histogram is to be created.
- 3 Click the **Plot** button.

A plot of the cross track (offline) histogram for that source file is generated and displayed.

The number of bins and their sizes can be modified using the two scroll bars.

Working Seismic Sources (.ASC) File

The **Working Seismic Sources (.ASC)** file is used to reference related **Source (.SRC)** data files collected during a seismic survey. The size of the **Working Seismic Sources** file is typically quite small because the file simply consists of the **names** of recorded **Seismic (.SRC)** files. The purpose of this “two-tiered” system is to improve the organization of the typically large data sets produced when undertaking a seismic survey.

WinFrog also organizes **Seismic Receivers (.RCV)** and **Data (.DAT)** using the same two-tiered file structure; **.RCV** data are referenced in the **Seismic Receivers (.ALL)** file, and **.DAT** data are referenced in the **Data (.ALG)** file. This file structure was implemented for projects such as an Ocean Bottom Cable (OBC) seismic project, for example, where all three (source, receiver, and data) files could be used. You can quickly ascertain the nature of the data stored in a working file simply by looking at the three-letter file extension. See the **WinFrog File Formats** appendix for detailed information concerning the structure and contents of **.SRC**, **.RCV**, and **.DAT** files.

Unlike **Working Survey Lines**, **Waypoints**, and **Picture** files, which contain design data, the **Working Seismic Sources (.ASC) File** references **Seismic (.SRC)** files that contain event data actually recorded by WinFrog during navigation. You can edit any one of these individual events by editing a **.SRC** file contained in the **Working Seismic Sources (.ASC)** file. (The same is true for the contents of the **Working Seismic Receivers (.ALL)** file and **Working Data (.DAT)** file).

The contents of all three data types can be displayed in WinFrog **Graphics** or **Bird’s Eye** windows.

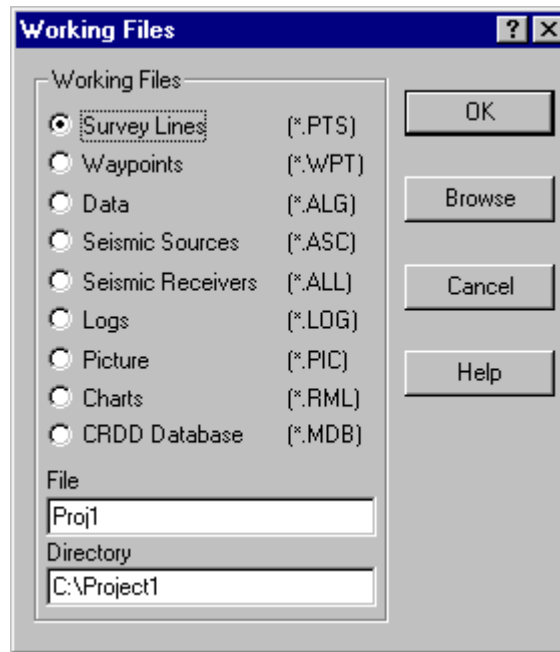
The data contained in these files are generated through automatic eventing based on time, distance, or an external trigger. For details about event generation, see the **Eventing** chapter.

Creating the Working Seismic Sources (.ASC) File

Seismic Sources (.ASC) files store the name and location of **Source (.SRC)** files. The **Working Seismic Sources** file contains all information pertinent to access a **Source** file for both “real-time” data collection and retrieval purposes.

To Create the Working Seismic Sources File

- 1 From the **File** menu, choose **Select Working Files**.



This opens a menu listing the different file types that are commonly used in WinFrog.

- 2 Select the radio button to the left of **Seismic Sources (*.ASC)**.

At the bottom of the **Working Files** dialog box, WinFrog displays the name of the current working shot points file in the **File** field and the file's path in the **Directory** field.

- 3 Enter the path of the desired (existing) directory into the **Directory** input field and the file name into the **File** input field.

Note: if you enter the name of a file that does not already exist, a new working file will be created.

Or, alternatively

- 3a Click the **Browse** button.
 - 3b Navigate to the desired directory.
 - 3c Select the desired file from the list of **.ASC** files in the **Working File** box.
 - 3d Click **Open**.
- 4 Click **OK**.

Adding Source Files to the Working Seismic Sources (.ASC) File

You can define which **Source (SRC)** files are to be referenced by the **Working Seismic Sources (.ASC)** file.

To Add Existing Source Files to the Working Seismic Sources File

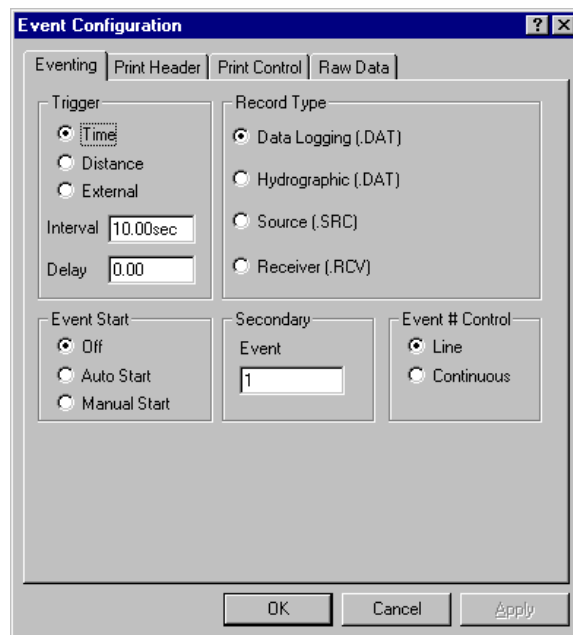
- 1 From the **File** menu, choose **Edit Working Files... > Seismic Sources**.
- 2 Click **Add**.
- 3 Navigate to the directory containing the source (**.SRC**) files.
- 4 Select the source file(s) you wish to add.
- 5 Click **Open**.
- 6 Click **OK**.

The **Source (.SRC)** file will now appear in the **Working Seismic Sources (.ASC)** file.

To Configure WinFrog to Create Source (.SRC) Files

WinFrog's data (**.SRC**) files can only be created by configuring automatic eventing. The following is a brief explanation of how to start automatic eventing. See the **Eventing** chapter for more information on generating automatic events.

- 1 From the **Configure** menu, choose **Data Events > Setup**.



- 2 In the **Record Type** area, select the **Source (.SRC)** radio button.

- 3 In the **Trigger** area at the top left of the **Event Generation** dialog box, select the **trigger** option and **interval** value required.
- 4 In the **Event Start** area at the bottom of the **Event Generation** dialog box, select either **Auto Start** or **Manual Start**.
- 5 Click **OK**.

The **Distance Fixing** dialog box displays, as seen below.

- 6 In the **Event Filename** field, enter the **Name** of the **Source File** that is to be created.

WinFrog appends the appropriate three-letter file extension, **.SRC**, when the file is created.

- 7 Configure the remaining parameters.

For detailed information about events and configuring these dialog boxes, see the **Eventing** chapter.

- 8 Click **OK**.

Editing the Working Seismic Sources (.ASC) File

You can modify **Source (.SRC)** event data contained within the **Working Seismic Sources (.ASC)** file. Any individual parameter within the source record can be modified or edited.

To Edit Data Contained in the Working Seismic Sources (.ASC) File

- 1 From the **File** menu, choose **Edit Working Files... > Seismic Sources**.

The **Working Seismic Sources** dialog box displays with a listing of all **Source** file names referenced by the **Working Seismic Sources** file.

- 2 Select the file you wish to edit.
- 3 Click **Edit**.

A dialog box opens listing all of the events contained within that **Source** file.

The event numbers correspond to the numbering configured during the setup of the **Event Generation** dialog box.

- 4 Select the desired event.
- 5 Click **Edit**.

The screenshot shows the 'Event' dialog box with the following fields and values:

- Number:** 9
- Vehicle:** First VEHICLE
- Position:** N3615862.54m, E485001.36m. Radio buttons for **Geo** (selected) and **Grid**.
- Time:** 12-22-98 12:10:47.5. Label: Month-Day-Year Hour:Minute:Second
- Height:** 0.00m
- Depth:** 0.00m
- Layback:** 0.00m
- Speed:** 0.00
- Heading:** 000.0
- CMG:** 0.00
- Offset:** (empty)
- QC:** 0.00
- Line Data:**
 - AlongLine:** -20.68m
 - OffLine:** -58.38m
 - KP:** -0.021

Buttons at the bottom: OK, Cancel, Help.

Data that may be modified in the **Event** dialog box are as follows:

Number	event number
Vehicle	the vehicle for which data is displayed
Position	the coordinates of the vehicle, displayed in geographic longitude and latitude (if the Geo radio button is selected) or in projection grid Northing and Easting (if the Grid radio button is selected)
Time	date and time

Height	height
Depth	water depth
Layback	layback
Speed	vehicle speed
Heading	vehicle heading in degrees
CMG	Course Made Good
Offset	Vehicle Offset being tracked
QC	reserved for future development
AlongLine	distance along current survey line being tracked
OffLine	distance off the current survey line being tracked
KP	kilometer post, distance downline

- 6 Edit the desired parameters.
- 7 Click **OK** to close this dialog box and save the changes.

To Add Data to the Working Seismic Sources (.ASC) File

- 1 From the **File** menu, choose **Edit Working Files... > Seismic Sources**.

The **Working Seismic Sources** dialog box displays with a listing of all **Source** file names referenced by the **Working Seismic Sources** file.

- 2 Select the file you wish to edit.
- 3 Click **Edit**.

A dialog box opens listing all of the events contained within that **Source** file.

The event numbers correspond to the numbering configured during the setup of the **Event Generation** dialog box.

- 4 Click **Add**.
- 5 The **Event** dialog box displays (detailed above) with empty parameter fields. Enter the desired parameters.
- 6 Click **OK** to close this dialog box and save the changes.

To Delete Data from the Working Seismic Sources (.ASC) File

- 1 From the **File** menu, choose **Edit Working Files... > Seismic Sources**.

The **Working Seismic Sources** dialog box displays with a listing of all **Source** file names referenced by the **Working Seismic Sources** file.

- 2 Select the file you wish to edit.

3 Click **Edit**.

A dialog box opens listing all of the events contained within that **Source** file.

The event numbers correspond to the numbering configured during the setup of the **Event Generation** dialog box.

4 Click **Delete**.

Creating a Histogram of the Source File Data

After a **Source (.SRC)** file is created in the **Working Seismic Sources (.ASC)** file, its event data may be viewed in a graphical manner. Assuming that the data have been acquired with line tracking enabled, this feature permits the generation of a histogram of cross track error data. A histogram for an entire line can be viewed to quickly ascertain the general accuracy at which the line was run.

To Generate a Histogram of Offtrack Data in a Source (.SRC) File

- 1 From the **File** menu, choose **Edit Working Files...> Seismic Sources** to open the **Working Seismic Sources** dialog box.
- 2 Select the **Source File** for which the histogram is to be created.
- 3 Click the **Plot** button.

A plot of the cross track (offline) histogram for that source file is generated and displayed.

The number of bins and their sizes can be modified using the two scroll bars.

Working Seismic Receivers (.ALL) File

The **Working Seismic Receivers (.ALL)** file is used to refer to related **Receiver (.RCV)** files. A **Receiver (.RCV)** file contains data collected during Automatic Eventing based on time or distance down line. See the **WinFrog File Formats** appendix for detailed information concerning the structure and content of a **.RCV** Receiver file.

The size of a **Working Seismic Receivers (.ALL)** file is typically quite small because the file simply consists of the names of **Receiver (.RCV)** files that are included in the working cables files.

Unlike a working survey lines file, a working waypoints file, or a working pictures file, which typically contain design data (plans for a survey), the **Working Seismic Receivers** file references **receiver (.RCV)** files that contain event

data recorded by WinFrog during navigation. The content and structure of a **Receiver (.RCV)** file is identical to that used in a **Data (.DAT)** file and a **Seismic Source (.SRC)** file. These file types are different only in their extensions and the application in which they are used. The reason WinFrog uses different working files for identical types of files is to improve file organization and permit you to quickly ascertain the nature of the data stored in a working file simply by looking at the three-letter file extension. (For details about event generations, see the **Eventing** chapter.)

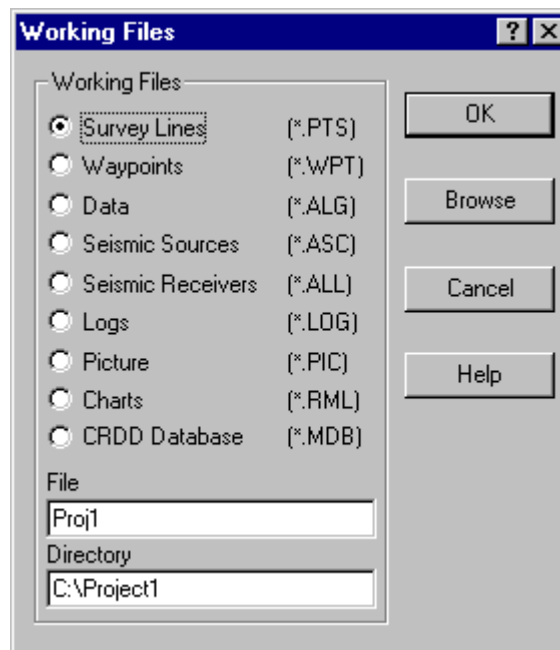
You must designate a **Working Seismic Receivers (.ALL)** file before you can begin collection of **Receiver (.RCV)** data. This file can contain multiple **Receiver (.RCV)** files and each **Receiver (.RCV)** file can consist of multiple events. All data within the **Working Seismic Receivers (.ALL)** File can be displayed in WinFrog's **Graphics** display.

Creating a New Working Seismic Receivers (.ALL) File

WinFrog stores the name and location of **Receiver (.RCV)** files in the **Working Seismic Receivers (.ALL)** file. These files contain all information pertinent to reference a **Receiver (.RCV)** file, including the file name and the directory tree to locate that file.

To Create a New Working Seismic Receivers (.ALL) File

- 1 From the **File** menu, choose **Select Working Files**.



- 2 Select the radio button to the left of **Seismic Receivers (*.ALL)**.

At the bottom of the **Working Files** dialog box, WinFrog displays the name of

the current **Working Seismic Receivers** file in the **File** field and the file's path in the **Directory** field.

- 3 Enter the path of the desired directory into the **Directory** input field and the file name into the **File** input field.

Note: if you type the name of a file that does not already exist, a new working file will be created.

Or, alternatively

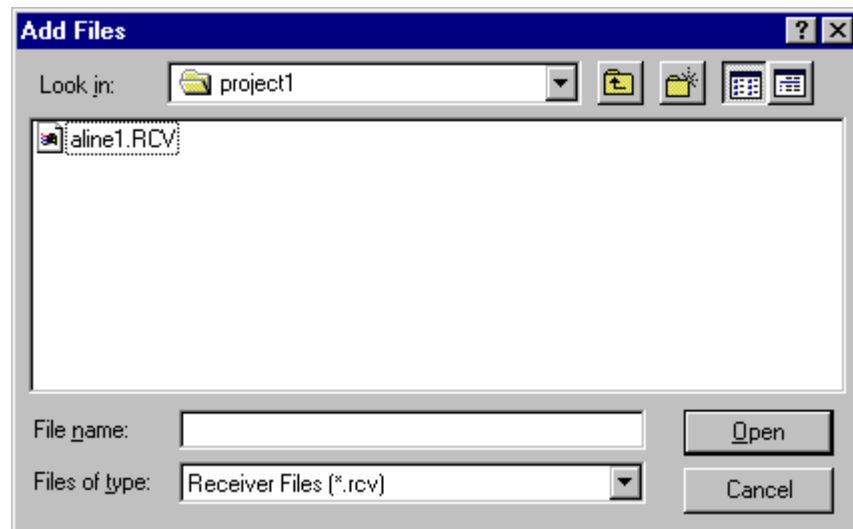
- 3a Click the **Browse** button.
- 3b Navigate to the desired directory.
- 3c Select the desired file from the list of **.ALL** files in the **Working File** box.
- 3d Click **Open**.
- 4 Click **OK**.

Adding a .RCV File to the Working Seismic Receivers (.ALL) File

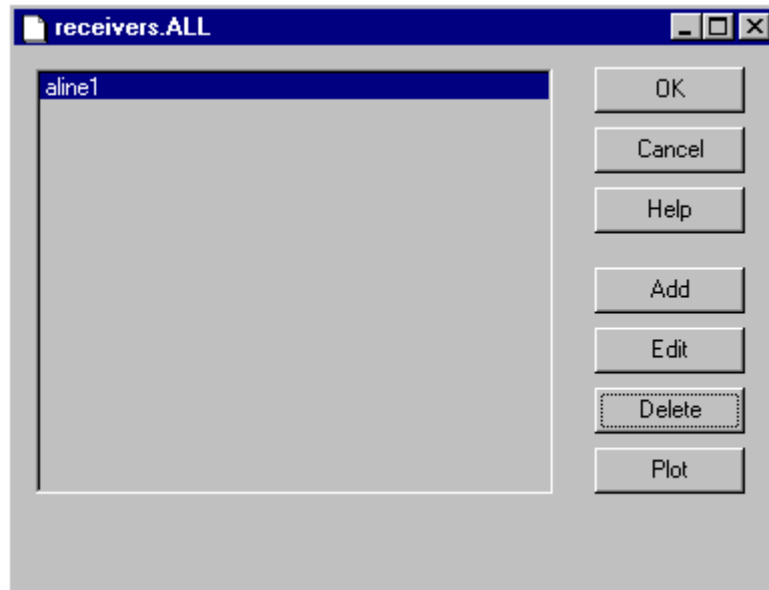
After the **Working Seismic Receivers (.ALL)** file is selected, you can then define which **Receiver (.RCV)** files are to be referenced by that file.

To Add Existing (.RCV) Files to the Working Seismic Receivers (.ALL) File

- 1 From the **File** menu, choose **Working... > Seismic Receivers**.
- 2 Click **Add**.



- 3 Navigate to the directory containing the **.RCV** files to be added.
- 4 Select the **.RCV** file to be added.
- 5 Click **Open**. WinFrog returns you to the **.ALL** contents dialog box, now listing the newly added file.rcv.

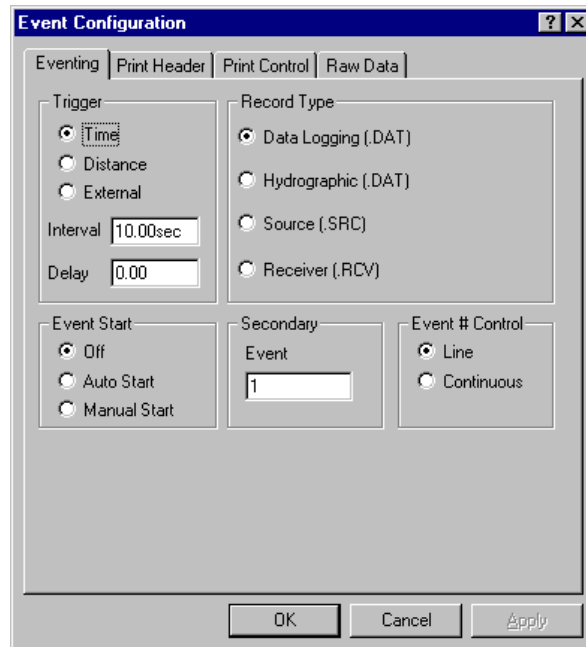


- 6 Click **OK**.

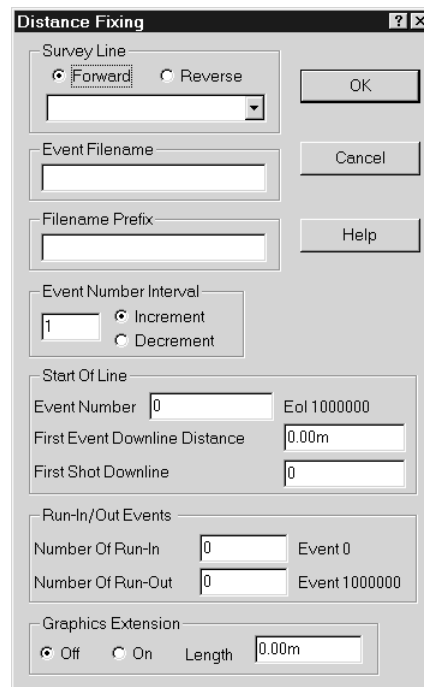
To Configure WinFrog to Create Receiver (.RCV) Files

WinFrog's receiver (**.RCV**) files can only be created by configuring automatic eventing. The following is a brief explanation of how to start automatic eventing. See the **Eventing** chapter for more information on generating automatic events.

- 1 From the **Configure** menu, choose **Data Events > Setup**.



- 2 In the **Record Type** area, select the **Receiver (.RCV)** radio button.
- 3 In the **Trigger** area, select the desired interval radio button and enter the desired **Event Interval**.
- 4 In the **Event Start** area at the bottom of the **Event Generation** dialog box, select either **Auto Start** or **Manual Start**.
- 5 Click **OK**.



- 6 In the **Event Filename** field, enter the name of the **receiver** file that that is to be created.

WinFrog appends the appropriate three-letter file extension, **.RCV**, when the file is created.

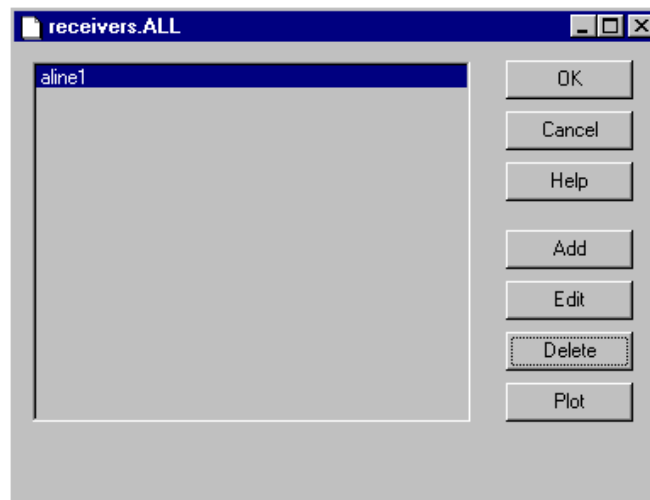
- 7 Configure the remaining parameters.
- 8 Click **OK**.

Editing the Working Seismic Receivers (.ALL) File

You can modify any parameter within a **Receiver (.RCV)** file via the **Working Seismic Receivers (.ALL) File**.

To Edit Data contained in the Working Seismic Receivers (.ALL) File

- 1 From the **File** menu, choose **Edit Working Files... > Seismic Receivers**.



The **.ALL** dialog box contains a listing of all **.RCV** file names referenced by the **Working .ALL** file.

- 2 Select the file to be edited.
- 3 Click **Edit**.

A dialog box opens listing all of the events contained within that file.

The event numbers correspond to the numbers generated by WinFrog during **Automatic Eventing**.

- 4 Select the desired event.
- 5 Click **Edit**.

The 'Event' dialog box is a standard Windows-style window with a title bar containing a question mark and close button. It contains several input fields and radio buttons. The 'Number' field contains '9'. The 'Vehicle' dropdown menu shows 'First VEHICLE'. The 'Position' section has two text boxes with 'N3615862.54m' and 'E485001.36m', and two radio buttons, 'Geo' and 'Grid', with 'Grid' selected. The 'Time' section has a text box with '12-22-98 12:10:47.5' and a label 'Month-Day-Year Hour:Minute:Second'. The 'Height', 'Depth', and 'Layback' sections each have a text box with '0.00m'. The 'Speed', 'Heading', and 'CMG' sections each have a text box with '0.00'. The 'Offset' section has an empty text box. The 'QC' section has a text box with '0.00'. The 'Line Data' section has three text boxes: 'AlongLine' with '-20.68m', 'OffLine' with '-58.38m', and 'KP' with '-0.021'. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

Data that may be modified in the **Event** dialog box are as follows:

Number	event number
Vehicle	the vehicle for which data is displayed (Select another vehicle in the dropdown box, if available.)
Position	the coordinates of the vehicle are shown either in geographic longitude and latitude (if the Geo radio button is selected) or in projection grid Northing and Easting (if the Grid radio button is selected)
Time	the date and time of that event
Height	the calculated height
Depth	water depth
Layback	the calculated layback
Speed	vehicle speed in knots
Heading	vehicle heading in degrees
CMG	course made good
Offset	name of vehicle offset point being tracked
QC	reserved for future development
AlongLine	distance along current survey line being tracked
OffLine	distance off the current survey line being tracked
KP	kilometer post, distance downline

- 6 Edit the desired parameters.
- 7 Click **OK**.

To Add Data to the Working Seismic Receivers (.ALL) File

- 1 From the **File** menu, choose **Edit Working Files... > Seismic Receivers**.

The **.ALL** dialog box opens containing a listing of all **.RCV** file names referenced by the **Working .ALL** file.

- 2 Select the file to be added to.
- 3 Click **Edit**.

A dialog box opens listing all of the events contained within that file.

The event numbers correspond to the numbers generated by WinFrog during **Automatic Eventing**.

- 4 Click **Add**.
- 5 The **Event** dialog box displays (detailed above) with empty parameter fields. Enter the desired parameters.
- 6 Click **OK**.

To Delete Data from the Working Seismic Receivers (.ALL) File

- 1 From the **File** menu, choose **Edit Working Files... > Seismic Receivers**.

The **.ALL** dialog box opens containing a listing of all **.RCV** file names referenced by the **Working .ALL** file.

- 2 Select the file to be edited.
- 3 Click **Edit**.

A dialog box opens listing all of the events contained within that file.

The event numbers correspond to the numbers generated by WinFrog during **Automatic Eventing**.

- 4 Select the desired event.
- 5 Click **Delete**.

Creating a Histogram of the Seismic Receivers (.ALL) File

After a **Receiver (.RCV)** file has been created or added to the **Working Seismic Receivers (.ALL)** file, its line tracking data may be viewed in a graphical manner. Assuming that the data have been acquired with line tracking enabled, this feature permits the generation of histogram of cross track error data. A histogram for an entire line can be viewed to quickly ascertain the general accuracy at which the line was run.

To Generate a Histogram of Offtrack Data in a Receiver (.RCV) File

- 1 From the **File** menu, choose **Edit Working Files... > Cables** to open the **Working Cables** dialog box.
- 2 Select the **Receiver** file for which the histogram is to be created.
- 3 Click the **Plot** button.

A plot of the cross track (offline) histogram for that source file is generated and displayed. The number of bins and their sizes can be modified using the two scroll bars.

Working Logs File

The **Working Logs (.LOG)** file stores “**Manual Events**” that are generated by the user with the press of a key. **Manual Events** are a “snapshot” of the navigation information at any particular instant of time, and include data such as vessel position, speed, heading, course over ground/course made good, etc. See the **Eventing** chapter for more details on **Manual Events**.

The **Graphics** and **Bird’s-Eye** windows can be configured to display the **Manual Events** recorded in the **Working Logs File**. **Manual Events** can also be tracked in the same way as **Waypoints**. After the survey, the **.LOG** file data can be used in post-processing, as all other WinFrog data.

To Create or Select the Working Logs (.LOG) File

- 1 Select the main menu item **File > Edit Working Files...**
- 2 Click the radio button beside **Logs**.
- 3 In the **File** entry field, enter the name of an existing **.LOG** file or a name for the new picture file.
- 4 In the **Directory** entry field, enter the location and name of an **existing** directory where the file will be located.

- 5 Click **OK** to create (select) the **Working Logs (.LOG) File**.

Editing the Contents of the Working Logs File

Once **Manual Events** have been recorded, it may be necessary to access or edit one or more of the **Manual Events** contained in the **Working Logs File**.

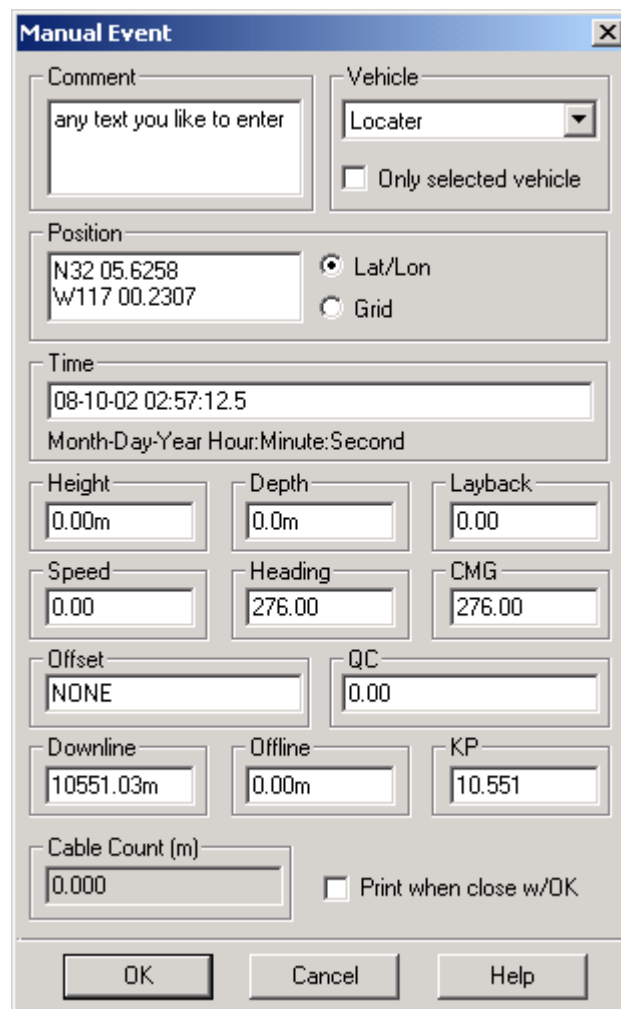
To Edit the Contents of the Working Logs File

- 1 From the **File** menu, choose **Edit Working Files... > Logs**.

WinFrog displays a list of all **Manual Events** contained in the **Working Logs** file.

- 2 Select the item to be edited.
- 3 Click **Edit**.

The **Manual Event** dialog box now appears, as seen below.



The **Manual Event** dialog box is a window for entering event data. It contains several input fields and checkboxes. The **Comment** field has the placeholder text "any text you like to enter". The **Vehicle** dropdown menu is set to "Locator", and the **Only selected vehicle** checkbox is unchecked. The **Position** section shows "N32 05.6258" and "W117 00.2307" with radio buttons for "Lat/Lon" (selected) and "Grid". The **Time** field displays "08-10-02 02:57:12.5" with the label "Month-Day-Year Hour:Minute:Second". Below this are three rows of three input fields each: **Height** (0.00m), **Depth** (0.0m), **Layback** (0.00), **Speed** (0.00), **Heading** (276.00), **CMG** (276.00), **Offset** (NONE), **QC** (0.00), **Downline** (10551.03m), **Offline** (0.00m), and **KP** (10.551). At the bottom, there is a **Cable Count (m)** field (0.000) and a **Print when close w/OK** checkbox (unchecked). The dialog has **OK**, **Cancel**, and **Help** buttons at the bottom.

The **Manual Event** dialog box allows you to modify any of the following parameters:

- Comment
 - Position
 - Date and Time
 - Height
 - Depth (of water)
 - Layback
 - Speed
 - Heading
 - CMG (course made good)
 - Offset
 - QC (quality control data)
 - Downline distance
 - Offline distance
 - KP distance downline in kilometers
 - Cable Count (if available)
 - Printing the event (select the **Print when close w/OK** checkbox)
- 4 Highlight the desired parameter and change as required.
 - 5 Click **OK** to close this window and return to the **Manual Event** listing.

Deleting a Manual Event from the Working Logs File

Any Manual Event can be removed from the **Working Logs** file.

To Remove a Manual Event

- 1 From the **File** menu, choose **Edit Working Files... > Logs**.
- 2 Select the **Manual Event** to be removed.
- 3 Click the **Delete** button.
- 4 Click the **OK** button to close this window and save the changes.

Working Picture (.PIC) File

A WinFrog **Picture** (.PIC) file is a WinFrog-specific file that contains a series of points that are connected to create a line that can be seen in WinFrog's **Graphics** displays. Picture file contents are somewhat similar to that of a **Survey Lines** file. The difference between the two is that survey lines are intended for vehicle

tracking purposes, while picture files are used only to display linear information as a background reference.

One example of a typical use for a picture file is to display the outline of a coastal area. Coastline coordinate information can be digitized from existing charts or even downloaded from the internet. This information (once formatted in the WinFrog specific format) can then be used to display the approximate location of the coastline in a selected area.

Picture file information from unknown or unreliable sources such as these must be used with caution. Some low resolution data sets may oversimplify the actual shore details. You must also ensure that the geodetic datum used in the reference data source is the same one selected in WinFrog. Positional discrepancies of several hundred meters (between actual features and their plotted positions) could result if these matters are not addressed correctly.

To Create or Select the Working Picture File

- 1 Select the main menu item **File > Select Working Files**.
- 2 Click the radio button beside **Picture**.
- 3 In the **File** entry area, enter the name of an existing **.PIC** file or a name for the new picture file.
- 4 In the **Directory** entry area, enter the location and name of an **existing** directory where the file is (or will be) located.
- 5 Click **OK** to create (select) the **Working .PIC File**.

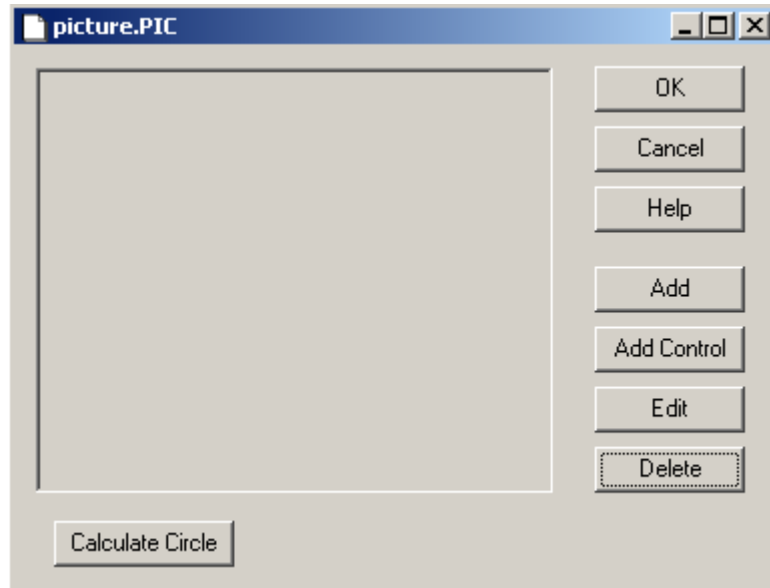
Creating a Line in the Working Picture File

With a **Working Picture** file now selected, the next step is to add the picture information. As mentioned above, a picture file contains a series of coordinated points that are joined together to create a line on WinFrog's **Graphics** display.

There are actually two main components that must be configured to be able to see the contents of the picture file. First, a new **Picture Control** item must be created. This defines the name, color, and style of the line. The second step is to add coordinated points to define the line's location. A **Picture Point** item is a point that defines a node in the picture file. In the **Working Picture** dialog box, all **Picture Point** items listed after a **Picture Control** item will be associated with that control item and will have the same color and line style.

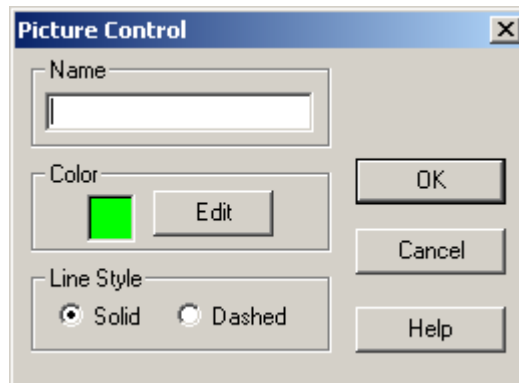
- 1 Select **File > Edit Working Files... Picture**.

The **.PIC** file dialog box appears, as seen below.

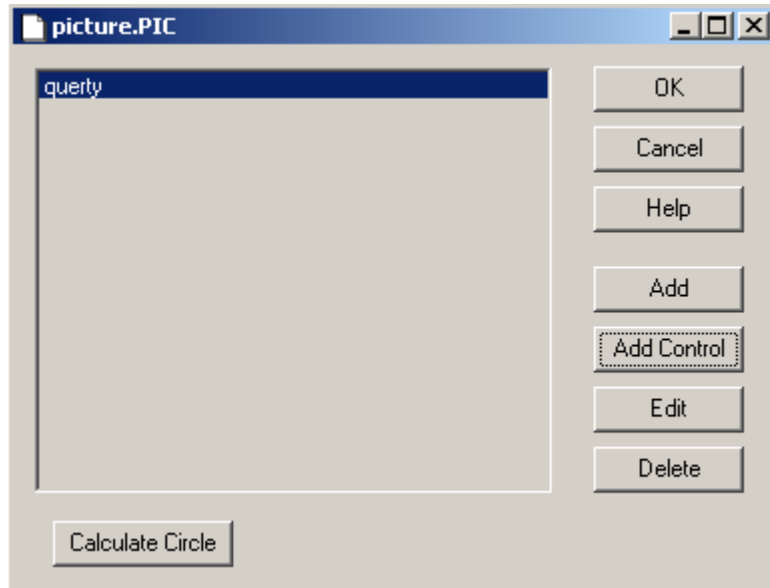


- 2 Click the **Add Control** button.

The **Picture Control** dialog box opens, as seen below.

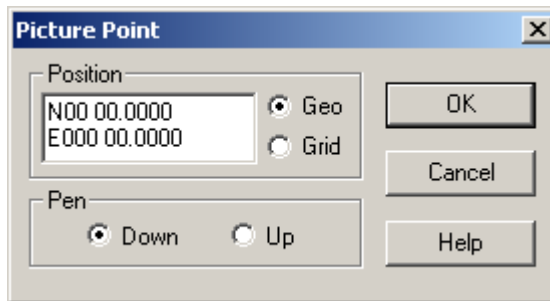


- 3 Enter a unique name in the **Name** field.
- 4 To change the color of the line, click the **Edit** button in the **color** area and select a different color from the available palette.
- 5 Select either the **Solid** or **Dashed** radio button in the **Line Style** area to define how the line appears (solid or dashed) on the **Graphics** display.
- 6 Click **OK** to close the **Picture Control** dialog box.



WinFrog adds this new **Picture Control** item to the list of items in the **Working Picture (.PIC)** dialog box.

- 7 Click the **Add** button to bring up the **Picture Point** dialog box, as seen below.



- 8 In the **Position** field of the **Picture Point** dialog box, enter the coordinates of the first point of the line.

The coordinates can be either entered in geographic latitude and longitude or in grid Northing and Easting.

- 9 In the **Pen** area, **select** either the **Down** radio button or the **Up** radio button.

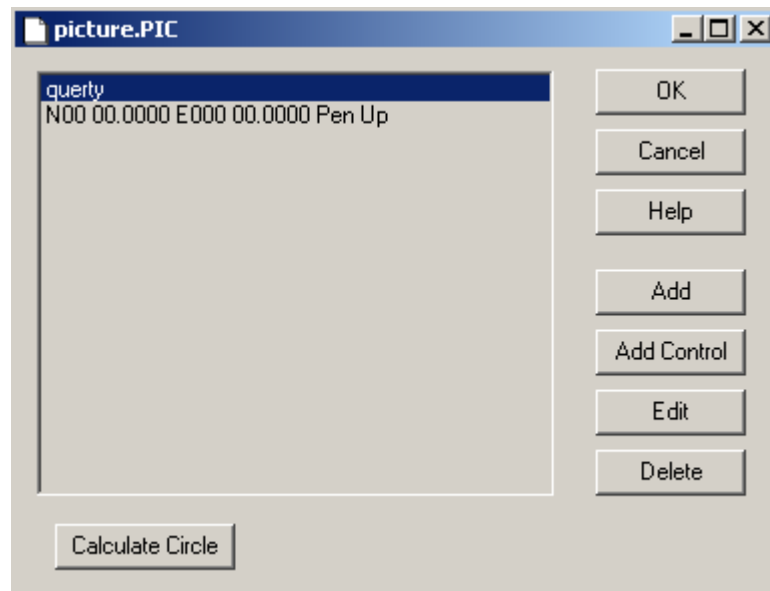
If **Pen Down** is selected, a line will be drawn from the previous **Picture Point** to this **Picture Point**, using the color and style defined by the above mentioned **Picture Control** item.

If **Pen Up** is selected, no line will be drawn from the previously entered **Picture Point** to this **Picture Point**.

Note: the **first Picture Point** added to the file must be configured with **Pen Up**. Failure to do so will result in an errant line being drawn from some random point to this point.

10 Click **OK** to add the **Picture Point** item to the **Working Picture File**.

Add more points by repeating steps 7 to 10.

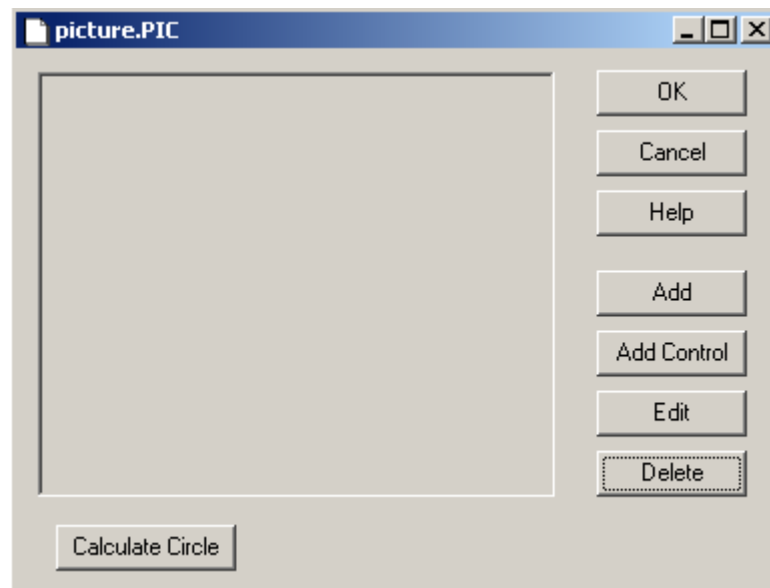


Creating a Circle in the Working Picture File

With a **Working Picture** file selected, a circle can easily be drawn by clicking the **Create Circle** button.

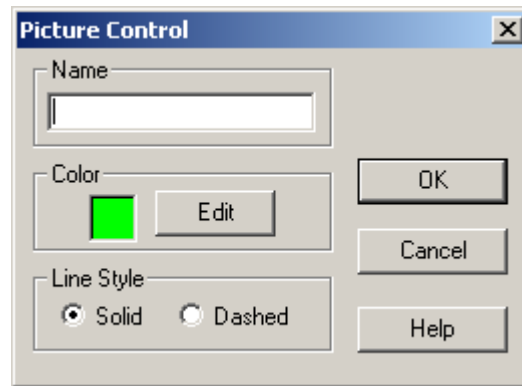
1 Select **File > Edit Working Files... > Picture**.

The **.PIC** file dialog box appears, as seen below.

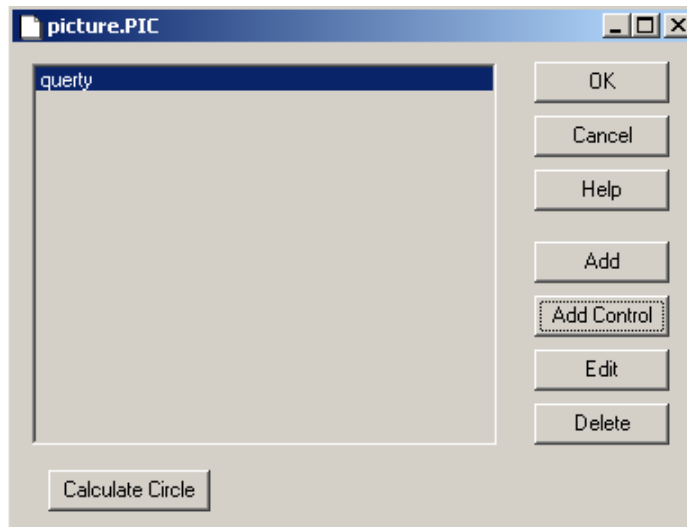


2 Click the **Add Control** button.

The **Picture Control** dialog box opens, as seen below.



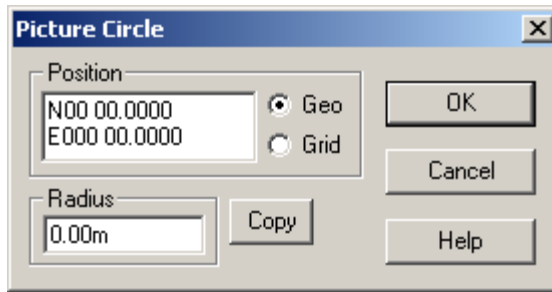
- 3 Enter a unique name for the circle in the **Name** field.
- 4 To change the color of the circle, click the **Edit** button in the **color** area and select a different color from the available palette.
- 5 Select either the **Solid** or **Dashed** radio button in the **Line Style** area to define how the line appears (solid or dashed) on the **Graphics** display.
- 6 Click **OK** to close the **Picture Control** dialog box.



WinFrog adds this new **Picture Control** item to the list of items in the **Working Picture (.PIC)** dialog box.

- 7 Click the **Calculate Circle** button.

The **Picture Circle** dialog box opens, as seen below.



- 8 In the **Position** field of the **Picture Circle** dialog box, enter the coordinates of the desired center point of the circle.

The coordinates can be either entered in geographic latitude and longitude or in grid Northing and Easting.

Click the **Copy** button to copy the coordinates in the system clipboard into the **Position** field.

- 9 In the **Radius** field enter the desired radius in meters of the circle to be drawn.
- 10 Click **OK** to calculate the circle points and add these points to the **Working Picture File**.

Add more circles by repeating steps 2 to 10.

Importing Files

Creating a complex picture in WinFrog can be a time consuming and error prone task, since you have to manually enter the coordinates of each point. WinFrog includes the ability to import two different types of drawing files and convert them to a picture file. This can save you much time and frustration in creating a picture file.

WinFrog supports the following types of input files:

- DPC Picture files
- Pelagos DMS files

To import drawing files into WinFrog:

- 1 Select **File > Import**. This will open the **Import File** dialog box.
- 2 Select the type of file to import using the appropriate radio button and click **OK**.
- 3 This will open the standard Open dialog box. This can be used to select the desired file. Click the **Open** button to import the file. WinFrog will immediately start reading the drawing entities found in the file.

- 4 Once the entities are all successfully loaded, WinFrog will create a new picture file. The picture file will have the same name as the input file with the file extension changed to **.PIC**. The file will be located in the Pictures subdirectory under the current project.
- 5 If the file already exists, WinFrog will open a dialog box stating that the file already exists and asking if WinFrog should overwrite the file. Click **OK** to overwrite the file, or **Cancel** to exit out of the import utility.
- 6 When WinFrog has finished converting all entities found in the input file, the **Import File Complete** dialog box is displayed. Click **OK** to return to the main WinFrog menu.
- 7 The imported picture file can then be used to display the imported information in the Graphics window. In addition, you can edit the control and point picture items as discussed in the section below.

Editing the Working Picture File

It is possible to modify any **Picture Control** or **Picture Point** item contained in the **Working Picture File**.

To Edit the Working Picture File

- 1 From the **File** menu, choose **Edit Working Files... > Picture**.
- 2 Select the item to be edited.
- 3 Click **Edit**.

The **Picture Control** dialog box opens if the selected item is a **Picture Control** item and the **Picture Point** dialog box opens if the selected item is a **Picture Point** item. These dialog boxes are identical to those used when the item was originally created.

- 4 Make the desired changes.
- 5 Click **OK** to confirm the changes and return to the **Picture Point File** content listing.

Removing an Item from the Working Picture File

It is possible to remove a **Picture Point** item contained in the **Working Picture File**.

To Remove a Picture Point from the Working Picture File

- 1 From the **File** menu, click **Edit Working Files... > Picture**.

- 2 Select the **Picture Point** item to be removed.
- 3 Click the **Delete** button.
- 4 Click **OK** to confirm the changes and return to the **Picture Point File** content listing.

Working Charts (.RML) File

The **Working Charts (.RML)** file contains raster image data that can be displayed in WinFrog's **Graphics** and **Bird's Eye** displays. These data can be loaded and displayed, but not edited. Three different formats of raster chart files can be loaded and displayed in WinFrog: **.RML**, **.BSB**, and **.HDR**. Each of these formats is a non-WinFrog-specific format.

To Load a New Working Chart (.RML/.BSB/.HDR) File

- 1 From the **File** menu, choose **Select Working Files**.
- 2 Select the **Charts (*.RML)** radio button.

At the bottom of the **Working Files** dialog box, WinFrog displays the name of the current **Working Chart (.RML) File** in the **File** field and the file's path in the **Directory** field.

- 3 Enter the desired directory path into the **Directory** input field and the desired file name into the **File** input field.

Note: the file and directory must already exist, a WinFrog will not create a new directory or a new working file.

Or, alternatively

- 3a Click the **Browse** button.
- 3b Navigate to the desired directory.
- 3c Select the desired file from the files listed in the **Working File** dialog box.
- 3d Click **Open**.
- 4 Click **OK**.

To View the Working Chart (.RML/.BSB/.HDR) File

After a **Chart File** has been specified as the **Working Chart File**, it can be viewed in WinFrog's **Graphics** and **Bird's Eye** displays. See the **Operator Display Windows** chapter for details on configuring WinFrog to display a chart.

Working CRDD Database (.MDB) File

The **Working CRDD (.MDB)** file contains data pertaining to Fugro Pelagos, Inc.'s **Cable Route Design Database (CRDD)**. This database is created using the **CRDD** software and loaded into WinFrog for use with WinFrog's real time cable lay modeling utilities.

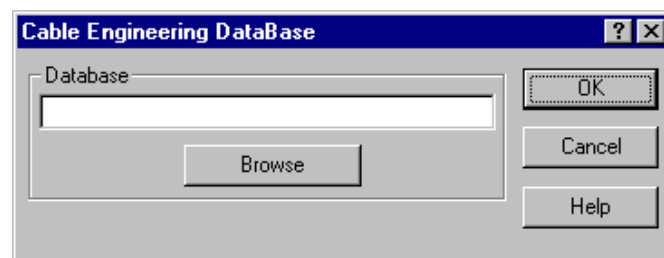
The CRDD database, as loaded into WinFrog, typically contains only pre-lay "plan" cable lay information such as the **Route Position List (RPL)**, the location of cable bodies, and the amount of cable slack that will be laid in the various sections of the cable route.

During the cable installation, WinFrog updates this database with actual "as-laid" cable data such as cable body locations and cable counts. This provides the on-board cable engineers the ability to analyze in near real-time how well the cable installation is matching the proposed installation plan and, subsequently, adapt the installation as required.

To Load a New CRDD Database (.MDB) File

Although WinFrog's **File > Select Working Files** menu lists the **CRDD Database File** as an option, this dialog window cannot be used to load a **.MDB** file.

- 1 Select the main menu item **File > Cable Data Base > Open Data Base**. The **Cable Engineering DataBase** dialog window appears, as seen below.



- 2 Enter the name and location of the **DataBase File** or select the **Browse** button to navigate to the desired file.
- 3 Select **OK** to confirm the entry and close this window.

At the bottom of the **Working Files (File > Select Working Files)** dialog box, WinFrog now displays the name of the **Working CRDD (.MDB)** file in the **File** field, and the file's path in the **Directory** field.

To Edit the Working CRDD (.MDB) File

Once a **CRDD File** has been loaded, it's contents can be viewed and edited. The **.MDB** file can also be used to generate a survey line in the **Working Survey Line** file.

Working Transponders (.XPT) File

The **Working Transponders** (also referred to as **Xponders**) file is used to maintain the position data and transponder specific attributes associated with either **Long Baseline (LBL)** or **Ultra Short Baseline (USBL)** subsea transponder **stations**. In the case of **Fixed** transponders, this approach allows for the support of the stations in a similar manner as taken to land control networks, including occupancy and re-occupancy of any given station by multiple transponders, either simultaneous or non-simultaneous. In the case of non-**Fixed** transponders, this approach does not affect the configuration or use of these except to enhance the configuration of the **Fixed** stations to measure to. The reader is referred the **LBL Operation**, **USBL Operation** and **Acoustic Calibration** chapters for details.

Multiple Xponders files may be created, saved and edited. However, only one can be set to be the **Working Xponders** file at any one time.

A **Working Xponders** file is required for all LBL and selected USBL operations.

In the context of WinFrog, the term transponders refers to subsea hardware devices that receive an impulse, either electronically or acoustically, that triggers them to transmit an acoustic pulse in return. Ranges are derived by analyzing the time it takes for the sound to travel (round trip) and knowing the speed of sound in water. In addition, some transponders are what are known as **smart transponders**. These are capable of performing operations other than simply responding to a signal, such as measuring to other transponders, reading internal sensors providing depth and attitude data and/or executing a sequence of pre-loaded commands. Smart transponders can usually be operated in more than one mode.

In the case of LBL acoustics, the transponders in the Xponders file generally include a network array of static **Fixed** transponders located on the seafloor or nearby structures at known coordinates. If these transponders are to be ranged to using transceivers connected directly to an LBL control unit, these are the only transponders required in the file. If transponders are to be used on static structures that require final position determinations or moving vehicles or structures that are to be tracked, they must also be included in the Xponders file.

In the case of USBL acoustics, the transponders in the Xponder file are generally static **Fixed** transponders (or other) which are used for the calibration of the USBL system. These **Fixed** units can also be used to position the vessel with the USBL system. USBL transponders can also be used in similar situations as LBL transponders to track and position subsea vehicles and structures. In this case, it is not currently necessary to include these in the Xponders file, but it is recommended. WinFrog currently utilizes the information for these tracking transponders if it is available in the Xponders file and future development will require it.

Transponders contained in the **Working Xponders** file can be displayed in WinFrog's **Graphics** and **Bird's Eye** window. See the **Operator Display Windows** chapter for more information about WinFrog graphics displays.

Note: Prior to performing any LBL acoustic calibrations or positioning, a **Working Xponders (.XPT)** file and a **Working Velocity (.VEL)** file must be created.

Note: Prior to performing a USBL calibration, a **Working Xponders (.XPT)** file must be created. A **Working Xponder (.XPT)** file is not required for USBL tracking of beacons, but is required if a beacon is fixed for use in tracking the USBL transceiver.

Overview of the Working Xponders Types

Transponders with varying capabilities are available from several manufacturers. The following is a list of the available transponder types and/or operational modes that WinFrog supports and an example of their application. It should be noted that in many cases, the same transponder can be used for any one of the modes simply by configuring it accordingly. Details on the configuring for each is given in **Editing Xponders**. The list mirrors the options available in the aforementioned section.

LBL

- **Fixed**

The transponder is static and is generally part of a network array of other **Fixed** transponders. It is measured to by a transceiver or a **smart transponder**, providing range data. The resulting observations are used in a Least Squares Adjustment to solve for the position of the transceiver or **smart transponder**. The **Fixed** transponders form the basis of almost all LBL acoustic positioning. The positions of the **Fixed** transponders are determined with an **LBL Calibration** (see **Chapter 20: LBL & USBL Calibrations**). These positions are then used as known data in associated adjustments.

- **Relay**

The **Relay** transponder is dynamic, usually mounted on an ROV. It is used for positioning in **Relay**, or **sing-around** mode and requires an array of **Fixed** transponders. An LBL control unit and its transceiver are usually located on a surface vessel. This control unit transmits a signal to the **Relay** transponder on a unique frequency. The **Relay** transponder then transmits a common interrogation signal. This signal is received by the originating transceiver. In addition, this signal is also received by the **Fixed** transponders in the array which each then transmit their own signals which are received by the aforementioned transceiver. A subsequent direct interrogation of the **Fixed** transponders by the transceiver completes the data collection cycle. By combining the observations, WinFrog derives the ranges from the **Fixed** transponders to the **Relay** transponder in addition to the range from the

control unit's transceiver to the **Relay** transponder. This data is then used in a Least Squares Adjustment to solve for the position of the **Relay** transponder.

- **Responder**

This is a special case of transponder. It is a transmit-only unit that is connected directly to a control unit via a cable. The control unit and its transceiver are usually located on a surface vessel. The **Responder** is used in the same way **Relay** transponder except that instead of receiving a signal from the control unit's transceiver acoustically, it receives it directly electronically via the cable. The **Responder** is usually located on an ROV and is connected to the control unit via the ROV's umbilical.

- **Simultaneous**

This is a **smart transponder** capable of performing its own range interrogation of other transponders (usually **Fixed**) when instructed to do so by the control unit via an acoustic trigger. The observed data is then acoustically telemetered to the control unit where they can be used in a Least Squares Adjustment to solve for the position of the **smart transponder**. **Simultaneous** transponders are usually mounted on ROVs and structures being placed or monitored on the seafloor.

- **Cyclic**

This is a **smart transponder** capable of being programmed with a series of measurement commands. Then on a trigger from the control unit, the series of commands is executed and the results are telemetered to the control unit for use in a Least Squares Adjustment to solve for the position of the **Cyclic** transponder. A **Cyclic** transponder is used for low dynamic situations such as the final positioning of a structure in acoustically noisy conditions.

- **Sequential**

This is a **smart transponder** capable of measuring baselines to specified **Fixed** transponders. WinFrog instructs the **Sequential** transponder to execute baseline measurements, sequencing through a list of specified **Fixed** transponders. The results are used in a continuous Least Squares Adjustment of the **Sequential** transponder position. That is, as new baseline data is observed, it replaces old data for the same baseline and a new position is determined using all baseline data currently available. The **Sequential** transponder is used for lower dynamic situations such as the final positioning of a structure in acoustically noisy conditions.

- **Static Transceiver**

This is a standard control unit transceiver. However, whereas the control unit transceiver is generally dynamic, attached to a moving vessel and therefore not included in the **Working Xponder File**, this is a special case where the transceiver is static, attached to a fixed structure or simply on the seafloor. The **Static Transceiver** is used to range to a dynamic array of

transponders. The observations are combined with observations from other **Static Transceiver** units or **Static Simultaneous** units in a Least Squares Adjustment of the position of the dynamic transponders. In addition, WinFrog can also be configured to perform a subsequent Least Squares Adjustment for the attitude and orientation of the dynamic transponders. (See **Static Simultaneous** and **Dynamic Array**.) This is used for monitoring the movement of a dynamic structure.

- **Static Simultaneous**

This is a **smart transponder** capable of operating as a **Simultaneous** transponder. However, like the **Static Transceiver** whereas a **Simultaneous** transponder is generally dynamic, attached to a moving vehicle, this is a special case where the transponder is static, attached to a fixed structure or simply on the seafloor. The **Static Simultaneous** is used to range to a dynamic array of transponders. The observations are combined with observations from other **Static Simultaneous** units or **Static Transceiver** units in a Least Squares Adjustment of the position of the dynamic transponders. In addition, WinFrog can also be configured to perform a subsequent Least Squares Adjustment for the attitude and orientation of the dynamic transponders. (See **Static Transceiver** and **Dynamic Array**.)

- **Dynamic Array**

This is a **Fixed** transponder mounted on a moving vehicle or structure. It is required for use with the **Static Transceiver** and **Static Simultaneous** units. In addition, it can be part of a network array of **Dynamic Array** transponders on the moving structure that have been precisely surveyed prior to deployment. This provides precise baselines for each **Dynamic Array** transponder pair. These baselines are constrained in the Least Squares Adjustment using the observations from the associated **Static Transceiver** and **Static Simultaneous** units for the positions of the **Dynamic Array** transponders and subsequent Least Squares Adjustment for the attitude and orientation of the structure the **Dynamic Array** transponders are mounted on.

- **Synchronized Pinger**

This is a pinger that outputs a pulse at regular intervals. The beacon is synchronized with an atomic clock so that the epoch of the pulse is known. Thus the travel time from it to a passive hydrophone can be determined without actually triggering the beacon.

USBL

- **Fixed**

This beacon is static. In most applications, it is deployed and used only for the calibration of the USBL hydrophone, although it can also be used to position a vessel with a USBL hydrophone mounted on it.

- **Tracking**

This beacon is dynamic, generally attached to an ROV or towed body. It is positioned from a vessel with a USBL hydrophone mounted on it.

USBL Beacon Types

- **Transponder**

The beacon is an independent unit, that when interrogated with an acoustic signal, responds.

- **Pinger**

The beacon is an independent unit that transmits an acoustic signal at a predefined rate.

- **Responder**

The beacon is a unit linked to the USBL control unit by cable. It is interrogated with an electrical signal and responds with an acoustic signal.

Working with Xponders Files (*.XPT)

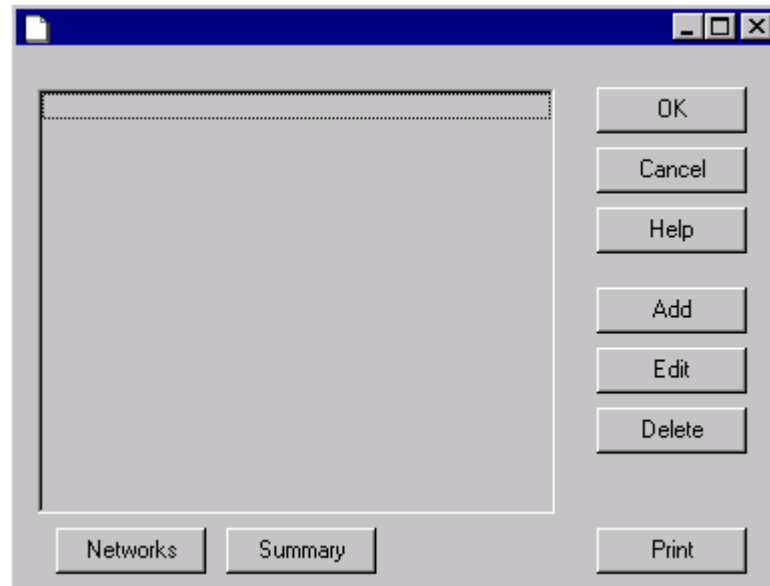
Multiple Xponder files may be created, saved and edited. However, only one can be set to be the **Working Xponders** file at any one time.

The **Working Xponders (.XPT)** file must be created (or selected) before data for information for a specific transponder can be added.

Creating a New Xponders File

The creation of an Xponders file is detailed in the **Creating and Selecting Less Common Working Files** section earlier in this chapter.

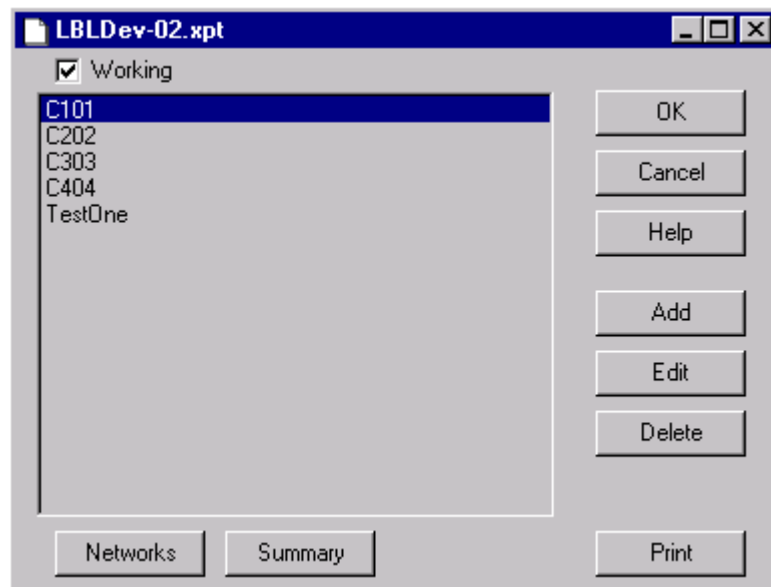
In addition, the Xponders file can be created directly from the Acoustic Window via **File\ New...>Xponder**.



In both cases, before the xponders file can be saved to disk, at least one xponder must be added (see **To Add an Xponder to the Working Xponders File**). WinFrog will then detect that the document has been altered and prompt you to save it.

Opening an Xponders File

The opening of an existing Xponders file is detailed in the **Creating and Selecting Less Common Working Files** section earlier in this chapter. Once open, the file can be edited or assigned as the **Working Xponders** file. Upon the completion of editing, WinFrog will detect that changes have been made and prompt you to save the file.



The Xponders file can be edited even if it is not set to be the **Working Xponders** file. The editing is performed as detailed in **Editing the Working Xponders File** below with the exception that the non **Working Xponders** file must be opened from the Main Menu **File\ Open** item.

When an existing or **Working Xponders** file is opened, the name of the file will be displayed as the title for the dialog.

Designating an Xponders File to be the Working Xponders File

The designation of an Xponders file as the **Working Xponders** file is detailed in the **Creating and Selecting Less Common Working Files** section earlier in this chapter.

In addition, the Xponders file can be set to be the **Working Xponders** file directly from the Acoustic Window via **File\ Set to Working...>Xponders**. This accesses a browse dialog allowing you to find and select the Xponders file to set to the **Working Xponders** file. When done this way, the file is not presented for editing but simply set to be the working file.

Editing the Working Xponders File

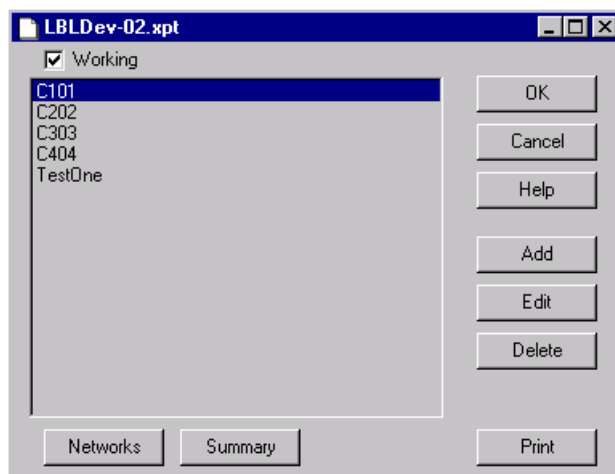
This section details the steps required to perform basic file operations. The specific details of editing the actual Xponder configuration is given **Editing the Xponder** section in this chapter.

To Open the Working Xponders File

- 1 From the main menu **File** item, choose **Edit Working Files... > Xponders**. The **Working Xponders** file will open.

Or

- 2 From the Acoustic Window **File** item, choose **Edit...> Xponder**. The **Working Xponders** file will open. Note the **Working** checkbox will be checked for the file that is currently set to be the **Working Xponders** file.



To Add a Transponder to the Working Xponders File

- 1 Open the **Working Xponders** file.
- 2 Click **Add** to bring up the **Transponder/Beacon** dialog.

- 3 Configure the Xponder (see **Editing Xponders**) and click the **OK** button. WinFrog will check that a name has been entered and if not return you to the **Transponder/Beacon** dialog to correct this.

To Delete a Transponder from the Working Xponders File

- 1 Open the **Working Xponders** file.
- 2 Select those Xponders from the list that are to be deleted. Multiple Xponders can be selected by holding the **Ctrl** key while selecting the Xponders with the mouse.
- 3 Click **Delete** to remove the selected Xponders from the list and file.

To Edit a Transponder in the Working Xponders File

- 1 Open the **Working Xponders** file.
- 2 Click on the Xponder in the list to be edited and click the **Edit** button to bring up the **Transponder/Beacon** dialog.

Or

- 3 Double-click on the Xponder in the list to be edited to bring up the **Transponder/Beacon** dialog.

- 4 Configure the Xponder (see **Editing the Xponder**) and click the **OK** button. WinFrog will check that a name has been entered and if not return you to the **Transponder/Beacon** dialog to correct this.

Special Case: Double Occupancy

WinFrog supports multiple transponders co-located on the same station. This addresses two main scenarios. The first is when transponders of different frequencies (generally MF and EHF) are placed at the same location to support surface ranging and baseline observations when EHF observations are required for optimum baseline accuracy, but the water depth is too great for the EHF to be interrogated from the surface. In this case, each transponder is added and edited accordingly and referenced to the same point, both horizontally and vertically. The latter is generally achieved using the **Height of Instrument** entry. The second scenario is when a transponder that supports both USBL and LBL operations is used, the USBL mode for surface ranges and the LBL mode for baseline observations. In this case an Xponder is created for each operation mode, again ensuring that they are both referenced to the same point horizontally and vertically. The vertical reference must be the transducer of the transponder. In both scenarios it is critical that the same name be entered for each Xponder entry.

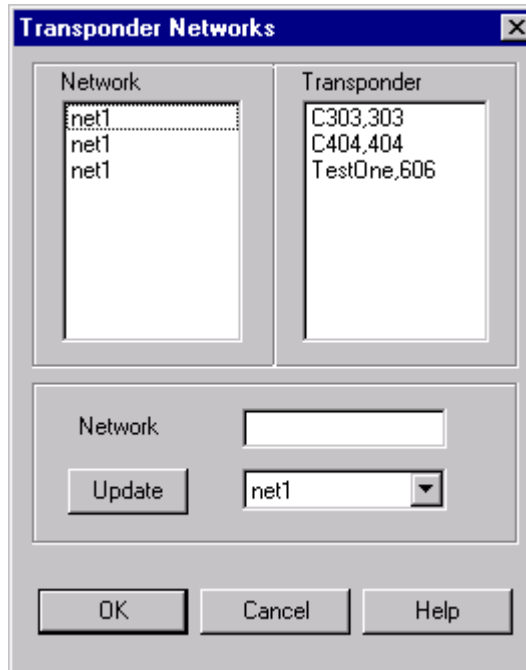
When WinFrog detects that a name used for an Xponder is the same as that used for another, it will report this and ask for confirmation that this is correct. If it is not, you are returned to the Xponder configuration dialog for the one just edited/added so that the name can be changed.

To Configure the Fixed Transponder Networks

Transponders in an Xponders file can be associated in groups or networks. Currently, this functionality is limited to the collection of calibration data. This grouping of the transponders allows WinFrog to be set to automatically determine all possible baselines between **Fixed LBL** transponders in a given network, initiate the measurements of these and log the results to the calibration data file. Similarly, WinFrog can be configured to automatically interrogate all the transponders in a given network for depth observations and log the results to the calibration data file.

All **Fixed LBL** transponders default to be part of **Net1**.

- 1 Open the **Working Xponders** file.
- 2 Click **Networks** to bring up the **Transponder Networks** dialog.



The **Transponder Networks** dialog provides the following information and controls:

Network list	This lists the network the corresponding transponder is a member of. Selecting a network in this list results in the corresponding transponder in the Transponder list to be highlighted and the network to be displayed in the Network field.
Transponder list	This lists all the Fixed LBL transponders in the Working Xponders file. Selecting a transponder in this list results in the corresponding network in the Network list to be highlighted and the network to be displayed in the Network field.
Network field	This presents the network the currently selected transponder is a member of. It also allows you to change and add networks.
Available Network list	This is a drop down list of all the networks that existed when the dialog was opened plus those added during the current editing.
Update button	This allows you to apply changes made to the network association for the currently selected transponder, made either via the Network field or the Available Network list.

3 To Change a Transponder's Network to a New Network

- i Select the transponder in the **Transponder** list that is to be a member of the new network.
- ii Enter the name of the new network in the **Network** field.
- iii Click the **Update** button.
- iv The name of the network as displayed for the edited transponder will be updated to the new network name. In addition, the new network name is added to the **Available Network** list.

4 To Change a Transponder's Network to an Existing Network

- i Select the transponder in the **Transponder** list that is to be changed to an existing network.
- ii From the **Available Network** list, select the desired network.
or
- iii Enter the name of the existing network.
- iv Click the **Update** button.
- v The name of the network as displayed for the edited transponder will be updated to the new network name.

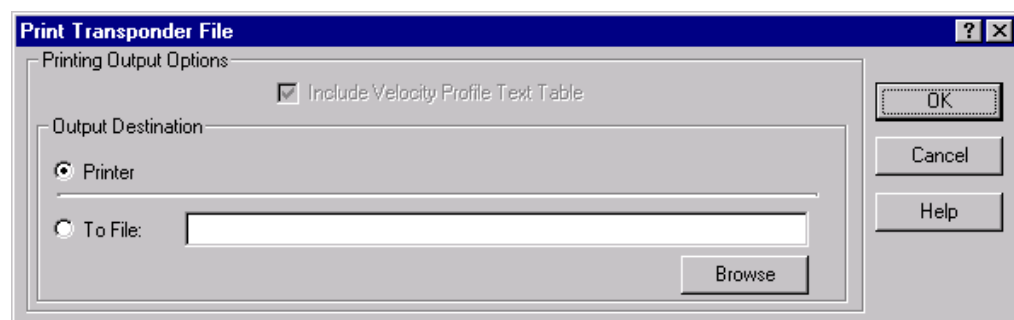
- 5 Click **OK** to exit the **Transponder Networks** dialog and apply the changes to the **Working Xponders** file.

Or

- 6 Click **Cancel** to exit the **Transponder Networks** dialog and without apply the changes to the **Working Xponders** file.

To Print the Transponder File

- 1 Open the **Working Xponders** file.
- 2 Click **Print** to bring up the **Print Transponder File** dialog.



- 3 Select either **Printer** or **To File** option. Selecting **Printer** results in the print going directly to the Windows default printer. If selecting the **To File** option, you must either enter the target file or use the **Browse** button to locate or enter an appropriate file name.
- 4 Click the **OK** button. This will exit this dialog and execute the appropriate printing. When the printing is completed, you will be informed with a message box stating **Writing to File Finished**.

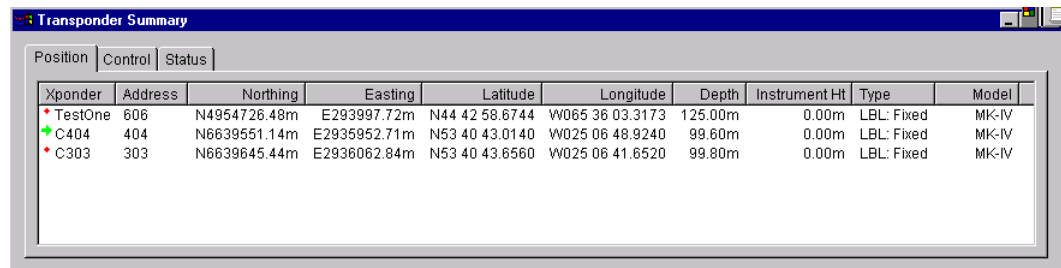
To View the Transponder File Summary

WinFrog provides an Xponders File summary window where the information for all transponders in the file can be viewed together. The information is presented in a tab format in resizable window, complete with scroll bars as required.

Clicking on selected column headers will result in the information being sorted based upon the information in that column.

A transponder can be edited by double clicking the name. The **Transponder/Beacon** dialog appears. You must be careful as multiple **Transponder/Beacon** dialog boxes can be opened in this manner, even for the same transponder.

- 1 Open the **Working Xponders** file.
- 2 Click **Summary** to bring up the **Transponder Summary** window.



The screenshot shows a window titled "Transponder Summary" with three tabs: "Position", "Control", and "Status". The "Position" tab is active, displaying a table with the following data:

Xponder	Address	Northing	Easting	Latitude	Longitude	Depth	Instrument Ht	Type	Model
TestOne	606	N4954726.48m	E293997.72m	N44 42 58.6744	W065 36 03.3173	125.00m	0.00m	LBL: Fixed	MK-IV
C404	404	N6639551.14m	E2935952.71m	N53 40 43.0140	W025 06 48.9240	99.60m	0.00m	LBL: Fixed	MK-IV
C303	303	N6639645.44m	E2936062.84m	N53 40 43.6560	W025 06 41.6520	99.80m	0.00m	LBL: Fixed	MK-IV

- 3 The first tab presented is the **Position** tab, presenting in the following columns:

Xponder	The name of the transponder station (supports sorting).
Address	The address of the transponder station (supports sorting).
Northing	The Map Projection Grid Northing of the transponder station.
Easting	The Map Projection Grid Easting of the transponder station.
Latitude	The Working Ellipsoid latitude of the transponder station.

Longitude	The Working Ellipsoid longitude of the transponder station.
Depth	The depth of the transponder station.
Instrument Ht.	The height above the station the transponder's transducer is.
Type	The LBL Mode/Type and/or USBL Mode setting of the transponder station (supports sorting).
Model	The manufacturer model of the transponder station (supports sorting).

- 4 Clicking the **Control** tab shows the following information:

Xponder	Address	Network	Tx Code	Rx Code	Rng Corr	Bcn Code
C303	303	network5	1	CIF	0.000ms	
C404	404	net2	4	CIF	0.000ms	
TestOne	606	net2	6	CIF	0.000ms	

Xponder	The name of the transponder station (supports sorting).
Address	The address of the transponder station (supports sorting).
Network	The name of network the transponder is assigned to.
Tx Code	The frequency or corresponding channel the transponder is set to reply to common interrogations on (supports sorting).
Rx Code	The frequency or corresponding command the transponder is expecting to receive (supports sorting).
Rng Corr	The correction to the TWT'T un-accounted for by the LBL acoustic control unit to be applied by WinFrog.
Bcn Code	The USBL transponder identifier (supports sorting).

- 5 Clicking the **Status** tab shows the following information. This is specifically designed to support Sonardyne hardware.

Xponder	The name of the transponder station (supports sorting).
Address	The address of the transponder station (supports sorting).
Firm Ver.	The firmware version number of the transponder.
Enabled	The operation mode/status of the transponder (supports sorting).
Reply Chan	The channel the transponder will reply to an Individual

	Interrogation Frequency (IIF) interrogation.
Int Wait	The length of time in milliseconds the transponder is configured to wait between receiving an interrogation command and interrogating the specified transponder.
Reply Wait	The length of time in milliseconds the transponder is configured to wait for a response to its interrogation command.
Tel Wait	The length of time in milliseconds the transponder is configured to wait between commands when operating in Cyclic mode and between telemetry bursts when operating in Simultaneous mode.
Battery	The type of battery installed in the transponder.
Time	The time of the last Status update.

Editing Xponders

The editing and configuring of transponders is done from the **Transponder/Beacon** dialog. The options available depend upon the transponder model and application mode. Those options that are not applicable for the current model and application mode are disabled to eliminate confusion.

In addition, there are two distinct configuration option sets, one for what is considered standard application mode, and another for non- standard application mode. Non-standard mode are **Static Transceiver**, **Static Simultaneous** and **Dynamic Array**. All others are considered to be standard. This section looks at each individually.

For standard **Fixed** applications, the concept of a survey station is applied in that the station is defined in the Xponder file plus the transponder that is mounted at that station. That is, the **Name**, **Depth of Monument** and **Position** information refer to the station independently of the transponder itself. The occupying transponder is referenced to the station by the **Height of Transducer Above Monument** information. This supports the simultaneous occupancy of one station by multiple transponders. It also facilitates the use of mounting buckets for holding transponders in a semi-permanent array. The transponder is assumed to be mounted vertically over the station. In the case of a non-vertical deployment, the station **Depth of Monument** and **Position** should be related to the transponders transducer and the **Height of Transducer Above Monument** be set to 0.

WinFrog identifies **Fixed** transponders by station **Name** and **Address**.

Editing Standard Xponders

The following details the configuration options for standard application mode transponders. Please refer to **Overview of the Working Xponders Types** for a description of each application mode to decide which is required.

The screenshot shows the 'Transponder/Beacon' configuration window. It is divided into several sections: 'Name/Position' with fields for Name (C101), Depth of Monument (100.0m), Height of transducer above monument (0.00m), and Position (N53 40 48.888000, W025 06 50.760000); 'Type' with a 'Depth Sensor' button and a 'Model' button; 'LBL Mode/Type' with radio buttons for Fixed, Relay, Responder, Simultaneous, Cyclic, Sequential, Static Transceiver, Static Simultaneous, Dynamic Array, and Synchronized Pinger; 'USBL Mode' with radio buttons for Fixed (selected), Tracking, and Pinger; 'USBL Type' with radio buttons for Pinger, Transponder, and Responder; 'Control Parameters' with fields for Transmit (1), Receive (1), Address (101), and Range correction to be subtracted by WinFrog (0.0 ms); and a 'USB Code' field. At the bottom are buttons for Sensor Setup, Cyclic Setup, Save, Extended Status, OK, Cancel, Print, and Help.

Name/Position

Name field

Enter a **unique** name for the **station**. Stations can have more than one transponder assigned to them. If more than one transponder is located at the same station, whether simultaneously or not, each must have an Xponder (**station**) added to the file with the same name used for both. Transponders are differentiated by WinFrog using the (station) **Name** and transponder **Address**.

Depth of Monument field

If this is an **LBL Fixed** or **USBL Fixed** transponder application, then this value is the depth of the station, that is some point on the seafloor that will remain constant regardless of what transponder is deployed over it. If the transponder is not deployed vertically over the station, this should be set to the depth of the transducer.

**Height of transducer
above Monument
field**

If this is an **LBL Fixed** or **USBL Fixed** transponder application, then this value is the distance from the station to **Monument** to the transponder's transducer, also referred to as a **Height of Instrument** or **HI**. If the transponder is not deployed vertically over the station, this should be set to 0.

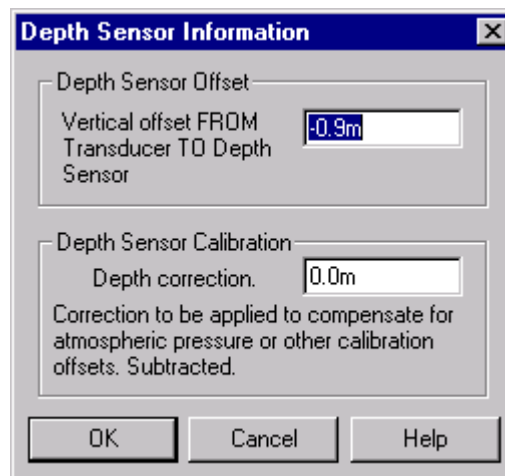
Position field

If this is an **LBL Fixed** or **USBL Fixed** transponder application, enter the coordinates of the station the transponder is located over. If the transponder is not deployed vertically over the station, this should be set to the position of the transducer.

The coordinates can be either entered in the Working Ellipsoid geographic latitude and longitude or in the currently selected Map Projection grid coordinates, Northing and Easting.

**Depth Sensor
button**

This accesses a **Depth Sensor Information** dialog. This allows you to enter the data required to relate the depth sensor to the transponder's transducer.



Depth Sensor Offset

This is the vertical offset **from** the transponder's transducer **to** the depth sensor. This value is automatically set based on the transponder model selected, but may be changed to suit the actual conditions. It must be modified in cases where the transponder is not mounted vertically with the transducer on the top.

Note: The sign convention to use is as follows: if the **transducer** is above the depth

Depth Sensor Calibration

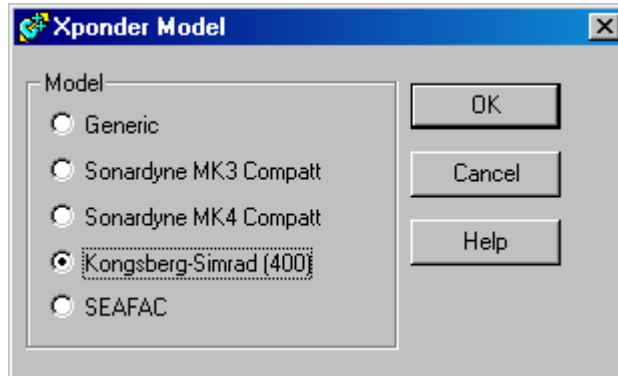
sensor, this value is a **negative** number; if the **transducer** is below the depth sensor, this value is a **positive** number.

This field is for entry of the depth sensor calibration value for that particular sensor. To obtain this value, observe the sensor's apparent depth while the transponder is on the deck. Enter the observed value here, keeping the same sign.

Type

Model button

This opens the **LBL Xponder Model** dialog box, as seen below. Note that the model selection impacts the transponder configuration options. Selecting **MK3** or **MK4 Compatts** causes the **LBL Mode Responder** radio button to disable, as this is not supported for the **PAN** device. It also causes the **Extended Status** button to become **active** as this is only supported for the **Sonardyne** transponders. Additionally, the **Control Parameter** edit boxes become dropdown boxes with preset values for **Sonardyne** transponders.



Generic

The default setting is **Generic**. This is the setting for all LBL and USBL transponders except for those listed below.

MK3 Compatt

This is a specific Sonardyne **smart transponder** model used with the **Sonardyne PAN** or **ROVNAV** device. Setting this enables WinFrog to provide extended functionality, including **Extended Status** monitoring.

MK4 Compatt

This is a specific Sonardyne **smart transponder** model used with the **Sonardyne PAN** or **ROVNAV** device. Setting this enables

WinFrog to provide extended functionality, including **Extended Status** monitoring.

Note: Select this model for the MK 5 COMPATTs also.

Kongsberg Simrad (400)

This is a specific Kongsberg Simrad USBL beacon (or similar if it emulates the same) that is used primarily with the HPR 400 systems and APOS software. The associated beacon codes are not simple integers. Selection of this type instructs WinFrog to accept entry and display of the USBL beacon code in the native format (e.g. B61).

SEAFAC

This is a specific type of acoustic equipment using passive hydrophones and synchronized pingers.

LBL Mode radio buttons

Select one of the following if the transponder is for LBL use. For more information regarding each option, see **Overview of the Working Xponders Types** at the beginning of this chapter. For information concerning their use, see the **LBL Acoustic** chapter.

Fixed	This is a static transponder located at a known point. A group of these form a network array(s) that provide the basis for all the standard LBL applications.
Relay	This is generally a mobile transponder, normally attached to a subsea vehicle. It is interrogated acoustically by a ship-based transceiver/control unit.
Responder	This is generally a mobile transponder, normally attached to a subsea vehicle, that is actually attached to the LBL control unit via a cable and triggered electronically.
Simultaneous	This is generally a mobile transponder, normally attached to a subsea vehicle, that upon being triggered acoustically by a transceiver attached to a control unit, performs measurements to other transponders and transmits the data acoustically to the originating transceiver.
Cyclic	This is generally a mobile transponder (low dynamics), normally attached to a subsea vehicle, that upon triggering acoustically by a transceiver attached to a control unit, executes a series of preprogrammed commands.
Sequential	This is generally a mobile transponder (low dynamics), normally attached to a subsea vehicle. If an XPONDER data type is attached to a vehicle, WinFrog automatically

	sequences through a list of Fixed transponders commanding this Sequential transponder to measure the baseline to each one in turn.
Static Transceiver	See Editing Non-Standard Xponders .
Static	
Simultaneous	See Editing Non-Standard Xponders .
Dynamic Array	See Editing Non-Standard Xponders .
Synchronized Pinger	This is disabled unless the SEAFAC model is selected. Select this mode to describe the pinger mounted on the vehicle to be positioned.

USBL radio buttons

The configuration for the USBL transponders is broken into two parts, **Mode** and **Type**.

Note: The term transponders is used here as a general term for USBL systems. As seen below, there are actually different types. In addition, the units are often referred to as beacons.

USBL Mode

The **Mode** refers to how the transponder used.

Note: WinFrog currently bases some optional timing control for positioning a tracked beacon upon data entered in the Working Xponders file for the tracked beacon. If the tracked transponder is not entered in the Working Xponders file, WinFrog will assume it is a transponder.

Fixed	The transponder is static at a known location and used for positioning the hydrophone vehicle, or for a USBL Calibration.
Tracking	The transponder is attached to a moving vehicle, generally an ROV or towed body, whose position is being tracked from the USBL hydrophone vehicle.

USBL Type

The **Type** refers to the actual operating type of beacon.

Pinger	This unit transmits a signal at a set frequency and rate, it is not interrogated by the USBL system.
Transponder	This unit is acoustically interrogated by the USBL system and replies.
Responder	Like the Responder for the LBL acoustics, this unit is connected to the USBL system via a cable. It is

electronically interrogated by the USBL system and replies with an acoustic signal.

Control Parameters

LBL group

Transmit field

Enter the **transmit frequency** or **code** of the **LBL** transponder. If the **LBL** equipment uses actual **frequencies** rather than a **code** or a **channel**, then the **frequencies** must be entered with a decimal point and all significant digits, including zeros. Essentially, what is entered here must match the data string coming from the instrument. In the case of Benthos, the information associated with the transponder transmitting at 14kHz will have 14.00 in the message coming from the instrument. (i.e. for Benthos xponders, 14 kHz must be entered as **14.00**).

If the **LBL** equipment uses **codes** or **channels** rather than actual **frequencies**, then enter the appropriate **code** or **channel** (i.e. **Common Interrogate Frequency** should be entered as **CIF**, and **channel 3** should be entered as **3**).

A **Fixed** transponder's **transmit** frequency (channel) will normally be the transponder's **Output** frequency (i.e. 14.0 or 3).

A **Relay transponder** or **Responder's Transmit frequency/channel** will normally be the **Fixed transponder's Receive** frequency (i.e. **11.50** or **CIF**).

Receive field

Enter the **LBL** transponder's **Receive frequency** or **code**. If the **LBL** equipment uses actual **frequencies** rather than **code** or **channel**, then the **frequencies** must be entered with a decimal point and all necessary significant digits including zeros. (i.e. 11.5 kHz should be entered as **11.50**). The value entered here must match the data string coming back from the instrument. In the case of Benthos, the information associated with the transponder receiving at 11.5kHz will have 11.50 in the message coming from the instrument.

If the **LBL** equipment uses **code** or **channel** rather than actual **frequencies**, enter the **code** or **channel** (i.e. **Common Interrogate Frequency** should be entered as **CIF**, and Simultaneous interrogation is selected as **SI** or **FS**).

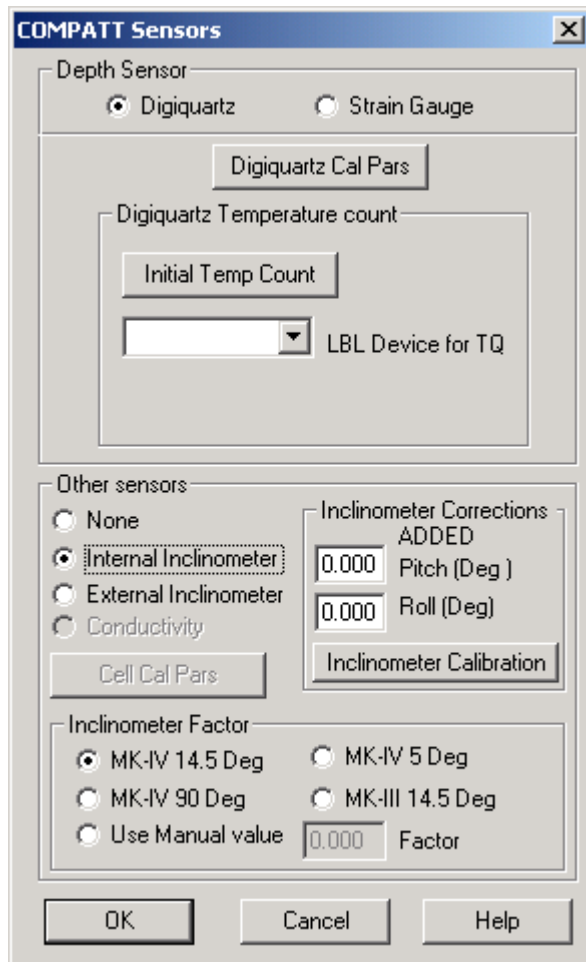
A **Fixed** transponder's **receive** frequency or **channel** will normally be the **transceiver's** (or **relay transponder's**) **transmit** frequency (i.e. 11.50 or **CIF**).

A **Relay transponder's receive** frequency or **command/channel** will normally be the **transceiver's** transmit frequency (i.e. 9.0 or **RY1**).

	A Responder , although triggered by a physical connection (i.e. a wire), still requires a receive frequency/channel to be entered to match the configuration of the acoustic hardware.
Address field	Enter the transponder address . This is only applicable to MK-III and MK-IV Compatts. Note: Do not enter an address for transponders that do not use addresses. Also ensure there are no blanks present in any entries made.
Range Correction to be subtracted by WinFrog field	This entry is that portion of the transponder's turn-around-time (TAT) that is not accounted for by the LBL control unit. It is subtracted from the two-way-travel-time (TWTT) for this transponder received by WinFrog. This entry is not the value actually subtracted by the acoustic electronics before a range is sent to WinFrog.
USBL group Code field	Enter the code of the USBL beacon. If the USBL device is a Kongsberg Simrad HPR 400 (see Type above), enter the HPR beacon code (e.g. B61).

Supporting Configuration Options: Sensor Setup Button

To access the extended sensor configuration options available for Sonardyne MK-III and MK-IV Compatt transponders click the **Sensor Setup** button. Note that only one sensor can be available in one transponder due to space constraints.



Depth Sensor

Select the depth sensor type installed in the transponder, either **Digiquartz** or **Strain Gauge** (default).

Digiquartz Cal Pars button

This accesses the **Digiquartz Calibration Coefficients** dialog.

Coefficients

Enter the coefficients directly from the digiquartz coefficient sheet provided with a digiquartz equipped transponder.

Depth Calculation Method

Select either the UNESCO formula or average density. If the average density is selected then enter the density to use in the edit box. The formula used to convert the pressure to depth is

$$D = (\text{pressure} - \text{atmosphere pressure}) / \text{density}$$
If the UNESCO formula is selected, enter the latitude of the work area in the edit box. The UNESCO formula is described by Fofonoff N.P. and Millard R.C. Algorithms for computation of fundamental properties of seawater UNESCO technical papers in marine science No 44 (1983).

Water Density

Enter the average water density for the water column in kilograms per metre³.

Latitude

Enter the latitude of the work area in degrees.

Atmospheric Pressure

Enter the ambient atmospheric pressure in millibars.

Depth Rating

Select the appropriate rating for the digiquartz sensor.

Digiquartz Temperature count (COMPATT Sensors dialog box)

LBL Device for TQ

If interrogating the transponder for a temperature count, select the LBL Device to use to obtain the initial count.

Initial Temp Count

Clicking this button will cause WinFrog to interrogate the transponder for a **Temperature Count** value. The response is automatically associated with this transponder for subsequent digiquartz value interrogations (DQ commands).

Other Sensors

Select any other sensor that is installed in the transponder.

None

There is no other sensor available.

Internal Inclinometer

There is an internal inclinometer installed in the transponder. This enables use of the **ATTITUDE** data item with the transponder.

External Inclinometer

There is an external inclinometer installed in the transponder. This enables use of the **ATTITUDE** data item with the transponder.

Inclinometer Corrections

Enter calibration values for this inclinometer. The values entered here are saved with this transponder in the *.XPT file, but not applied directly from here. However, they may be accessed from this transponder from the **ATTITUDE** data item when edited, after assigning to a vehicle.

Inclinometer Calibration button

The corrections may be determined by performing a calibration. Click this button to perform an inclinometer calibration. An LBL device must already be available to perform the calibration, as readings of the inclinometer are required. See below.

Conductivity

Future development.

Cel Cal Pars

Future development.

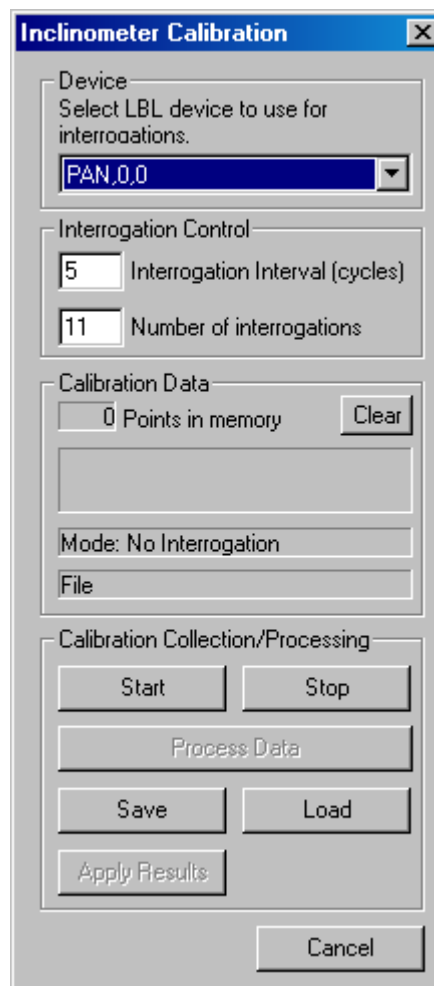
Inclinometer Factor

The inclinometer factor is used to convert the observed analog value (volts) to an angle. The factor depends upon the range of the instrument and the COMPATT. Several preset values can be obtained by selecting the COMPATT model and range. If none of these options are correct for this COMPATT and inclinometer, a manual factor may be entered. WinFrog uses the following formula to convert the voltage to an angle:

$$\text{Angle} = \sin^{-1}(\text{voltage}/\text{factor})$$

Inclinometer Calibration

When you click the Inclinometer Calibration button the following dialog opens:



The dialog box is titled "Inclinometer Calibration" and contains several sections:

- Device:** A dropdown menu with the text "Select LBL device to use for interrogations." and the value "PAN.0.0" selected.
- Interrogation Control:** Two input fields: "Interrogation Interval (cycles)" with the value "5" and "Number of interrogations" with the value "11".
- Calibration Data:** A section with a "0 Points in memory" label and a "Clear" button. Below this is a large empty text area, a "Mode: No Interrogation" label, and a "File" input field.
- Calibration Collection/Processing:** A section with buttons for "Start", "Stop", "Process Data", "Save", "Load", "Apply Results", and a "Cancel" button at the bottom right.

This dialog is used to obtain pitch and roll readings of a transponder that can be compared to known values in order to estimate a calibration or correction factor. Note: When performing this calibration you should stop all other interrogation activity.

Device

Device	Select the device to use to interrogate the transponder.

Parameters

Interrogation Interval	Enter the time interval between interrogations in seconds.
Number of interrogations	Enter the total number of observations.

Information

Points in memory	This is the current number of pitch and roll observation in memory.
Clear	This button clears all the points currently in memory. All of this data will be lost so be sure to save it first.
Blank Area	When a telegram is received from the device in response to a command it will be displayed here.
Mode	Indicates if the device is being interrogated or not.
File	File name of the data.

Controls

Make Observations	Click to start the observation process. If other interrogations are taking place these observations will be queued.
Stop	Stops the observations if they have not finished.
Process Data	When the desired amount of data has been obtained and interrogation has ceased, click this button to compute the calibration values. A dialog box will appear, see below.
Save and Load	These buttons allow the data to be saved in an ASCII text file or loaded from such a file. The default file type is *.ATT

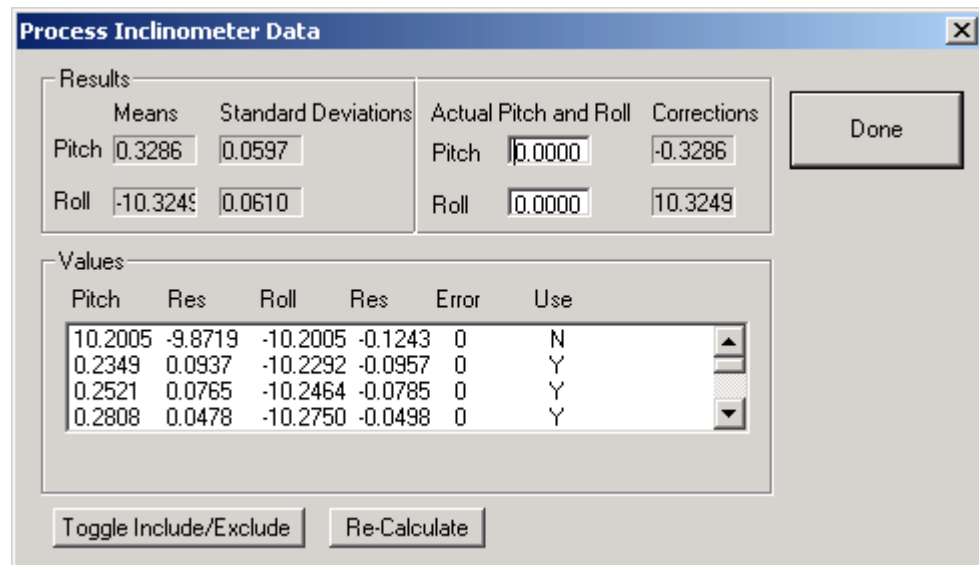
Apply Values

After the data has been processed, this button will become active. Click this button to copy the corrections to the COMPATT Sensors dialog. Note: it does not apply them to observations for the ATTITUDE data item. You must edit this data item and enter

the values manually or select these values by selecting this COMPATT from the dropdown list of COMPATTS.

Processing the Inclinometer Data

- 1 After the data has been obtained, click the **Process Data** button to obtain the following dialog box:



The dialog box titled "Process Inclinometer Data" contains several sections for data processing. The "Results" section has input fields for Means, Standard Deviations, Actual Pitch and Roll, and Corrections. The "Values" section contains a table with columns for Pitch, Res, Roll, Res, Error, and Use. At the bottom are buttons for "Toggle Include/Exclude" and "Re-Calculate".

Means		Standard Deviations		Actual Pitch and Roll		Corrections	
Pitch	0.3286	0.0597		Pitch	0.0000	-0.3286	
Roll	-10.3249	0.0610		Roll	0.0000	10.3249	

Pitch	Res	Roll	Res	Error	Use
10.2005	-9.8719	-10.2005	-0.1243	0	N
0.2349	0.0937	-10.2292	-0.0957	0	Y
0.2521	0.0765	-10.2464	-0.0785	0	Y
0.2808	0.0478	-10.2750	-0.0498	0	Y

The dialog opens with the data set already processed. Displayed is the mean, standard deviation and residuals of the pitch and roll data set. Corrections are also determined based on default actual pitch and roll values of zero.

The "Error" indicator in the Values list box is the error code received from the LBL device.

To reject an observation set, highlight it in the Value list box and click the Toggle Include/Exclude button. Although the observation of pitch and roll of this record will no longer be used to calculate the mean and standard deviation, the difference between the mean and the observation will be displayed under the Res heading.

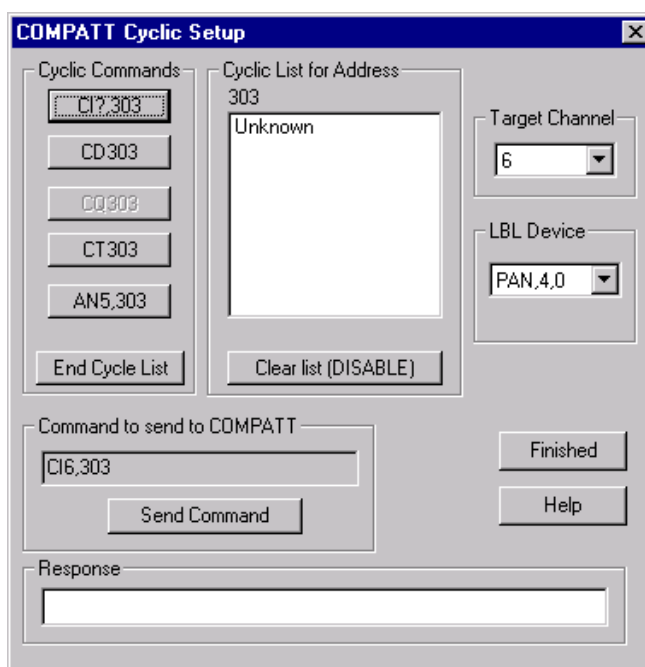
If the default "Actual Pitch and Roll" of zero is incorrect, enter the actual pitch and roll of the transponder while the observations were taken.

When all the desired changes have been made, click the **Re-Calculate** button.

Click **Done** to close the box and carry the corrections back to the previous dialog where the Apply button will become active.

Supporting Configuration Options: Cyclic Setup Button

To access the Cyclic setup dialog, click the **Cyclic Setup** button. To enable the cyclic transponder mode the transponder address must be entered, the model must be set to either a Mk III or Mk IV COMPATT and the LBL Mode must be set to “Cyclic”. (Note: if the address is entered last the focus must be changed from the address edit box before the “Cyclic” button will enable.) Since setting up a COMPATT for cyclic operation requires communication with the COMPATT, either a PAN or ROVNAV device must be added to WinFrog before the cyclic setup can be accomplished. In addition, the Xponders file must be the current **Working Xponders** file. If either of these conditions have not been satisfied when the cyclic button is clicked a message box will appear informing you of the lack of communications.



The dialog box presents only those commands available for loading to the transponder’s memory. This dialog also acts as a terminal to communicate with the COMPATT via the PAN or ROVNAV. Each command is a two part operation; a) select the desired command which will then appear in the “Command to send...” box, where it can be edited, then b) push the “Send Command” button and wait for the response before closing.

Initially WinFrog does not know which commands are stored in the COMPATT’s table, thus it is recommended that the list be cleared before continuing. First select the device from the “LBL Device” drop down list box, ignore the numbers after the device’s name. Then click the **Clear list (DISABLE)** button and send the COMPATT disable command. Once the device responds the cyclic command list will clear. Then select and send the desired commands. To send a sequential command (CI) first select the target channel, only those

currently in the transponder file will appear the list. Once all the desired commands have been sent click on the **Finish** button to send the **Terminate Cycle** (TC) command. This will prevent additional commands from being placed in the table until the next time the **Clear list (DISABLE)** is clicked. Older COMPATT's may not support the TC command, thus additional commands to this COMPATT will enter the table. The reader is referred to the Sonardyne documentation.

Supporting Configuration Options: Save Button

To force the saving of this transponder configuration to the Xponders file on disk, click the **Save** button. Note that this effectively accepts the configuration changes and therefore the **OK** button is disabled and the **Cancel** button is changed to a **Done** button. Click the **Done** button to exit the dialog.

Supporting Configuration Options: Extended Status Button

To view the status and configuration of this transponder, click the **Extended Status** button. This is specifically for the Sonardyne **MK-III** and **MK-IV Compatts**. You must interrogate the transponder using the **TS**, **BC** and **PS** commands via one of WinFrog's acoustic **Terminal Windows**. See in the **Operators Display Windows** chapter.

The screenshot shows the 'COMPATT Status' dialog box. It contains several sections with parameters and their values:

General	
Address	606
Firmware Ver.	V8.0
Jitter	N/A
Tilted	NO
Enabled	YES
Sim Rx Card	YES

Battery	
Type	Alkaline
Current Count	1437
Maximum	1728
Voltage	27.80
OverRide	NO
Low Alarm	NO

Tx Power	
LBL Ranging	HI
Telem Start Pulse	LOW
Telem Data	LOW

Receiver Status	
Channel	6
Gain	MED
TAT	125.00
CIF Rx	ON
IIF Rx	OFF
USBL Rx	OFF
IIF Reply	CRF

Waits	
Before Interrog	1.00
For Reply	1.50
Between Telem	0.25

Last Update : 09-25-03 17:20:10.6

Buttons: Done, Help, Print

Note: It is important to note that if a transponder's IRF is changed, the TS must be executed so that WinFrog can note the new IRF to use in its commands.

Note: The Sonardyne Dual Band Compatts must be treated carefully since the status they return when interrogated depends upon the mode they are operating in, i.e. either the EHF status or the MF status. WinFrog currently only supports a single status configuration for each transponder station and therefore cannot maintain the status for both frequencies, nor does it differentiate between the two. As a result, if the operator is not careful, the status information displayed may actually reflect a bit of each frequency.

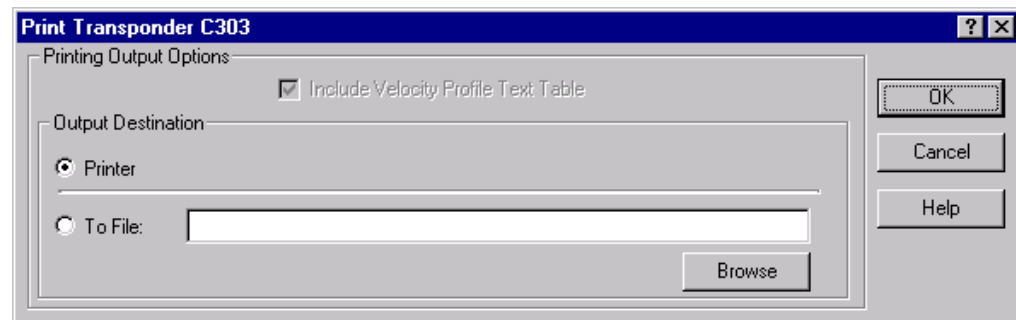
The time of the latest interrogation with the TS or BC command is given.

To print the extended status for the transponder, click the **Print** button.

Refer to Sonardyne's technical manual for an explanation of the status information.

To Print The Transponder Configuration

- 1 To print this transponder, click the **Print** button.



- 2 Select either **Printer** or **To File** option. Selecting **Printer** results in the print going directly to the Windows default printer. If selecting the **To File** option, you must either enter the target file or use the **Browse** button to locate or enter an appropriate file name.
- 3 Click the **OK** button. This will exit this dialog and execute the appropriate printing. When the printing is completed, you will be informed with a message box stating **Writing to File Finished**.

Completing the Configuration

Click the **OK** button to exit and keep the configuration changes or **Cancel** to exit and discard the configuration changes made. WinFrog checks for a valid transponder/station name. If one is not detected you are so informed and returned to the Transponder/Beacon dialog.

Editing Non-Standard Xponders

The following details the configuration options for non-standard application mode transponders. These non-standard applications involve fixed LBL Transceivers and Simultaneous COMPATTS and the moving transponders arrays, that is, the inverse of the *standard* application. Please refer to **Overview of the Working Xponders Types** for a description of each application mode to decide which is required.

The following details the configuration options for each specific LBL Mode/Type option associated with this application, that is, the **Static Transceiver**, **Static Simultaneous** and **Dynamic Array** settings.

Note: The **Model**, **Save**, **Extended Status** and **Print** buttons use is the same as that for standard applications. They are enabled and disabled accordingly.

Configuring the Static Transceiver

The Static Transceiver refers to a Sonardyne transceiver connected to either a PAN or ROVNAV MkIV and located at a known fixed point. The configuration of this unit within the Xponder file is independent of the actual device interface. The configuration options for this mode option are shown in the following figure.

You are prompted for the information that will enable WinFrog to determine the position of the Static Transceiver's actual transducer. A Static Transceiver will most likely be associated with a structure and /or vehicle and thus the configuration reflects this. However, it is important to note that the application is not restricted to this and any position can be entered for the Static Transceiver. The data entry options are as follows:

Transponder/Beacon

Name/Position
 Name: RN1
 CRP Position: N65 32.000002, E001 31.999994
 Depth: 6.50m
 Orientation: Pitch: 0 0 00.00, Roll: 0 0 00.00
 F/A Offset: 1.52m, P/S Offset: -1.29m, U/D Offset: 0.01m
 Transceiver Position and Depth: N00 00.000, E133 25.342097, 6.49m
☐ Apply Projection Line Scale Factor

Type
 Model
 LBL Mode/Type
☐ Fixed
☐ Relay
☐ Responder
☐ Simultaneous
☐ Cyclic
☐ Sequential
☒ Static Transceiver
☐ Static Simultaneous
☐ Dynamic Array
☐ Synchronized Pinger

USBL Mode
☐ Fixed
☐ Tracking
 USBL Type
☒ Pinger
☐ Transponder
☐ Responder

Control Parameters
 LBL
 Transmit: , Receive: , Address: , Range correction to be subtracted by WinFrog: 0.00 ms
 USBL Code:

Save Extended Status OK Cancel Print Help

Name/Position

Name

Entry of the name by which the transceiver is to be known (maximum 24 characters).

CRP Position

The position of the CRP of the structure to which the transceiver is attached. If the transceiver is not attached to a specific structure, the known position of the transceiver's transducer is entered. The coordinate entry is in either Grid or Geographic coordinates depending upon which of the Geo or Grid radio buttons is selected.

Depth

The depth of the CRP of the structure to which the transceiver is attached. If the transceiver is not attached to a specific structure, the known depth of the transceiver's transducer is entered.

Orientation	The orientation of the structure to which the transceiver is attached. This is entered in either Grid or True depending upon which of the Geo or Grid radio buttons is selected. If the transceiver is not attached to a specific structure, the position and depth entered is for the transceiver's transducer and therefore the orientation is not required and can be left at 0.
Pitch	The pitch of the structure to which the transceiver is attached. If the transceiver is not attached to a specific structure, the position and depth entered is for the transceiver's transducer and therefore the pitch is not required and can be left at 0. Note that the sign convention is bow up, pitch is positive.
Roll	The roll of the structure to which the transceiver is attached. If the transceiver is not attached to a specific structure, the position and depth entered is for the transceiver's transducer and the roll is not required and can be left at 0. Note that the sign convention is starboard down, roll is positive.
F/A Offset	The foreward/aft offset from the structure's CRP to the transceiver's transducer. Foreward is positive, aft is negative. If the transceiver is not attached to a specific structure, the position of the transceiver's transducer is located at is entered and this offset is left at 0.
P/S Offset	The port/starboard offset from the structure's CRP to the actual transceiver's transducer. Starboard is positive, port is negative. If the transceiver is not attached to a specific structure, the position of the transceiver's transducer is located at is entered and this offset is left at 0.
U/D Offset	The up/down offset from the structure's CRP to the actual transceiver's transducer. Up is positive, down is negative. If the transceiver is not attached to a specific structure, the position of the transceiver's transducer is entered and this offset is left at 0.

**Apply Projection Line
Scale Factor**

This allows you to apply scaling of offsets to the Map Projection before being applied to the CRP position to determine the transducer position. In addition, the INVERTED LBL data types that use this Xponder will check this setting and if it is set, all observations will be scaled to the Map Projection before being used. If this option is not set, the observations are not scaled and the resulting positioning is truly relative. The default and normal mode would for this not to be set.

When the above data is entered, WinFrog automatically uses the CRP position and depth, orientation, attitude (pitch and roll) and offsets to compute the position and depth for the Static Transceiver's transducer. This data is displayed in the bottom of this panel. The position is displayed in either Grid or geographic coordinates depending upon which of the Geo or Grid radio buttons is selected.

No other options or operator I/O is available for this mode.

Configuring the Static Simultaneous

The Static Simultaneous (COMPATT) refers to a Sonardyne COMPATT located at a known fixed point. The configuration of this unit within the Xponder file is independent of the actual device interface. The configuration options for this mode option are shown in the following figure.

You are prompted for the information that will enable WinFrog to determine the position of the Static Simultaneous COMPATT's actual transducer. A Static Simultaneous COMPATT will most likely be associated with a structure and/or vehicle and thus the configuration reflects this. However, it is important to note that the application is not restricted this and any position can be entered for the Static Simultaneous COMPATT. The data entry options are as follows:

Name/Position

Name

Entry of the name by which the COMPATT is to be known (maximum 24 characters).

CRP Position

The position of the CRP of the structure to which the COMPATT is attached. If the COMPATT is not attached to a specific structure, the known position of the COMPATT's transducer is entered. The

	coordinate entry is in either Grid or Geographic coordinates depending upon which of the Geo or Grid radio buttons is selected.
Depth	The depth of the CRP of the structure to which the COMPATT is attached. If the COMPATT is not attached to a specific structure, the known depth of the COMPATT's transducer is entered.
Orientation	The orientation of the structure to which the COMPATT is attached. This is entered in either Grid or True depending upon which of the Geo or Grid radio buttons is selected. If the COMPATT is not attached to a specific structure, the position and depth entered is for the COMPATT's transducer and therefore the orientation is not required and can be left at 0.
Pitch	The pitch of the structure to which the COMPATT is attached. If the COMPATT is not attached to a specific structure, the position and depth entered is for the COMPATT's transducer and therefore the pitch is not required and can be left at 0. Note that the sign convention is bow up, pitch is positive.
Roll	The roll of the structure to which the COMPATT is attached. If the COMPATT is not attached to a specific structure, the position and depth entered is for the COMPATT's transducer and therefore the roll is not required and can be left at 0. Note that the sign convention is starboard down, roll is positive.
F/A Offset	The forward/aft offset from the structure's CRP to the COMPATT's transducer. Forward is positive, aft is negative. If the COMPATT is not attached to a specific structure, the position and depth entered is for the COMPATT's transducer and therefore this offset is not required and can be left at 0.
P/S Offset	The port/starboard offset from the structure's CRP to the actual transceiver's

U/D Offset

transducer. Starboard is positive, port is negative. If the COMPATT is not attached to a specific structure, the position and depth entered is for the COMPATT's transducer and therefore this offset is not required and can be left at 0.

The up/down offset from the structure's CRP to the actual transceiver's transducer. Up is positive, down is negative. If the COMPATT is not attached to a specific structure, the position and depth entered is for the COMPATT's transducer and therefore this offset is not required and can be left at 0.

Apply Projection Line Scale Factor

This allows you to apply scaling of offsets to the Map Projection before being applied to the CRP position to determine the transducer position. In addition, the INVERTED LBL data types that use this Xponder will check this setting and if it is set, all observations will be scaled to the Map Projection before being used. If this option is not set, the observations are not scaled and the resulting positioning is truly relative.

When the above data is entered, WinFrog automatically uses the CRP position and depth, orientation, attitude (pitch and roll) and offsets to compute the position and depth for the Static Simultaneous COMPATT's transducer. This data is displayed in the bottom of this panel. The position is displayed in either Grid or geographic coordinates depending upon which of the Geo or Grid radio buttons is selected.

The remaining configuration options are the same as those for a Sonardyne COMPATT with the exception of the Sensor and Cyclic setup options.

Configuring the Dynamic Array

The Dynamic Array refers to a transponder located on a moving vehicle/structure and thus is not fixed. The transponder's offsets with respect to the CRP of the vehicle in the vehicle's local coordinate reference frame are known, but the actual position and depth are unknown. The configuration options for this mode option are shown in the following figure.

You are prompted for information that will enable WinFrog to determine a CRP position after the position of the transponder's transducer is determined.

Name/Position

Name

Entry of the name by which the COMPATT is to be known (maximum 24 characters).

F/A Offset

The forward/aft offset from the structure's CRP to the COMPATT's transducer.

Foreward is positive, aft is negative.

P/S Offset

The port/starboard offset from the structure's CRP to the actual transceiver's transducer. Starboard is positive, port is negative.

U/D Offset

The up/down offset from the structure's CRP to the actual transceiver's transducer.

Up is positive, down is negative.

The remaining configuration options are the same as those for a Sonardyne COMPATT with the exception of the Sensor and Cyclic setup options.

Working Control Stations (.CLS)

The **Working Control Stations (.CLS)** file is used to store all of the pertinent attributes of a reference station. This information is required when using **Range/Range** peripheral devices. Some **Range/Range** systems (Such as Racal's MicroFix) are internally configured with the control station coordinates and so are able to calculate (and output) a final position. Other ranging systems require that the coordinates of the transponders (AKA **Control Stations**) be entered into WinFrog where the final coordinates are then calculated. Control station information includes the station's name, code, position, elevation and calibration values.

Control stations entered in the **Working Control Stations** file can also be displayed in WinFrog's **Graphics** window.

Creating a Working Control Station (.CLS) File

To Create a New Working Control Stations File

The creation and designation of a file as the **Working Control Station** file is detailed at the beginning of this chapter in the **Creating and Selecting Less Common Working Files** section.

To Add a Control Station to the Working Control Stations File

- 1 From the **File** menu, choose **Edit Working Files... > Control Stations**.
- 2 Click the **Add** button. The **Control Station** dialog box displays, as seen below.

- 3 Highlight the various windows to change the entries, as detailed below:

Station Identity

Station Name

This can be any identifying name up to 25 characters.

Station Code

This is the code that the ranging system uses to identify the range data in the serial output. For example, for the Del Norte Trisponder 540 DDMU, it is the first two digits of the three-digit beacon code.

Station Coordinates

Position

Enter the station coordinates as referred to the current **Working Ellipsoid (datum)** or the current **Map Projection**.

Elevation

Enter the **mean sea level** elevation. This is used to reduce the slope range to a horizontal distance.

Calibration

Calibration

Enter the calibration value to be **added** to the raw range.

- 4 Click **OK** to save the entered data and return to the main **Working Control Station** dialog box.

Editing the Working Control Stations File

You can edit any **Control Station** parameter via the **Working Control Stations File**.

To Edit Parameters in the Working Control Stations File

- 1 From the **File** menu, choose **Edit Working Files... > Control Stations**.

The **Working Control Stations** dialog box contains a listing of all **Control Stations** in the **Working Control Stations** file.

- 2 Select the name of the **Control Station** that requires editing.
- 3 Click **Edit**.
- 4 Highlight the desired entry and make the required changes.
- 5 Click **OK** to save the changes and return to the main **Control Station** dialog box.

Removing a Control Station from the Working File

Any **Control Station** can be removed from the **Working Control Stations File**.

To Remove a Control Station from the Working Control Station File

- 1 From the **File** menu, choose **Edit Working Files... > Control Stations**.
- 2 Select the **Control Station File** to be removed.
- 3 Click the **Delete** button.
- 4 Click **OK** to save the changes and return to the main **Control Station** dialog box.

Working Velocities (.VEL) File

A Velocities file is used to store a single sound velocity profile. A sound velocity profile is a table that contains the speed of sound through water at various water depths. This information is essential in the accurate calculation of underwater ranges using acoustic travel times. Sound velocity is never constant through a water column and is affected by the temperature, salinity, and conductivity of the water. Environmental, oceanographic, and/or meteorological factors dictate the rate that sound velocity varies, both spatially and temporally.

One of the Velocities files must be set to be the **Working Velocities (.VEL)** file to enable its use for the long baseline (LBL) algorithms in WinFrog to convert

acoustic travel times into actual subsea ranges. An incorrect definition of the sound velocity profile for a work area will result in erroneous range calculations and subsequently erroneous subsea positioning.

Multiple Velocities files may be created, saved and edited. However, only one can be set to be the **Working Velocities** file at any one time.

Note: The validity of the velocity data is checked upon the loading of a file into WinFrog. If loading during boot up and the data fails the validity tests, you are alerted and the file is not loaded. If loading from an operator initiated file opening and the data fails the validity tests, you are alerted and the file is loaded. The velocity file check tests that the velocity values are between 1450m/s and 1575m/s and that the depths are in sequentially descending order.

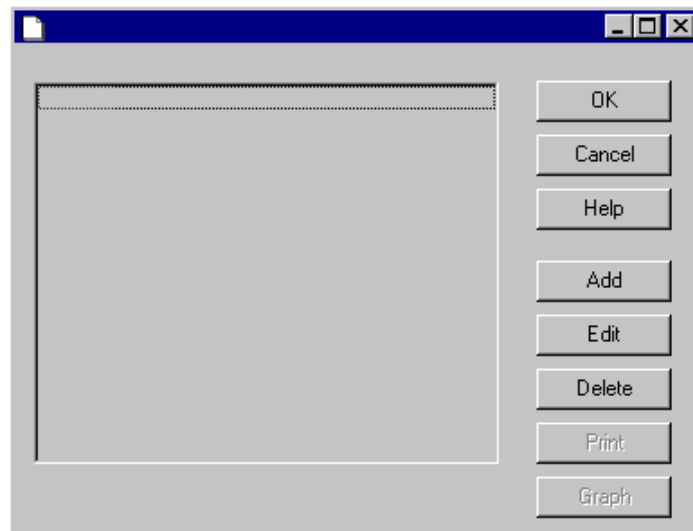
Creating and Opening the Working Velocities File

The **Working Velocities** file must first be created or selected before the sound velocity data is added.

To Create a New Velocity File

The creation of a velocities file is detailed in the **Creating and Selecting Less Common Working Files** section earlier in this chapter.

In addition, the Velocities file can be created directly from the Acoustic Window via **File\ New...>Velocity**.



In both cases, before the velocities file can be saved to disk, at least one velocity record must be added (see **To Add a Velocity Record to the Working Velocities File**). WinFrog will then detect that the document has been altered and prompt you to save it.

To Open a Velocities File

The opening of an existing Velocities file is detailed in the **Creating and Selecting Less Common Working Files** section earlier in this chapter. Once open, the file can be edited or assigned as the **Working Velocities** file. Upon the completion of editing, WinFrog will detect that changes have been made and prompt you to save the file.

The Velocities file can be edited even if it is not set to be the **Working Velocities** file. The editing is performed as detailed in **Editing the Working Velocities File** below.

To Designate a Velocities File to be the Working Velocities File

The designation of a Velocity file as the **Working Velocities** file is detailed in the **Creating and Selecting Less Common Working Files** section earlier in this chapter.

In addition, the Velocity file can be set to be the **Working Velocities** file directly from the Acoustic Window via **File\Set to Working...>Velocity**. This accesses a browse dialog allowing you to find and select the Velocities file to set to the **Working Velocities** file. When done this way, the file is not presented for editing but simply set to be the working file.

Editing the Working Velocities File

To Open the Working Velocities File

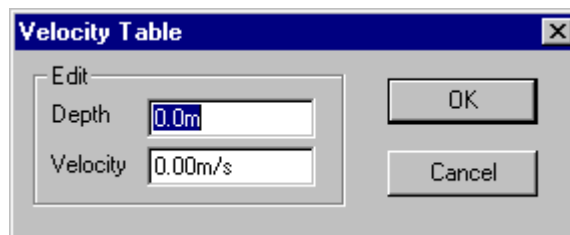
- 1 From the main menu **File** item, choose **Edit Working Files... > Velocities**. The **Working Velocities** file will open.

Or

- 2 From the **Acoustic Window File** item, choose **Edit...> Velocity**. The **Working Velocities** file will open.

To Add a Velocity Record to the Working Velocities File.

- 1 Open the **Working Velocities** file.
- 2 Click **Add**. The **Velocity Table** dialog box appears, as seen below.



The following information can be modified in the **Velocity Table** dialog box:

Depth field Enter the depth of the sound velocity observation. This is displayed and entered in the Default Water Depth units.

Velocity field Enter the sound velocity observation. This is displayed and entered in the default Distance units per second.

- 3 Enter the appropriate values in these two fields.

NOTE: Velocities must be between 1450 and 1575 m/s.

NOTE: All depths must be in the correct sequence starting at the water surface.

NOTE: All depths must be below the water surface, that is, a negative value cannot be entered.

- 4 Click **OK** to confirm these entries and close this window. WinFrog will check the data entry and prompt you if it is detected that the entered depth does not fit the descending order sequence or the velocity value is outside the above limits.
- 5 Repeat steps 2 to 4 entering depth/velocity to a depth greater than the expected working depth. The final depth/velocity entry should be at a depth greater than the maximum working depth to ensure that the interpolation of velocities is complete through the entire water column.

To Edit a Velocity Record in the Working Velocities File

- 1 Open the **Working Velocities** file.
- 2 Select the entry that requires editing.
- 3 Click **Edit**. Or,
Double-click the desired record. Or,
From the Velocity Profile Graph (see **Viewing a Velocities File Graphically**), double-click the desired point.
- 4 The same **Velocity Table** dialog box used to initially add the depth record is opened, displaying the current data. Make the desired changes.
- 5 Click **OK** to save the changes and close this window. WinFrog will check the data entry and prompt you if it is detected that the entered depth does not fit the descending order sequence or the velocity value is outside the above limits.

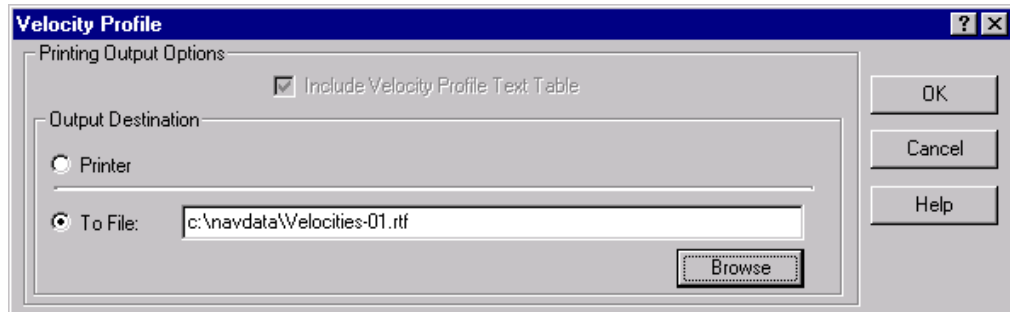
To Delete a Velocity Record in the Working Velocities File

- 1 Open the **Working Velocities** file.
- 2 Select the entry to be removed.
- 3 Click the **Delete** button.
- 4 Click **OK** to save the changes and close this window.

Printing a Working Velocities File

- 1 Open the **Working Velocities** file or an existing Velocities file not set to be the **Working Velocities** file.
- 2 Click the **Print** button. This will present the Velocity Profile Print Options dialog.

Note: The **Print** button is only enabled if there is at least 1 velocity record in the file.



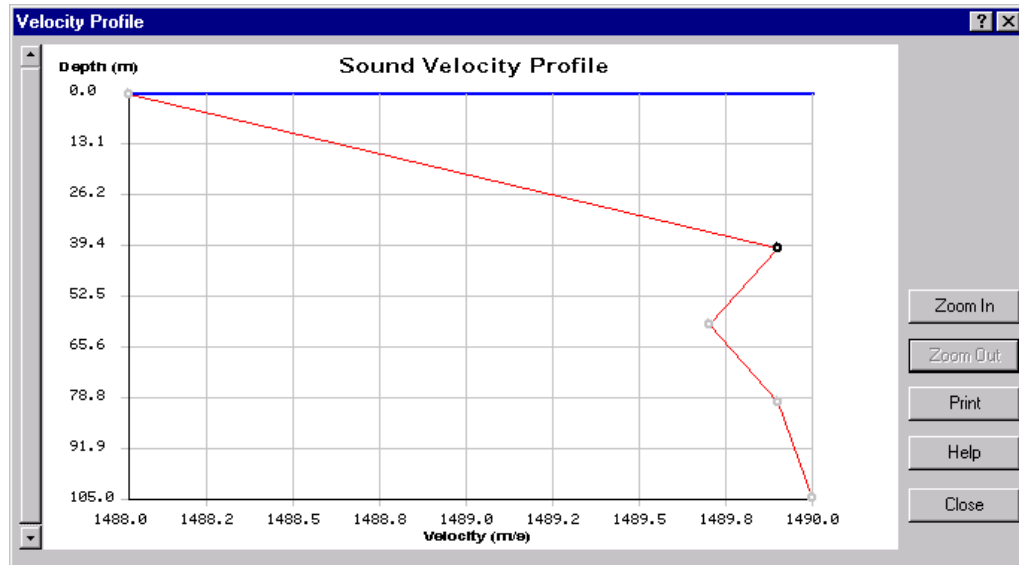
- 3 Select either **Printer** or **To File** option. Selecting **Printer** results in the print going directly to the Windows default printer. If selecting the **To File** option, you must either enter the target file or use the **Browse** button to locate or enter an appropriate file name.
- 4 Click the **OK** button. This will exit this dialog and execute the appropriate printing. When the printing is completed, you will be informed with a message box stating **Writing to File Finished**.

Viewing a Velocities File Graphically

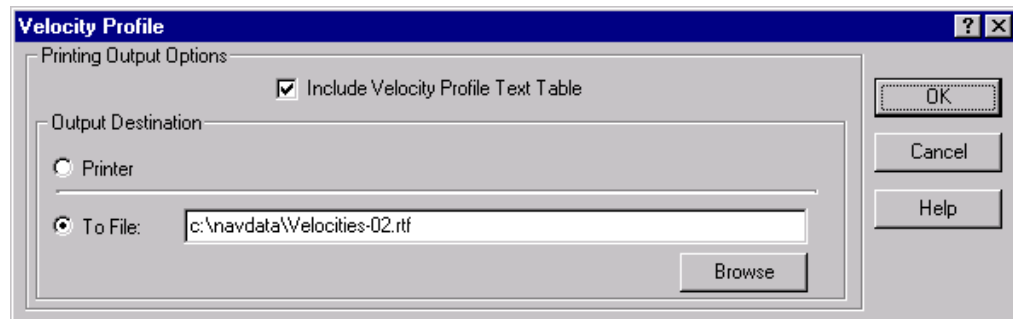
This feature allows you to view the velocity data graphically complete with zoom in and out, direct data editing and printing features.

- 1 Open the **Working Velocities** file or an existing Velocities file not set to be the **Working Velocities** file.
- 2 Click the **Graph** button. This will present the Velocity Profile dialog.

Note: The **Graph** button is only enabled if there are at least two velocity records in the file.

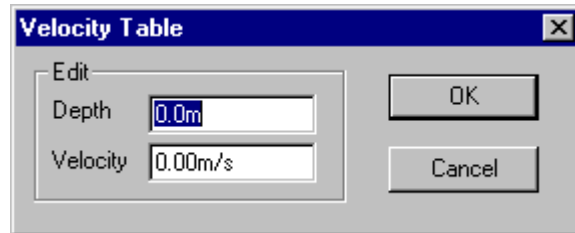


- 3 Clicking the **Zoom In** button presents a more detailed view of the data. Note that the vertical sliding bar on the left of the window allows you to move up and down the water column to view the data.
- 4 Clicking the **Zoom Out** button presents a less detailed view of the data. This button is only active if the data has been Zoomed In already. The vertical sliding bar on the left of the window allows you to move up and down the water column to view the data if required.
- 5 Clicking the **Print** button presents the Velocity Profile Print Options dialog.



- i Select either **Printer** or **To File** option. Selecting **Printer** results in the print going directly to the Windows default printer. If selecting the **To File** option, you must either enter the target file or use the **Browse** button to locate or enter an appropriate file name. Check the **Include Velocity Profile Text Table** if you wish to print the velocity file data in tabular form with the graphics.

- ii Click the **OK** button. This will exit this dialog and execute the appropriate printing. When the printing is completed, you will be informed with a message box stating that **Writing to File Finished**.
- 6 Double-clicking near a data point in the graphics area of the screen will enable you to edit the data for the velocity data point nearest the cursor. The **Velocity Table** dialog box appears.



See **To Add a Velocity Record to the Working Velocities File** for details on entering data in this dialog.

Working Cable Events (.CET) File

The **Working Cable Events (.CET)** file is used to store **Cable Events** generated by the user. **Cable Events** are specifically used for submarine cable lay operations, where they are used to record navigation and cable lay slack information at the press of button. For more information about **Cable Events**, see the **Eventing** chapter.

The **Graphics** and **Bird's Eye** windows can be configured to display cable events recorded in the **Working Cable Events** file. This provides a graphical record of the cable events logged during the survey.

Creating the Working Cable Events File

In order to record cable events, the **Working Cable Events** file must first be defined.

To Create a New Working Cable Events File

The creation and designation of a file as the **Working Cable Events** file is detailed earlier in this chapter in the **Creating and Selecting Less Common Working Files** section.

Editing the Working Cable Events File

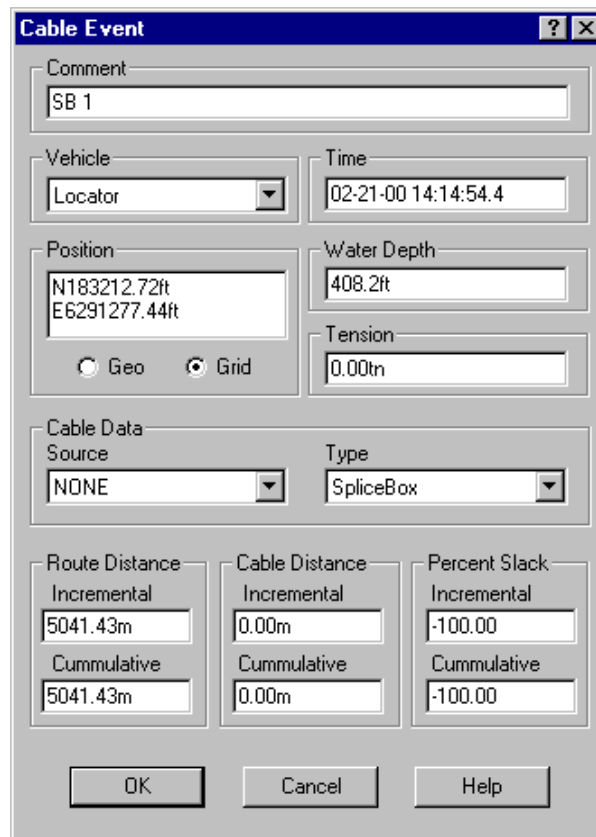
Once the **Working Cable Events File** has been designated and cable events have been recorded, it may be necessary to edit the cable events contained in the file.

To Edit the Contents of the Working Cable Events File

- 1 From the **File** menu, choose **Edit Working Files... > Cable Events**.

The **Working Cable Events** dialog box displays a listing of all cable events contained in the **Working Cable Events** file.

- 2 Select the cable event that requires editing.
- 3 Click **Edit**. The same **Cable Event** dialog box that appeared when the cable event was initially taken opens, as seen below.



This dialog box allows you to modify any of the following parameters:

Comment entry field	allows you to enter a comment to describe the event.
Vehicle dropdown menu	allows you to select the vehicle associated with the other parameters in this dialog box.
Time field	indicates the time and date that the cable event was taken.
Position field	indicates the position of the vehicle selected in the dropdown menu.
Water Depth	The depth of the water at the vessel when the cable event was taken.

Tension	The amount of tension in the cable at the instant that the cable event occurred.

Cable Data

Source dropdown menu	selects a cable counter peripheral device previously added to this vehicle.
Type dropdown menu	selects the kind of icon that will be used to represent the cable event in the Graphics display. The types are specific to cable laying jobs: KM Mark Transition Splice Box Repeater Branch Cable End Additional generic options are available, such as square, circle, and triangle.

Route Distance

Incremental	The distance traveled along the route since the previous Cable Event.
Cumulative	The distance traveled along the route since the first cable event in the Working CET file (i.e. the sum of the Incremental Distances).

Cable Distance

Incremental	The amount of cable let out since the previous cable event.
Cumulative	The amount of cable let out since the first cable event in the Working CET file (i.e. the sum of the Incremental Distances).

Percent Slack

Incremental	The calculated amount of slack in the cable since the previous cable event.
Cumulative	The calculated amount of slack in the cable since the first Cable Event in the Working CET file.

- 4 Highlight the appropriate data field and make the desired changes.
- 5 Click **OK** to close this dialog and return to the **Cable Event Table** dialog.
- 6 Click **OK** close this dialog box and save the changes.

Deleting a Cable Event

Any cable event can be removed from the **Working Cable Events** file.

To Remove a Cable Event

- 1 From the **File** menu, choose **Working... > Cable Events**.
- 2 Select the record to be removed.
- 3 Click the **Delete** button.

To Add a Cable Event to the Working Cable Events File.

Use the following instructions to add **Cable Events** to the .CET file “after the fact”. See the **Eventing** chapter for details on adding **Cable Events** to the .CET table in “real-time”.

- 1 From the **File** menu, choose **Edit Working Files... > Cable Events**.
- 2 Click **Add**. The same **Cable Event** dialog box opens as when a cable event is taken or when a record is edited.
- 3 Configure the various parameters, as detailed above.
- 4 Click **OK** to close this window.
- 5 Click **OK** to close the **Cable Events Table** and to save the changes made.

Chapter 6: Vehicles

WinFrog allows you to define up to 25 vehicles for real-time navigation, tracking, and data collection purposes. A vehicle may be a vessel, an ROV, a towed body, a sea plow or any other object associated with navigational data.

WinFrog provides you the ability to modify various vehicle parameters, including its name, size, shape, color, tracking offsets, associated devices, fairleads, and event generation capabilities. In order to ensure consistency throughout a project, it is suggested that all configuration be complete before any real-time navigation or data collection begins.

All vehicle configuration parameters (and all other WinFrog parameters) are saved in the **Winfrog_3.ini** file. **Note:** the **Winfrog_3.ini** file (found in the WINNT directory) is overwritten with the current configuration each time WinFrog is exited correctly. WinFrog reads this same file each time the program is started.

WinFrog's configuration can also be saved without exiting the program by creating a **System Config (.cfg)** file. A **.cfg** file can be loaded at any time, re-configuring WinFrog instantly to reflect the stored configuration parameters. The vehicle's shape can be saved in a separate **.veh** file, eliminating the need to manually enter the various dimensions each time that particular vessel is used.

This chapter discusses WinFrog vehicles and is divided into three main sections: **Adding a Vehicle**, **Configuring a Vehicle**, and **Deleting a Vehicle**.

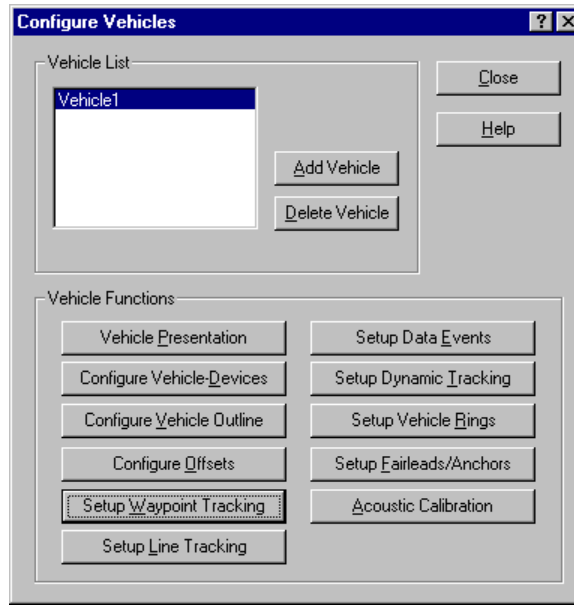
Adding a Vehicle

By default, WinFrog is configured with a single vehicle named **Vehicle1**. However, various types of projects, such as ROV, towed body, or anchor handling operations, require the configuration of multiple vehicles. Each vehicle that is created within WinFrog must be modified to suit its individual configuration.

To Add a Vehicle to WinFrog

- 1 From the **Configure** menu, choose **Vehicles**.

WinFrog opens the **Configure Vehicles** dialog box, as seen below.



- 2 Click the **Add Vehicle** button.

The vehicle added is given the name **VehicleX**, where **X** is the next sequential number available.

Configuring a Vehicle

The configuration of a vehicle is an essential step in any work using WinFrog. For example, whenever a new vehicle is created you must configure the vehicle to inform WinFrog which devices will be used to provide navigation information for the vehicle. You may also want to detail the ship's shape more accurately to assist in real-time interpretation of WinFrog's **Graphics** displays. These changes must be initiated at the start of the project to ensure that all real-time navigation and subsequent data collection operations are accurate.

The **Configure Vehicles** dialog box has the following eleven configuration buttons:

- Vehicle Presentation
- Configure Vehicle - Devices
- Configure Vehicle Outline
- Configure Offsets
- Setup Waypoint Tracking
- Setup Line Tracking
- Setup Data Events
- Setup Dynamic Tracking
- Setup Vehicle Rings
- Set up Fairleads/Anchors
- Acoustic Calibration

The eleven options are listed above in the order that you would approach them in a typical WinFrog operation. These eleven buttons open dialog boxes that control the configuration of the many vehicle parameters available in WinFrog. For example, to access the configuration parameters associated with a vehicle's position calculations, you would highlight the desired vehicle using the mouse, and then click the **Configure Vehicle-Devices** button. In this example, WinFrog would open the **Configure Vehicle-Devices** dialog box. You would then make the desired modifications to the position calculations parameters and click the **OK** button. When all configuration changes have been made, clicking the **Close** button in the **Configure Vehicle-Devices** dialog box would return you to WinFrog's main menu. Each of these buttons (and their associated configuration options) are discussed in the following sections.

Vehicle Presentation

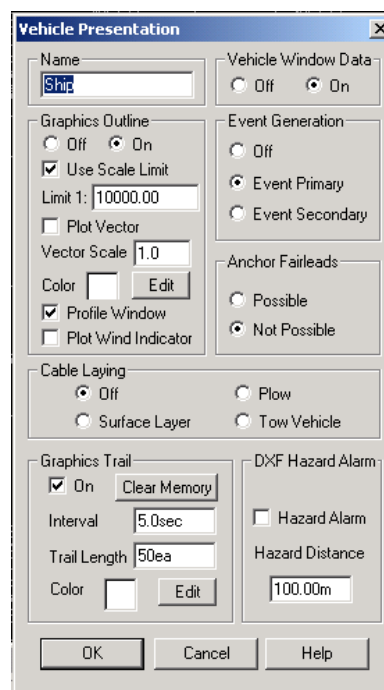
Select the **Vehicle Presentation** button to open the **Vehicle Presentation** window. This window allows for definition of the vehicle's name as well as the configuration of several other very significant options.

To Display the Vehicle Presentation Window

- 1 From the main menu items select **Configure > Vehicles**.

The **Configure Vehicles** window displays

- 2 Click the **Vehicle Presentation** button to open the **Vehicle Presentation** window, as shown below.



The following parameters are configurable using the **Vehicle Presentation** dialog box:

Name

Name field

The name of the vehicle is shown here. Each vehicle in WinFrog must have a unique name so that it can be identified quickly during real-time operations, as well as to remove any confusion during data processing. The vehicle name must be limited to 18 characters, which can include spaces, but cannot include semi colons, quotation marks, or forward or back “slashes.”

Note: if configuring a **Smart Remote** system, the vehicle name must be identical in the WinFrog software on both the “master” WinFrog system and the smart remote system.

Vehicle Window Data

Vehicle Window Data

radio buttons

These control whether the current vehicle appears in the **Vehicle Text** window. If the **Off** radio button is selected, the information for this vehicle is not displayed in the **Vehicle Text** window. If the **On** radio button is selected, the vehicle’s data are shown.

Graphics Outline

Graphics Outline

radio buttons

These control the presentation of the vehicle in the **Graphics** and **Bird’s Eye** windows. If the **On** radio button is selected, the vehicle’s outline is drawn on the displays. If the **Off** radio button is selected, the vehicle’s outline does not appear.

Use Scale Limit box

This is a control for how small the vehicle displays in the **Graphics** and **Bird’s Eye** windows when the window is zoomed out. If this checkbox is selected, WinFrog will not draw the vehicle any smaller than the size (scale limit) specified in the **Limit 1:** field. This prevents the vehicle from becoming too small and difficult to see when

	“zooming out” in either the Graphics or Bird’s Eye windows.
Limit 1: field	The value entered here controls the scale of the vehicle on the Graphics window when the Use Scale Limit checkbox is selected. The scale can be set from 1:1000 to 1:10000.
Plot Vector box	If this checkbox is selected, WinFrog displays a vector in the Graphics and Bird’s Eye windows. This vector represents the vehicle’s current speed and course made good. An arrow is drawn from the vehicle’s origin, pointing in the direction of the vehicle’s course made good. The length of the arrow is proportional to the vehicle’s speed.
Vector Scale field	The value entered here controls the scale of the vector on the Graphics window. For example, entering a “2” will double the vector’s size to represent the same velocity.
Color box	Select the Edit button, choose a new color, and click OK to change the color of the vehicle.
Profile Window box	This setting controls whether the current vehicle appears in the Profile window. If the box is checked, this vehicle will be displayed in the Profile window.
Plot Wind Indicator box	This setting controls whether a wind vector will appear in the Graphics window. This option requires that a wind measuring device is interfaced to WinFrog and added to a vehicle’s position device list.

Event Generation

Event Generation radio buttons	These buttons are used to control the event generation status of the vehicle. The generation of events can be controlled by only one vehicle at a time. This vehicle is designated as the Event Primary vehicle. This means that it is used to trigger all time and distance events. In the case of external events, an external hardware trigger is used. If event-based data logging for other vehicles is also required, those vehicles must have the

Event Secondary radio button selected in the **Vehicle Presentation** dialog box. If no event recording is required, select the **Off** radio button.

Note: WinFrog will not allow you to delete the **Event Primary** vehicle.

Anchor Fairleads

Anchor Fairleads
radio button

this button defines the anchor-handling capabilities of the vehicle. Select the **Possible** button if the vehicle has anchors to be deployed. This vehicle is then added to the list of barges in the **Anchor Handling** dialog box.

If the vehicle does not have anchors to be tracked or displayed by WinFrog, select the **Not Possible** radio button. In this case, the vehicle is then added to the list of vehicles capable of dropping and picking up anchors in the **Anchor Handling** dialog box.

Cable Laying

Cable Laying
radio buttons

The selection here defines how this vehicle will be utilized in real-time cable modeling calculations.

Graphics Trail

On checkbox

If this box is checked, WinFrog displays a graphics trail in the **Graphics** and **Bird's-Eye** views. The trail is drawn based upon the number of points entered in the **Trail Length** field (50 is the default) and shows the past locations of the vehicle.

The density of the points displayed is defined by the time interval entered in the **Interval** field. For example, the default setting of 50 means that 50 points are drawn, with the oldest point being removed as a new point is added.

Color box

Click the **Edit** button, select a new color, and choose **OK** to change the color of the trail.

Clear Memory button

Allows you to clear the memory of the

Hazard Alarm checkbox

Graphics Trail points displayed in the **Graphics** and **Bird's-Eye** views.

If this box is checked, it sets the hazard alarm to alert you that the vehicle is within 100 meters of a designated **Map** object.

Note 1: The hazard alarm will work with BML and BMM files added as a background layer in the Graphics window. See **Chapter 8 – Operator Display Windows** for a description of how to use and create these BMM and BML files. The hazard alarm will work with BMM files that have one layer of type SHP or DWG or DXF. The hazard alarm will also work with BML files that have the following user drawn widgets: arc, circle, text, point, polyarc and polyline. A polygon and DGN map layer cannot be selected as a hazard.

Note 2: In order to designate an item in a BMM or BML file as a hazard, select the 'arrow' icon in the 'drawing tools' toolbar and click within 5 meters of this item in the Graphics window while the Hazard Alarm button in the 'options' toolbar is selected.

Configure Vehicle Outline

WinFrog allows you to configure how vehicles are displayed in the **Graphics**, **Bird's Eye**, and **Profile** windows. Vehicle size measurements are made from a single reference position on the vehicle. This coordinate origin is referred to as the **Common Reference Point (CRP)**. The CRP can be at any point on the boat i.e., the GPS antenna, the vessel's center of gravity, the main mast, etc. Once the location of the CRP has been established, all measurements entered in WinFrog must be made from that location.

To Configure a Vehicle's Outline

- 1 Click the **Configure Vehicle Outline** button in the **Configure Vehicle** dialog box.

Configure Vehicle Outline

Entry
☒ Ship
☐ Outline
☐ Graphical

Width Of
 Bow
 Stern

Origin To
 Bow
 Stern
 Bow Curve
 Starbd Side
 Port Side

Moonpool
☐ Used Size
 Fore/Aft
 Port/Stbd

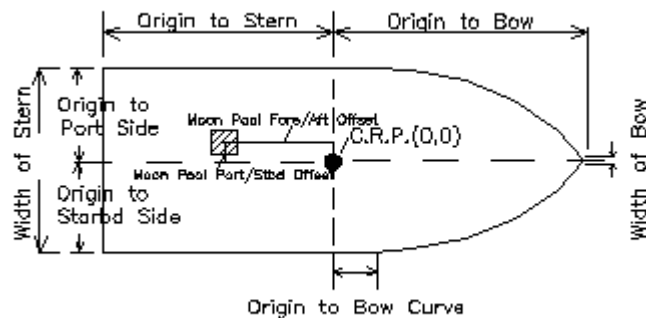
Vessel size from/to file

OK
Cancel
Help

The **Vehicle Outline** dialog box allows you to define a generic ship shape by entering various vessel dimensions. You can also define a custom vehicle shape by entering “coordinates” relative to the vessel’s CRP using the Outline or Graphical entry methods.

Ship Dimensions

A generic ship shape is created by defining the parameters seen in the diagram below:



To Define a Vehicle's Dimensions

- 1 With the **Configure Vehicle Outline** dialog box still open, select the **Ship** radio button in the **Entry** area.
- 2 Change the values in the **Width Of** and **Origin To** fields to match the measurements for your vehicle.

Note: the word *origin* in **Origin To** refers to the vehicle's **Common Reference Point**.

- 3 If the vehicle contains a **Moonpool** (an opening in the vessel to allow access to the water), you must define it's size and location. The single value required for the **Moonpool's** size refers to the fact that the **Moonpool** will be drawn as a square. For the **Moonpool** location, **Forward** and **Starboard** offsets are positive values, while **Aft** and **Port** offsets are negative values.

To Define a Moonpool

- 1 Check the **Used** box in the **Moonpool** area of the **Vehicle Outline** dialog box.
- 2 Enter the size of the moonpool in the **Size** field.

WinFrog creates a square with sides of length equal to this value.

- 3 Enter the values in the **Fore/Aft** field and the **Port/Stbd** field to locate the center of the moonpool with respect to the origin (common reference point).

Custom Outline

WinFrog also allows you to define a vehicle's shape using relative X, Y, and Z coordinates. To display the vehicle, WinFrog joins the coordinates in the order that they are entered. The outline can begin at any point of the vehicle, but must be continuous in direction, returning to the first point entered.

The origin of this relative coordinate system is the origin of the vehicle (the common X, Y, Z reference point); the y-axis is parallel to the vehicle's heading (positive forward); the x-axis is perpendicular to the Y axis (positive starboard).

There are two methods for defining a vehicle's outline, the Outline entry method and the Graphical entry method. The Outline entry method provides a basic interface to enter the vehicle's shape. The Graphical entry method provides advanced vehicle shape entry features along with a visual representation of the vehicle as it is being defined.

To Define a Vehicle's Outline using the Outline Entry Method

- 1 Select the **Outline** radio button in the **Entry** area of the **Vehicle Outline** dialog box.

WinFrog displays the default “generic” ship shape converted to the relative coordinate data format.

The point coordinates are shown in the form **X = #.###, Y = #.###, pen = #, Z Top = #.###, Z Bottom = #.###**.

The **X, Y and Z** entries are distances from the **CRP** in the user-defined measurement units. (To change units, close this window then select the main menu item **Configure > Units > Distances**).

Note: for **Z** values you must enter a negative sign for points below the **Z** reference datum.

Pen number is either **0** or **1** where:

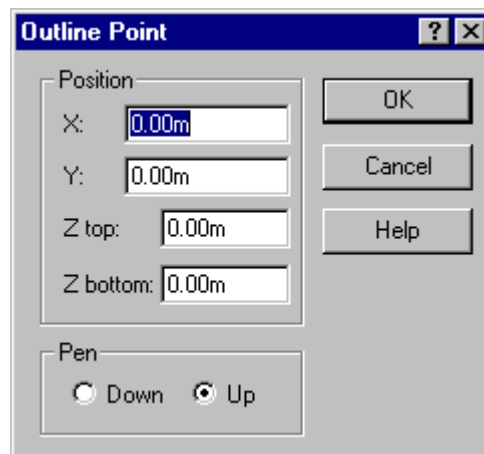
pen=0	the previous segment is configured “pen up.”
pen=1	the previous segment is configured “pen down.”

If the segment is configured “pen down,” WinFrog draws the line. If the segment is configured “pen up,” WinFrog does not display the line, allowing you to move from one coordinate to another without drawing a line segment.

Note: you must configure the first entry made in this window as **pen up**.

- 2 Click the **Add**, **Edit**, or **Delete** button to enter the coordinates required to properly depict the vehicle’s shape. When defining a new vehicle shape, first **delete** all of the default entries and then **add** new points.

Add	Select this button to add a new point to the list. WinFrog inserts the new point immediately after the currently highlighted point. Use this if you forgot to add a point in the original entry of coordinates. When you click the Add button the Outline Point dialog box opens, as seen below.



Highlight the appropriate field and enter the value. Use the keyboard's "Tab" and "arrow" keys to move between entry options. Select **OK** to confirm the entries and return to the previous window.

Edit

allows you to change the parameters of a selected point. Clicking the **Edit** button opens the same **Outline Point** dialog box (seen above). Highlight the desired entry and change the values as required.

Delete

removes the highlighted point.

- 3 To save or recall a defined shape, click the **Save** or **Load** buttons.

Save

saves the entered coordinates to a **.veh** file.

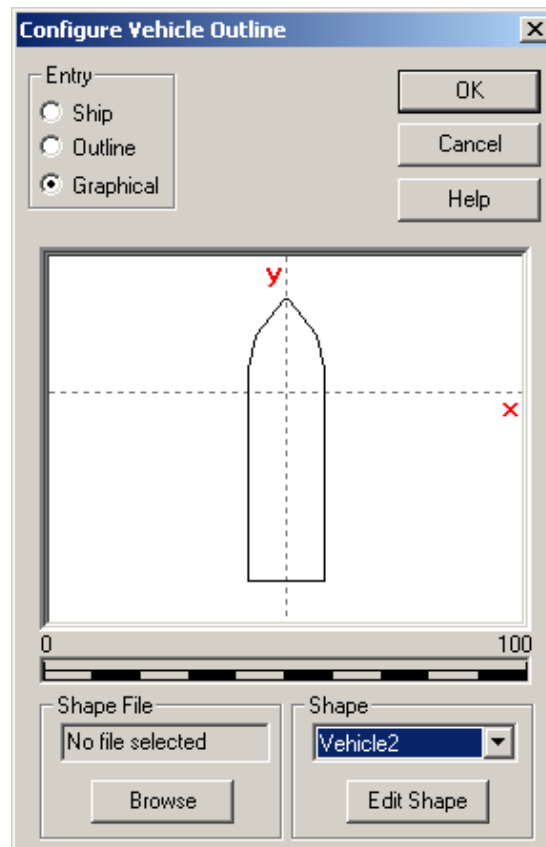
Load

opens the **Select File** dialog box to allow you to find and open a previously created **.veh** file.

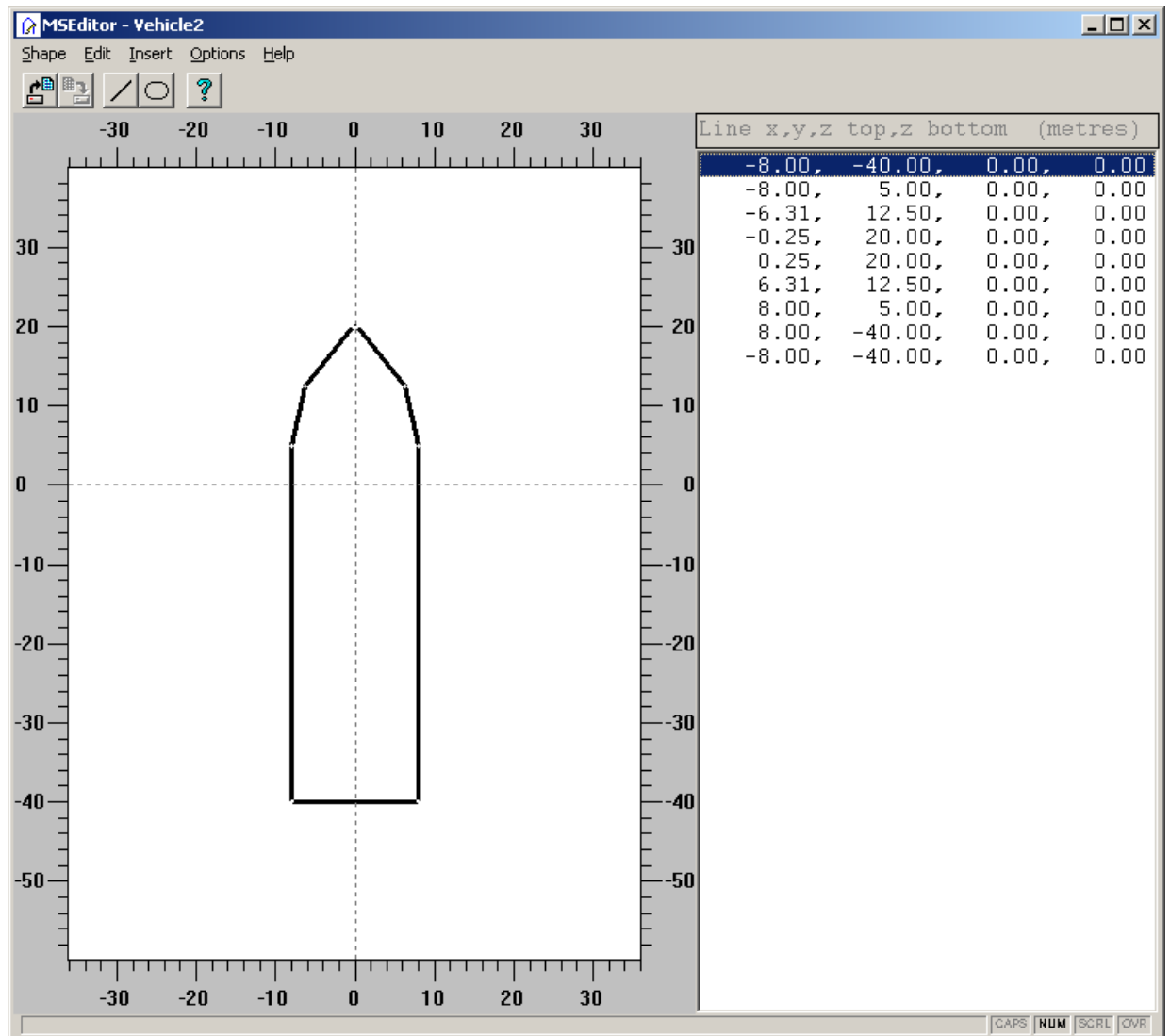
To Define a Vehicle's Outline using the Graphical Entry Method

- 1 Select the **Graphical** radio button in the **Entry** area of the **Vehicle Outline** dialog box.

WinFrog displays the default "generic" ship shape in the shape display.



- 2 Click the **Edit Shape** button to modify the vehicle's shape. This will launch the MEditor program.



Modify the vehicle's shape using the MEditor program; refer to the following MEditor section for help on using the MEditor program. When the modifications are completed save the vehicle's shape and exit the MEditor program. The modified shape will be displayed in the WinFrog Configure Vehicle Outline dialog. Click OK to set the vehicle's shape to the new shape.

- 3 To recall a defined shape, select the vehicle definition file by clicking the Browse button. When a vehicle definition file is selected, the shapes are loaded from the file and added to the shape dropdown list box. Select the desired shape from the shape list box. The shape can then be edited and implemented as described in step 2.

MSEditor

The following parameters are configurable from the **MS Editor** program:

Shape Menu

New Shape

Opens a new, untitled shape page. The application prompts you to name untitled shapes when they are closed.

Load Shape

Displays the **Shape Load** dialog box so you can select a shape to load into a new shape window.

Store Shape

Saves the shape in the active window to disk. If the shape is unnamed, the **Store Shape As** dialog box is displayed so you can name the shape.

Store Shape As

Allows you to save a shape under a new name. The command displays the **Store Shape As** dialog box. You can enter the new shape name. If you choose an existing shape name, you are asked if you want to overwrite the existing shape.

Delete Shape

Allows you to delete a shape from the shape file. The command displays the **Delete Shape** dialog box.

Import LBR File

Allows an existing shape from an LBR file to be imported. The command prompts you to select the LBR file to import the shape from. The **Shape Load** dialog box is then displayed so you can select the shape to import.

Exit

Exits MSEditor. If you've modified any shapes and not saved the changes, you'll be prompted to save before exiting.

Edit Menu

Move Shape Origin

Allows the origin to be shifted relative to the shape. This command displays the **Move Origin** dialog box.

Warning: ensure that any other offsets already defined with respect to the origin are not compromised. When selected as a shape for a mobile in the main application the origin point will become the Datum Point.

Horizontal, Vertical

Displacement of the origin in the current Units.

Resize Shape	Allows the shape to be scaled by a percentage. This command displays the Resize Shape dialog box.
Horizontal	Enter percentage value to modify horizontal X values.
Vertical	Enter percentage value to modify vertical Y values.
Previous Component	Selects the previous item (line or ellipse) in the shape and highlights it on the drawing area.
Next Component	Selects the next item (line or ellipse) in the shape and highlights it on the drawing area.
Move Component	Allows the selected item to be moved relative to the origin. This command displays the Move dialog box.
Horizontal, Vertical	Displacement of the point in the current Units.
Delete Component	Allows the selected line or ellipse to be deleted in its entirety.
Ins Pt	Allows a point to be inserted at the highlight cursor for the currently selected line. The command displays the Edit a Point dialog box.
X, Y	Co-ordinates of the point entered in the current Units.
Edit	Allows the point at the highlight cursor to be edited for the currently selected line or ellipse. The command displays the Edit a Point or Edit an Ellipse dialog box. This can also be achieved by double-clicking the point to be edited in the co-ordinates window.
Edit a Point	
X, Y	Co-ordinates of the point entered in the current Units.
Edit an Ellipse	
Centre X, Y	Co-ordinates of the centre point of the ellipse entered in the current Units.
Horiz, Vert Radius	Horizontal and vertical radii for the ellipse entered in the current Units.
Del Pt	Deletes the point indicated by the highlight cursor.

Insert Menu

Line

Allows a new line within the shape to be defined. The command displays the **Edit a Point** dialog box. (Described above under the Edit menu, Edit command.)

Ellipse

Allows a new ellipse within the shape to be defined. The command displays the **Edit an Ellipse** dialog box. (Described above under the Edit menu, Edit command.)

Options Menu

Drawing Area

Defines the minimum and maximum X,Y values for the display area. This command displays the **Drawing Area** dialog box.

Left, Right, Bottom, Top

The area is scaled isotropically - the two axes will be scaled identically. The scale chosen by the application will accommodate the largest minimum to maximum separation.

As shape lines and ellipses are added then the application checks whether or not it falls within the drawing area. If not the user is warned.

Units

Specifies the measurement units to be used for the co-ordinate entry. This command displays the **Units** dialog box.

The application will always store the values entered in meters irrespective of how they are viewed.

If the units are changed when a shape is currently being edited then the application prompts to know whether the existing measurements need to be converted. If the answer is yes then any entered values will be modified to the new units.

Meters

Co-ordinates to be entered in meters.

Feet

Co-ordinates to be entered in feet. All entered values will be multiplied by 0.3048 prior to storage.

Other	Co-ordinates to be entered in a user defined system, the Conversion to Meters value being used to multiply the entered values prior to storage.
Conversion to Meters	When Other is used as the units then the entered values are multiplied by this conversion prior to storage.

Help Menu

Contents, Keyboard	Displays on line Help for MSEditor including instructions on using the Windows keyboard function keys.

The Toolbar

The Toolbar is a row of buttons at the top of the main window that represent application commands. Clicking one of the buttons is a quick alternative to choosing a command from the menu. Buttons on the toolbar activate and deactivate according to the state of the application.

Button	Action
	Load Shape
	Store Shape
	Insert Line
	Insert Ellipse
	Help Contents

Configure Vehicle-Devices

One of the most important steps in configuring a vehicle in WinFrog is to correctly configure the vehicle's devices. This **Configure Vehicles-Devices** option defines which data sources are used to provide the vehicle's information (position, heading, depth, etc.). Typically, only real-time data sources are used for primary navigation purposes, whereas smart remote systems utilize a network data source.

WinFrog is capable of having more than one vehicle configured. Thus, you must define which devices are added to which vehicle. Once added to a vehicle, each device must be edited to suit that particular installation.

The **Configure Vehicles-Devices** window is also used to control the amount of filtering that can be applied to the raw data being used to calculate the vessel's position, speed, and course made good.

To Configure a Vehicle's Devices

- 1 Click the **Configure Vehicles-Devices** button in the **Configure Vehicles** dialog box.

The screenshot shows the 'Configure Vehicle-Devices' dialog box. It has a title bar with a close button. The dialog is divided into several sections: 'Position' with fields for latitude (N31 59.9796), longitude (W116 59.9880), elevation (0.00m), and heading (0 0 00.38T), along with radio buttons for 'L/L' and 'Grid', a 'Copy' button, and an 'Update' checkbox; 'Data Source' with radio buttons for 'Simulated', 'Real-Time', 'Network', 'File', 'Ctrl'd Remote', and 'Pipe Track'; 'Calculations' with checkboxes for 'Heading' and 'Streamer', and a 'Max Time Variance (s)' field set to 60s; 'Kalman Filter' with a value field (0.10), 'Off' and 'Purge' checkboxes, and a checked 'Dead Recon' checkbox; 'Velocity Filter' with a value field (20), 'Off' and 'Purge' checkboxes; and 'Range Gate' with a checked 'Off' checkbox and a value field (100.00m). At the bottom, there is a 'Devices' list box, and buttons for 'Add', 'Edit', 'Delete', 'OK', 'Cancel', and 'Help'.

The following parameters can be configured from the **Configure Vehicle-Devices** dialog box:

Position

Entry field

This window is used primarily with a simulated positioning device and to initialize MultiRef and LBL calculations. To enter a new initial position for the

	vehicle, select the appropriate radio button and enter the respective coordinate – geographic (lat/lon) or grid (Northing/Easting). The vehicle will move to the position entered in the Position input field only if the Update box is checked.
Copy button	Copies the position of the cursor in the active Graphics or Bird's Eye window (via the clipboard memory) into the Position entry field.
Update box	If this is checked, when OK is selected to close the Configure Vehicle-Devices window, the vehicle position will move to the coordinates entered in the Position input field; if this box is not checked, the newly entered position is ignored.
Elev field	The elevation of the vehicle's origin above the current spheroid can be entered into the Elev input field. The elevation entered here will only be used if the Update box is checked.
Heading (LBL Calcs) field	Used for entry of initial heading for LBL inverted Transceiver Xponder vehicle calculations.

Kalman Filter

WinFrog applies “Kalman filtering” to help smooth raw data received from positioning devices. This includes the input of position data and LBL range data. The **Kalman Filter** analyzes a series of observations and calculates (predicts) the acceleration (in both latitude and longitude) for the next program update. If the next raw position observed by WinFrog causes a jump in position that exceeds the limit of acceleration allowed in the **Kalman Filter**, then the observation is not used. Instead, the maximum acceleration value entered in the **Kalman Filter** (in meters/second ²) is used to calculate the next position.

This predicted position is then used for waypoint and line tracking, as well as for speed and course made good calculations. This predicted position is also displayed in the **Vehicle Text** window and recorded in events generated by manual fixes or by automatic eventing.

You can change the amount of filtering that is applied by changing the settings found in the **Configure Vehicle-Devices** window. The following sections detail the different options found in this window.

Entry field	This box allows you to change the Kalman

Scroll bar

Off box

Purge box

Dead Recon box

Filter setting for the vehicle. Highlight and overwrite the value shown in this window, to a maximum value of 1.00 m/s^2 . You can also use the scroll bar to change the setting. The scroll bar controls the maximum allowable acceleration parameter (m/s^2) in the **Kalman Filtering** routines. This can range from 0.01 to 1.0 m/s^2 . The larger the number, the more acceleration, or “noise”, that is permitted to pass through the filter. Therefore, the larger the number, the more freedom allowed and the less filtering applied to the vehicle’s positioning.

If this box is checked, the **Kalman Filter** is not used and the **Velocity Filter**, (a median filter), is used instead. (Information describing the use of the **Velocity Filter** is described below).

If this box is checked, the **Kalman Filter** is reset when **OK** is selected. This may be necessary if a series of bad observations is received by WinFrog causing the filter calculations to be skewed incorrectly.

If this box is checked, the vehicle’s position will continue to update (based on the last observed speed and course made good) even when no position information is being received. After 15 seconds of “dead reckoning”, an asterisk is displayed next to the latitude, longitude, Northing, and Easting in the **Vehicle Text** window. These items will also change to yellow to represent the dead reckoning status.

Additionally, if a **Calculations** window is open and configured to display the vehicle’s **position** information, an alarm will sound after 30 seconds of no new positional data being received. This alarm is silenced by clicking the **ACK** button in the **Calculations** window. (**View > Calculations**)

Note: Rho/Theta and layback positional information is not **Kalman Filtered**. Instead it is passed through a median filter (see **Velocity Filter** immediately below for more information).

Velocity Filter

Entry field

In addition to the **Kalman Filter**, WinFrog also has the capability to pass positional velocity information through a median filter. This median filter, called the **Velocity Filter**, is used for **Rho/Theta** and **layback** navigation data. It is also used for all navigation data if the **Kalman Filter** is switched **Off**.

The following controls are used to configure the velocity filter:

Scroll bar

You define the “length” of the filter with the scroll bar. This “length” is the number of epochs of data to be used in the median filter. The larger the value, the more stable the predictions will be and, hence, the more filtering that is applied to the velocity.

Purge box

If this box is checked, the median filter resets when you click **OK**.

Range Gate

Off box

When this box is unchecked (not turned off), WinFrog will test new position and range data against the current position. If the new position or range differs from the current value by more than the value entered here, WinFrog will not use the new data. (See the **Range/Range Devices** chapter for more information.)

Scroll box

This is used to set a range gate value from 5 to 100 meters. If range and position data do not pass this test they are excluded from the calculations process.

Data Source

radio buttons

These are used to select the source of position information. For more information on the various data sources, see the **Vehicle Data Source** chapter.

Calculations

Heading checkbox

Selecting the **Heading** checkbox instructs WinFrog to use the results of positioning data types associated with the vehicle to

	calculate a True heading for the vehicle. This is supported by USBL, LBL, POSITION and PSEUDORANGE data types. The calculated heading is then used as the primary heading source for this vehicle. It can be compared to other heading sources in the Calculation window.
Max Time Variance (s)	This control is enabled when the Heading option is activated. This is the maximum age, in seconds, of data that WinFrog will use to calculate a heading based on data type position information.
Streamer box	Reserved for future development. Leave this option “unselected.”
Devices	
Window list	This lists all devices that are associated with this vehicle.

The following buttons are associated with the **Devices** input box:

Add	allows you to add peripheral devices to the vehicle’s calculations. When Add is selected, the Select Data Items window appears listing all devices that have been added to WinFrog. Highlight the devices that you wish to associate with this vehicle, then select OK .
Edit	allows you to set the configuration parameters specific to a device highlighted in the Devices box. It is critical that every device that is added to a vehicle is properly configured for that vehicle. (For more information on configuration parameters for a specific device, refer to Appendix C: I/O Devices .)
Delete	removes the selected device from a vehicle’s calculations.

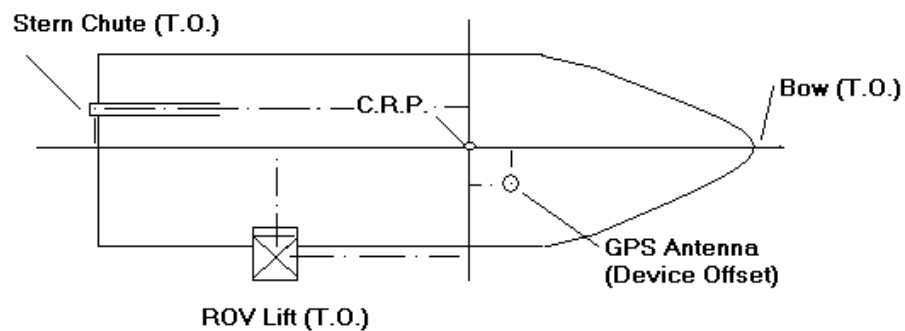
Note: for more information on configuring a vehicle’s devices, refer to the section describing real-time navigation in the **Vehicle Data Source** chapter.

Configure Tracking Offsets

WinFrog allows you to define and store up to fifteen **Tracking Offset** points per vehicle. With this information pre-configured and readily available, you can quickly change the point on the vessel to which WinFrog refers for its position display as well as its survey line and waypoint tracking calculations. Only one point on the vehicle can be selected for these calculations at any time.

The **Tracking Offset** points are defined by name and are entered as coordinates relative to the vessel's origin. You can configure WinFrog to display the **Tracking Offset** names in the **Graphics** and **Vehicle Text** window. In addition, you can view the real-time coordinates of all **Tracking Offsets**, as well as a trail from all **Tracking Offset** points.

Note: these **Tracking Offsets** are used to define the position of a specific point on the vehicle relative to the vehicle origin. These should not be confused with antenna offsets that are used to offset the position obtained at the navigation sensor to the vehicle origin. The drawing below shows the difference between a **Tracking Offset (T.O.)** and a **Device Offset**.



To Configure Tracking Offsets

- 1 With the **Configure Vehicles** dialog box still open, click the **Configure Offsets** button.

On	Plot Label	Name	Fore/Aft	Port/Stbd	Elev	Trail
☐	☐	bow	30.00m	0.00m	0.00m	☐
☒	☒	Stbd Chute	-100.00m	6.00m	0.00m	☐
☐	☐	Port Chute	-100.00m	-6.00m	0.00m	☐
☐	☐	Moon Pool	-50.00m	0.00m	0.00m	☐
☐	☐	ROV lift	-75.00m	12.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐
☐	☐		0.00m	0.00m	0.00m	☐

☐ Off
 ☒ Use Heading
 ☐ Use CMG

OK Cancel Help

- 2 Enter a descriptive name for the **Offset** in the **Name** field.
- 3 If you wish to see the **Offset** name in the **Graphics** window, check the **Plot** box next to the offset being defined. (This also enables the display of this tracking offset in the **Offset** display window).
- 4 Use the **Fore/Aft**, **Port/Stbd**, and **Elev** fields to describe the position of the **Offset** in relation to the vehicle's origin (distance from the **CRP**).
- 5 If you wish to see a series of dots follow the **Offset** point on the **Graphics** screen, check the **Trail** radio button top the right of the specific item.
- 6 To enable a **Tracking Offset**, select the **On** radio button beside the desired name. Ensure that the **Use Heading** or **Use CMG (Course Made Good)** radio button at the bottom of the screen is selected as desired. Typically, **Offset** points that refer to a physical location on the vessel must use the **Use Heading** option. If you wish to track the **CRP**, select the **Off** button at the bottom of the window.

Configure Fairleads/Anchors

WinFrog can calculate and display **Anchor** and **Fairlead** information in real-time. **Fairleads** refer to the location of anchors when they are onboard the "barge" vehicle. (In WinFrog, any vehicle that is configured as **Fairlead Possible** is referred to as a **Barge** in the **Anchor Handling** window).

Each vehicle can have different fairleads defined up to a limit of 16. Each fairlead have up to three **midbuoys** defined. **Midbuoys** are defined by the distance from their related anchor when the anchor is not on the barge.

Fairlead/anchor information can be displayed both numerically and graphically. The real-time display of numeric anchor handling data (including anchor placement target information) is found in the **Anchor Handling** display. The **anchors**, **fairleads**, and **targets** can also be seen in the **Graphics** display. (See the section on **WinFrog Displays** for more information.)

Note: the vehicle must be configured as **Fairlead Possible** before anchor handling operations are possible. This option is found under the **Configure > Vehicles > Vehicle Presentation** dialog window.

To Configure Fairleads and Anchors

- 1 Click the **Setup Fairleads/Anchors** button in the **Configure Vehicles** dialog box.

On	Name	Fore/Aft	Port/Stbd	Northing	Easting	Status
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD
☐		0.00m	0.00m	N0.00ft	E0.00ft	ON BOARD

Static Color
 Edit

Active Color
 Edit

OK Cancel Help

The following parameters are configurable from the **Fairleads** dialog box:

On checkbox	used to turn the display of a fairlead on and off
Name field	the name of the fairlead
Fore/Aft field	forward or aft offset of the fairlead’s onboard position with respect to the vehicle’s origin (CRP)

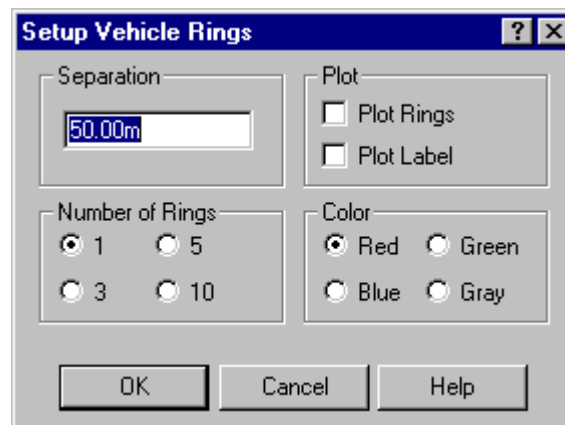
Port/Starboard field	Remember: forward values are positive and aft values are negative. the port or starboard offset value of the fairlead's onboard position with respect to the vehicle's CRP Remember: starboard values are positive and port values are negative.
Northing field	grid Northing of the anchor - if the anchor is on the bottom
Easting field	grid Easting of the anchor - if the anchor is on the bottom
Status field	indicates whether the anchor is currently On Board a vessel or On (the) Bottom .
Static Color field	the color of the anchor in the Graphics window when it is not being handled
Active Color field	the color of the anchor in the Graphics window when it is being handled.

Setup Vehicle Rings

You can configure WinFrog to display a series of circles (1, 3, 5 or 10 rings) centered on the point on the vehicle that is currently being tracked. These circles are used to give you a better sense of the scale of the **Graphics** display, or can be used as a moving guide when you wish to keep the vehicle a certain distance away from a point or line. These circles are called **Rings** in WinFrog.

To Setup Vehicle Rings

- 1 Click the **Setup Vehicle Rings** button in the **Configure Vehicles** dialog box.



The following parameters are configurable using the **Setup Vehicle Rings** dialog box:

Separation

Separation field defines the radius of the smallest circle - This is also the distance between successive circles.

Plot

Plot Rings checkbox Check this option to have WinFrog display the rings in the **Graphics** and **Bird's Eye** windows.

Plot Labels checkbox Check this option to have WinFrog display the numeric value of the radius of each circle in the **Graphics** and **Bird's Eye** windows.

Note: the **Plot Rings** checkbox must also be checked in order for labels to be displayed.

Number of Rings

radio buttons WinFrog can be configured to display 1, 3, 5, or 10 rings around the vehicle.

Color

Color radio buttons Select the color of the circles and labels to be red, green, blue, or gray.

Setup Waypoint Tracking

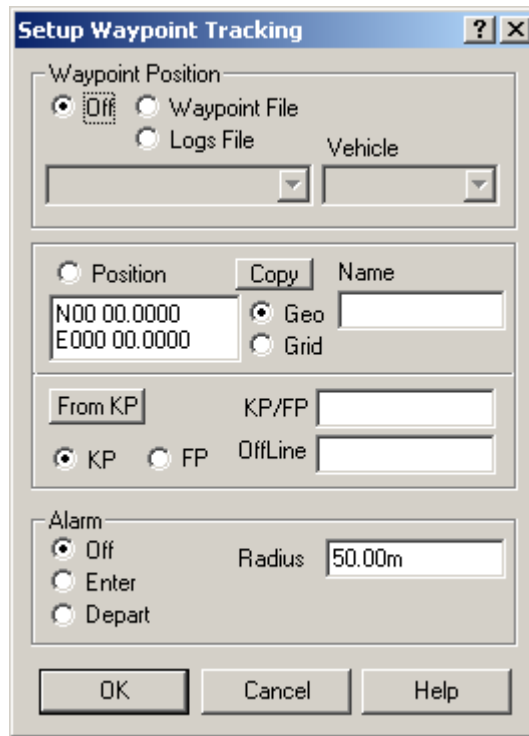
WinFrog can be configured to display the “**range**” and “**bearing**” from a vehicle to a **waypoint**. For every cycle of WinFrog, the range and bearing from the vehicle’s **Tracking Point** (i.e. any enabled **Tracking Offset**) to the waypoint is automatically re-calculated and displayed in the **Vehicle Text** window.

You can choose to track any entry in the **Working Waypoints** or **Working Logs** file, a temporary (unstored) point, or a point related to a certain distance downline and offtrack from a tracked **Survey Line**. (For details on creating **waypoints** in WinFrog, see the waypoints section of the **Working Files** chapter.)

In addition, WinFrog can be configured to trigger an audible alarm if the vehicle either enters or leaves a user-defined circle centered on the current waypoint. This is useful if you want to keep the vehicle within a certain distance of a stationary point or want to provide a warning if the vehicle gets too close to a certain point.

To Setup Waypoint Tracking

- 1 Click the **Setup Waypoint Tracking** button in the **Configure Vehicles** dialog box.



The **Setup Waypoint Tracking** dialog box allows you to select a fixed point for the vehicle to track.

- 2 Select one of the following types of points to track using the appropriate radio button:

Waypoint Position

Waypoint File

If this radio button is selected, the left dropdown menu is used to select the specific waypoint from the Working Waypoints file to be tracked.

Logs File

If this radio button is selected, the left dropdown menu is used to select the specific manual event (.log) from the current **Working Logs** file to be tracked. The right dropdown menu is used to select which specific vehicle's position (as recorded in the **.Log** event) to use.

dropdown menu

Selects the name of a point in the **Working Waypoints** or **Working Log** file to be tracked.

Vehicle menu

For use only when tracking a point from the **Working Log** file. Select the name of the vehicle whose logged position is to be tracked.

Position

input field

refers to the coordinates entered in the **Position** field

Position

If the **Position** radio button is selected, WinFrog tracks one of three different positions; the entered **coordinates**, a **KP/Offline** position or a **FP/Offline** position.

Note: these coordinates are “temporary” only and will not be stored in a WinFrog file.

Copy button

If you choose this, the coordinates of the cursor from the active **Graphics** window (via the clipboard memory) are inserted into the **Position** field.

Name field

name for the temporary waypoint

KP radio button

also known as **Kilometer Post** - Enter the **Kilometer Post** distance into the **KP/FP** field. Enter the offline distance into the **Offline** field. Click the **From KP** button. The coordinates displayed in the window below the **Position** button update to reflect the calculated coordinates.

FP radio button

also known as **Foot Post** - Enter the **Foot Post** distance into the **KP/FP** field. Enter the offline distance into the **Offline** field. Click the **From KP** button. The coordinates displayed in the window below the **Position** button update to reflect the calculated coordinates.

Alarm

To enable the alarm, select the **Enter** or **Depart** radio button and enter a circle radius into the **Radius** field.

To disable the alarm, return to this window and select the **Off** button. The alarm can also be silenced by clicking the **ACK** button in the **Calculations** window. The **ACK** button is displayed when the **Position** item is shown in the **Calculations** window. (For details, see the calculations section in the **Operator Display Windows** chapter.

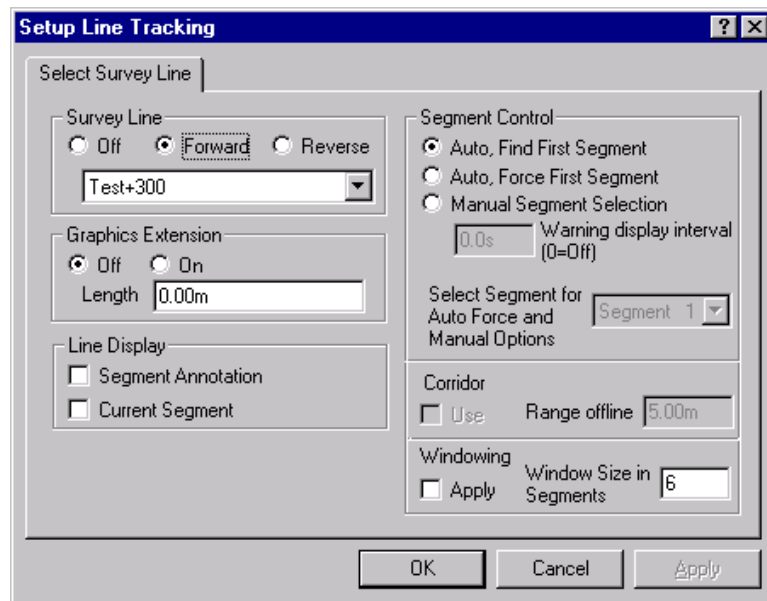
Setup Line Tracking

WinFrog allows you to configure a vehicle to track a **Survey Line** from the **Working Survey Line** file. When a vehicle is tracking a **Survey Line**, WinFrog calculates how far the vehicle is perpendicularly **off-line**, how far **downline** the vehicle is from the **Start of Line**, and how far the vehicle has to go to the **End of Line**. This information can be displayed in the **Vehicle Text**, **Helmsman**, and **Attitude** display windows.

Information on Line Tracking Calculation Options can be found in the Units (Calculations Tab) section in Chapter 3, Configuring Geodetics and Units.

To Configure a Vehicle to Track a Survey Line

- 1 Click the **Setup Line Tracking** button in the **Configure Vehicles** dialog box.



- 2 Using the dropdown menu, select the desired **Survey Line** from the **Working Survey Line File**.

(For details concerning adding **Survey Lines** to the **Working Survey Line** file, see the **Working Files** chapter.

- 3 Under the **Survey Line** area, select the radio button describing the direction of the survey line to be tracked.

In **Forward** mode, the **Start of Line** is the first coordinate entered when the survey line was created. In **Reverse** mode, the **Start of Line** is the last coordinate entered when the survey line was created.

- 4 Select the **On** radio button in the **Graphics Extension** area if you want WinFrog to draw a dashed line preceding the **Start of Line** point.

In the **Length** field, enter the value of the desired length of the **Graphics Extension** line. This option is useful to help the operator of the vehicle align the vessel with the line before passing the **Start of Line** point.

Segment Control

Note: only the operator has access to the relevant options depending upon the selections made directly from within the **Setup Line Tracking** dialog and the configuration of the line selected, as setup directly in the **Survey Line** dialog.

Auto, Find First Segment	When this mode is selected, WinFrog automatically determines which line segment is closest to the tracking vehicle and sets this as the current segment to track. The validity of the current tracked segment is constantly, automatically checked and updated appropriately as the vehicle moves with respect to the line.
Auto, Force First Segment	In this mode, the operator can force WinFrog to go to a specific line segment to start the line tracking. After selecting this mode, the operator must select the desired segment from the dropdown list included within this panel.
Manual Segment Selection	Selecting this mode puts WinFrog into a Manual Line Tracking mode. In this mode, WinFrog will constantly check to determine if it feels that a new line segment should be set for tracking, and alert the operator to this fact. However, the actual setting of the line segment to track is controlled manually by the operator.

- 5 If you wish to track a certain line segment, choose **Manual Segment Selection** and select the appropriate **Line Segment** from the dropdown window. Otherwise, select the **Auto Find First Segment** radio button in the **Segment Control** area.
- 6 The **Corridor** field is used to help WinFrog define which segment of a survey line to track. Check **Use** to enable this option, then enter a value for the **Range Offline**. This value instructs WinFrog to use only the line segment that falls within the specific offset distance from the vehicle. This is useful if you are tracking a survey line that doubles back on itself. When this function is enabled WinFrog displays the corridor in the **Graphics** display.

- 7 The **Windowing** feature is used to define the number of line segments that WinFrog will use to generate KP values. Check the **Apply** checkbox and enter a value in the **Window Size in Segments** field. This feature was developed to handle large survey lines with numerous segments. This option is typically left unselected.
- 8 The **Line Display** options affect the way that the tracked **Survey Line** displays in the **Graphics** window. Select **Segment Annotation** to enable the display of the all line segment numbers at the start of the appropriate segment. Select **Current Segment** to have WinFrog highlight (thicken) the particular segment of the line that is currently being tracked.
- 9 Click **OK** to close the **Survey Line** dialog box and have the vehicle begin tracking the selected **Survey Line**.

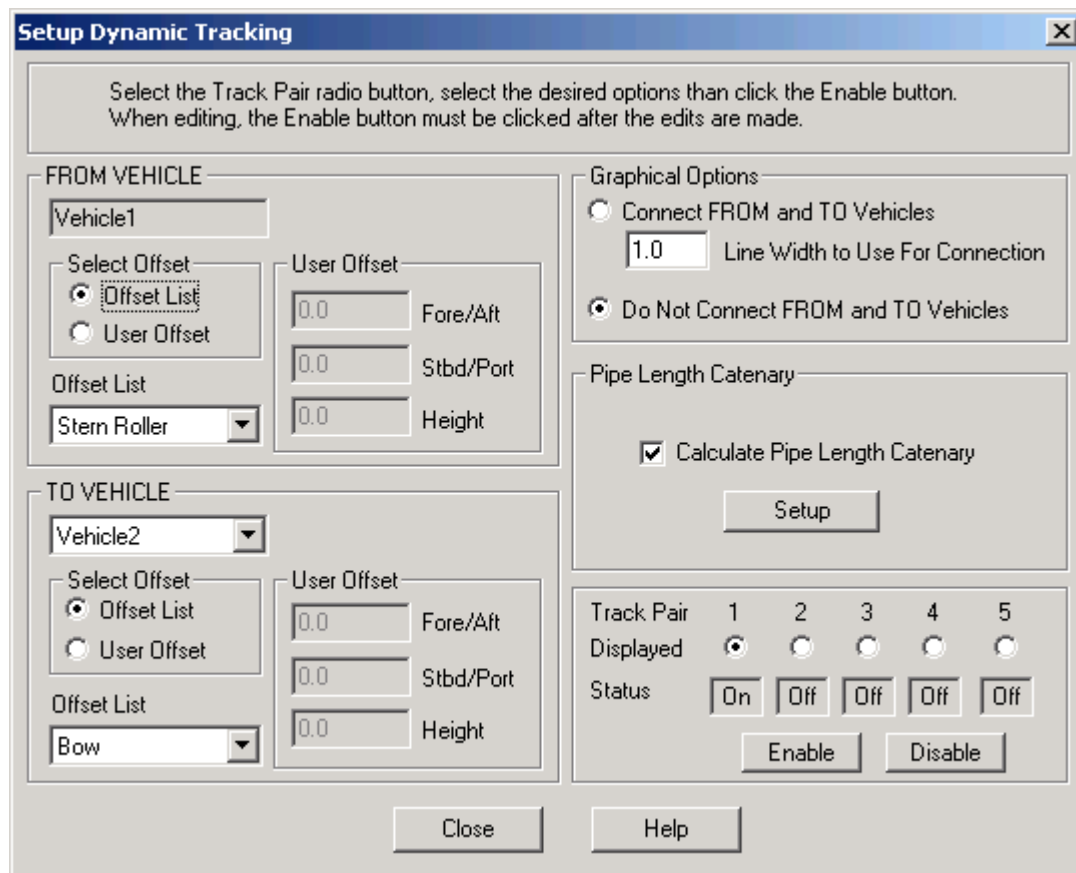
See the **Operator Display Windows** chapter for more information on configuring and viewing the **Vehicle Text**, **Attitude**, and **Helmsman** displays.

Setup Dynamic Tracking

WinFrog can calculate and display tracking information from any point on one vehicle to any point on another vehicle. You must first define the "**Tracked Pairs**", the points to be referenced on both vehicles. These points may be contained in the vehicle's **Offset** file or may just be temporary points. A maximum of 5 **Tracked Pairs** can be set up for each "From" vehicle. Repeat the setup for each vehicle from which you wish to display tracking calculations.

To Setup Dynamic Tracking Vehicles and Tracking Points

- 1 Open the **Configure Vehicles** dialog box (**Configure > Vehicles**). Highlight the desired vehicle **from** which tracking calculation will be made.
- 2 Click the **Setup Dynamic Tracking** button.



The **Dynamic Target Tracking Setup** dialog box is divided into five areas:

From Vehicle

The top area of the dialog box pertains to the vehicle **from** which the range and bearing are measured.

To Vehicle

The middle area of the dialog box pertains to the vehicle **to** which the range and bearing are measured.

Graphical Options

This area allows you to select whether or not to have WinFrog draw a line in the Graphics window connecting each Track Pair that has been enabled and displayed. The line width can be specified here.

Track Pairs

The bottom area allows you to enable or disable up to five possible target pairs, **Track Pairs**, from a specified point on the vehicle indicated in the **FROM VEHICLE** field to a specified point on the vehicle indicated in the **TO VEHICLE** field.

Pipe Length Catenary

Enables the calculation of a pipe catenary using the distance between the selected points on the selected vehicles and the depth. The setup button allows you some options on depth determination.

The catenary length and angle are calculated using the equations below:

$$L = \frac{C * \sinh^{-1}(\tan(\alpha))}{\tan(\alpha)}$$
$$C = \frac{W * \tan(\alpha)}{\cosh(\sinh^{-1}(\tan(\alpha))) - 1}$$

Where:

L = Layback; Horizontal distance between the ship offset point and ROV offset point

C = catenary length; Length of pipe from the ship offset point to the touch down point.

W = Water depth

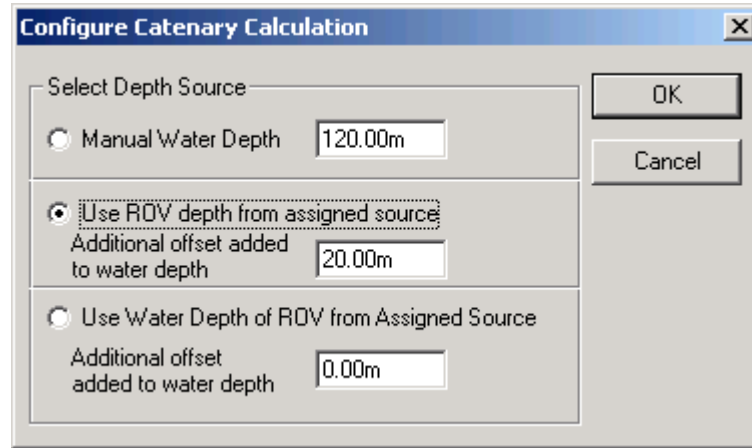
$\alpha = 90 - \theta$; θ (theta) is the angle between the vertical (down) and the tangent to the pipe at the departure point from the ship

- 3 Select one of the five **Track Pair Displayed** radio buttons. (To setup a new pair ensure that the status for this **Track Pair** is currently set to **Off**).
- 4 In the **FROM VEHICLE** group box select the point on the “From Vehicle” to measure from.

You can select a point on the **From** vehicle from the existing list of vehicle offset points (previously configured in the **Offsets** dialog box) by using the dropdown **Offset Vehicle List** (making sure the **Offset List** radio button is selected in the **Select Offset** area) or enter some other offset values in the three **User Offsets** fields (making sure the **User Offsets** radio button is selected in the **Select Offset** area). To select the vessel’s common reference point (**0,0 or CRP**), select the **User Offsets** radio button and enter zeros in the three **User Offsets** fields.

- 5 In the **TO VEHICLE** area in the lower left of the **Setup Dynamic Tracking** dialog box, select the vehicle to measure to. Then select a point on this vehicle to measure to, similarly to above.
- 6 If it is desired to draw a line on the Graphics window between the two vehicles’ reference points, click the **Connect FROM and TO Vehicles** radio button in the Graphic Options group box. You may also vary the line width.

- 7 To calculate the pipe angle and pipe catenary length for display in the Dynamic Tracking window, click the checkbox in the Pipe Length Catenary group box. (See above for details.) The setup button opens the following dialog:



The dialog box is titled "Configure Catenary Calculation" and has a close button (X) in the top right corner. It contains three radio button options under the heading "Select Depth Source". The first option is "Manual Water Depth" with a text box containing "120.00m". The second option is "Use ROV depth from assigned source" (which is selected) with a text box for "Additional offset added to water depth" containing "20.00m". The third option is "Use Water Depth of ROV from Assigned Source" with a text box for "Additional offset added to water depth" containing "0.00m". On the right side of the dialog are "OK" and "Cancel" buttons.

The touch down depth is required to make the catenary calculation. The first choice uses a manually entered value. The second choice uses the ROV's depth as the touch down depth for the catenary calculation. The edit box allows for an offset, such as altitude, to be applied to the ROV's depth for use as the touch down depth. The ROV's depth can be from any source such as a USBL depth or pressure sensor on the ROV; whatever is the current prime source of depth for the ROV will be used if this option is selected. For the third choice there must be a BOTTOMDEPTH data assigned to the vehicle. This data item determines water depth and for an ROV is most likely from an ROV device that provides ROV depth and altitude which, when combined with their offsets, will produce water depth. However, this water depth does not account for any offset between the water level and the departure point on the ship, thus an additional offset may be entered. This additional offset is added to the water depth.

- 8 Click the **Enable** button. Ensure that the **Status** changes to **On**. If any parameters are subsequently changed, you must click the Enable button before they take effect.

Enable turns on the display of the data in the **Dynamic Tracking** window. The target is only enabled or disabled by clicking the **Enable** or **Disable** button with the desired **Track Pair** selected.

- 9 To configure more **Track Pairs**, repeat steps 3 through 8.

- 10 When finished configuring **Track Pairs**, click **Close**.

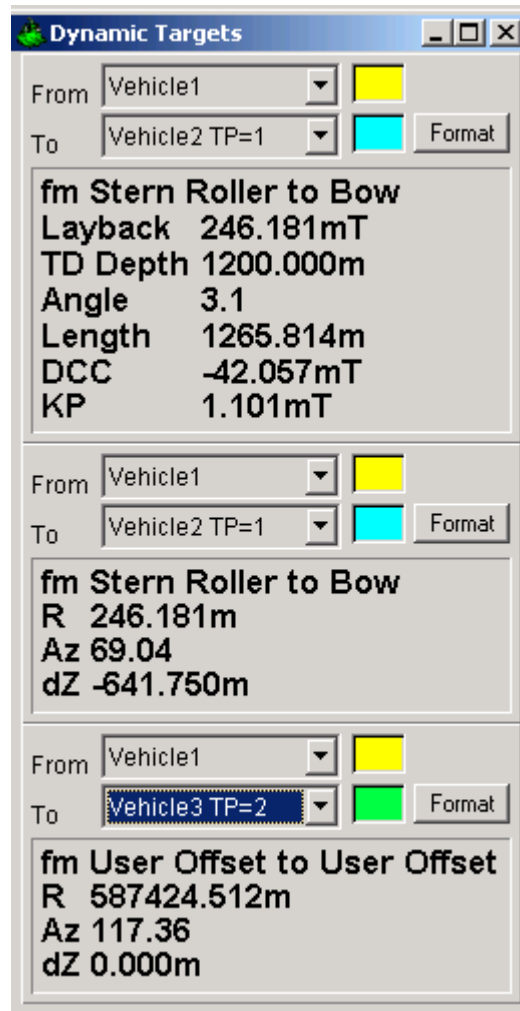
Note: When smart remotes are in use, each smart remote must be updated from the Smart Remote control window whenever these parameters are changed.

Display of Dynamic Tracking Information

Dynamic tracking information is displayed in its own window.

To View the Dynamic Tracking Information

- 1 Click the **Close** button in the **Configure Vehicles** dialog box.
- 2 Choose **View > Dynamic Tracking**.



The **Dynamic Tracking** window is divided into three identical areas, each allowing for the display of one **Track Pair**.

From dropdown	displays the list of vehicles configured with tracking pairs from which the range and bearing are measured
To dropdown	displays the list of tracking pairs configured with the vehicle selected in the From dropdown menu as the source from which the range and bearing are measured

Data area	displays the target data being tracked between the two points.
Format button	changes the type of target data displayed to one of five choices: • Range, Azimuth and delta Z • Delta X, delta Y, and delta Z • Delta north, delta east and delta Z • Range, relative azimuth and delta Z • Pipe catenary data Note: Delta X and delta Y are relative to the vehicle from which the data are calculated based on the heading of the vehicle. Note: The relative azimuth is calculated relative to the heading of the 'From' vehicle (i.e. heading of 'From' vehicle is a relative azimuth of zero, counting up clockwise). Note: Pipe Catenary Data. The layback is equal to the range above, the TD Depth is the touch down depth, which may be either the water depth, ROV depth or manually entered value. The calculated angle is measured from the vertical (down) to the pipe. Length is the calculated length of pipe between the reference points of both vehicles. The DCC is the amount the "To vehicle" is off line (+ right). The KP is the distance down line. If the distance is grid there will be a G after it, otherwise there will be a T. Both the TD Depth and catenary length are always true distances. If the water depth from the ROV is used for the catenary calculations and the ROV altitude is 0 from the device, the TD Depth line will turn red with the added text ALT=0.

- 3 Select the vehicle, in the **From** drop down, from which the range and bearing are to be measured.

This action fills the **To** drop down menu with the track pairs enabled for this particular vehicle. Each track pair is numbered.

- 4 Select the track pair to be displayed from the **To** list.

- 5 Click the **Format** button until the desired type of data is displayed.

Acoustic Calibration

This option provides you the ability to calibrate both LBL and USBL acoustic positioning systems. (See the **LBL Acoustics**, **USBL Acoustics**, and **USBL&LBL Calibration** chapters for more information describing the calibration of LBL or USBL devices.)

Setup Data Events

This option allows you to enable automatic event generation and data recording based on user-defined time or distance intervals, as well as the collection of raw device data. (See the **Eventing** chapter for information about configuring **Data Events**.)

Deleting a Vehicle

Unless a vehicle has been designated as the **Primary Eventing** vehicle, you can delete it from WinFrog at any time. (See the **Vehicle Presentation** section (above) for details about designating a vehicle as a **Primary** or **Secondary Eventing** vehicle.)

To Delete a Vehicle

- 1 Choose **Configure > Vehicles**.
- 2 Highlight the vehicle you wish to delete from the **Vehicle List**.
- 3 Click the **Delete Vehicle** button.
- 4 Confirm that you want to delete this vehicle.

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Chapter 7: Peripheral (I/O) Devices

WinFrog can be configured to receive data from and output data to peripheral input/output (I/O) devices connected to the computer's serial ports. The maximum number of devices is limited only by the performance capabilities or limitations of the operating system to a maximum of 64 serial devices. For example, WinFrog can be used with 16 I/O devices if the computer is configured with a 16-port **DigiBoard™** serial device. In addition, WinFrog is not limited in the number of instances of a specific device type that can be added, as long as each device has a unique name.

WinFrog allows for on-line editing of an added device's input/output communication parameters to suit the device's internally configured interface parameters. For example, changing a device's **Baud Rate**, **Data Bits**, **Parity**, **Stop Bits**, and **Comm Port** parameters can be accomplished by viewing a single screen in WinFrog, making changes very quick and easy. This makes initial device interfacing a simple process.

In addition to the communication parameters, some devices have numerous internal configuration options specific to the type of device added. WinFrog allows for the changing of the device configuration to accommodate these options. An example of a configuration parameter would be the type of NMEA format messages that a device can be configured to output.

A timeout may also be enabled for each serial device or network device that sends data to WinFrog. When data is not received from that device for longer than the interval, a dialog is displayed indicating the COM port or network device that stopped sending data. A different timeout interval may be set for each device.

This chapter examines how to add, modify, configure, and delete peripheral devices in WinFrog. Adding a device to WinFrog inherently adds the display, computation and recording routines required to effectively utilize the data.

Throughout this chapter the terms "peripheral device" and "I/O device" are used synonymously.

Adding a Device

Adding a peripheral device to WinFrog is a multi-step process.

The first step is to physically connect the device to the computer through a serial port. This is not a trivial task. Care must be taken to ensure that the device's internal configuration is correct, that the device is in fact operating correctly, and

that the wiring and connections between the device and the WinFrog computer will transfer the data correctly. This manual does not address these matters. You may have to consult the device's manual to ensure that these concerns have been addressed correctly.

The second step is to instruct WinFrog where to find the device (i.e. which serial port the device is connected to), what type of device it is, and how to communicate with it.

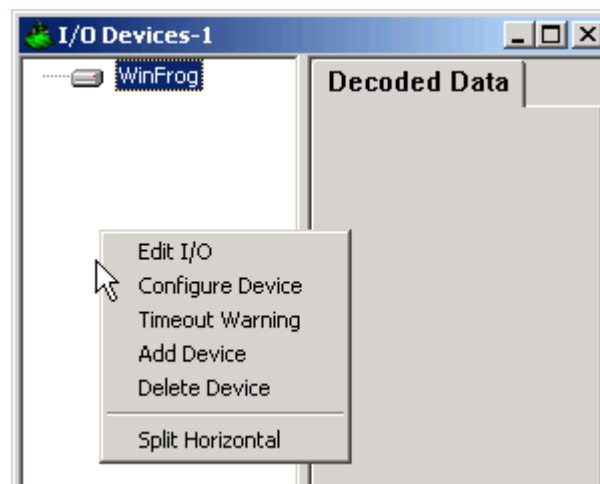
The third step is to associate the device's data with a specific vehicle. This topic is briefly introduced here and covered in greater detail in the **Vehicle Data Source** chapter.

To Add a Device to WinFrog

There are two ways to add devices to WinFrog. Both methods use the same **Add Device** dialog box. The only difference is how you access the dialog box.

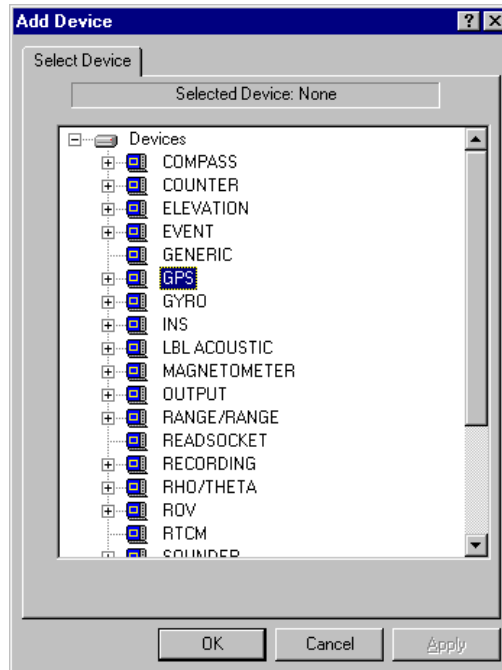
Recommended Method:

1A Select **View > I/O Devices** to display the **I/O Devices** window, as seen below.



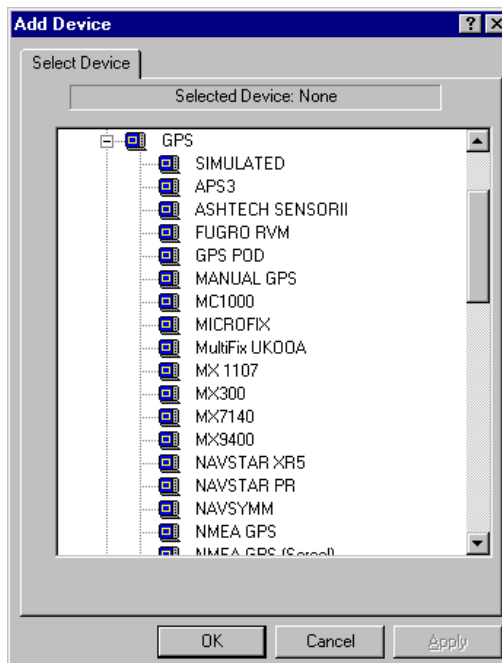
Next, place the mouse pointer within the white section (left side) of the **I/O Devices** window, click the right mouse button, and select **Add Device**.

1B Select **Configure > I/O Devices...Add**, at which point the same **Add Device** dialog box, shown below, displays.



The **Add Device** dialog box contains a list of **Device Groups**. Each device group contains one or more types of that particular device, including all common **NMEA** compliant data devices. For example, the **GPS** group contains device drivers for many commonly used GPS makes and models.

- 2 To view the various options of a particular device group, either click the “+” symbol beside the **Group** name, or double-click the **Device** group name. For example, double-clicking on the name **GPS** displays the various GPS options, as shown in the dialog box below.



- 3 Select the desired device from the list of drivers and click **OK**.

A dialog box opens that allows you to configure the communication parameters for that device. Depending on the type of device selected, one of three different dialog boxes opens.

- A If you select a **Simulated Real-time** device, a dialog box that allows for the configuration of the simulated device **name** only displays.
- B If you select a **Real-Time** device (i.e. a device connected through a serial port), the **Device I/O Parameters** dialog box displays.

The **Device I/O Parameters** dialog box is the most common as it is displayed after (almost) any real-time device is selected.

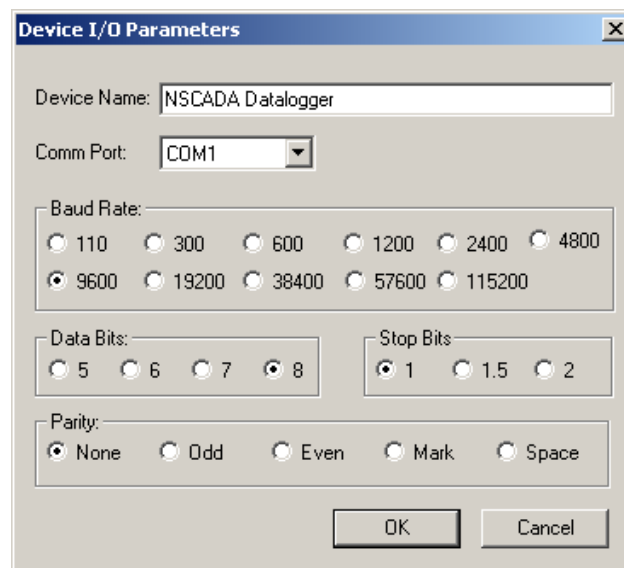
- C If you add a **NovAtel™ GPS** device to WinFrog, a **Novatel PC Card** dialog box displays, specifically for a **NovAtel CON** device connected through an ISA port.

Note: since Fugro Pelagos, Inc.'s systems are commonly configured with NovAtel™ GPSCards, this is described in specific detail in the **NovAtel PC Card** section later in this chapter.

- 4 When the desired communication parameters have been set, click **OK**.

Device I/O Parameters Dialog Box

For all devices connected to WinFrog through a **serial** port, the **Device I/O Parameters** dialog box is opened immediately after a device is selected.



You must configure the following serial port communication parameters in the **Device I/O Parameters** dialog box:

Baud Rate	data transmission speed
Data Bits	number of data bits sent
Stop Bits	number of bits separating two consecutive words
Parity	error checking algorithm
Name	should be a unique name to distinguish the device from other devices
Comm Port	use the dropdown box to select the operating system's communication port to which the device is connected. Note: this is typically not the DigiBoard™ port number unless specifically configured.

The **Baud Rate**, **Data Bits**, **Stop Bits** and **Parity** must be configured to be the same as those configured within the peripheral device. If these communication parameters are not set correctly, WinFrog will not be able to receive information from or send information to the device.

Most modern peripheral devices use the following configuration settings:

Baud Rate: 9600 **Data Bits:** 8 **Parity:** None **Stop Bits:** 1

Consult the device's manual for more information on communication settings for the device.

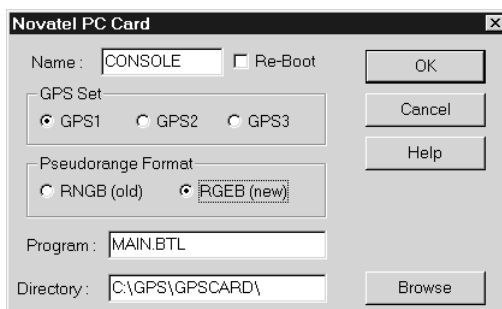
WinFrog attempts to initiate communications with the selected **Comm Port**. If the **Comm Port** is not found, an error message (such as the one shown below) displays and the device will not be added to WinFrog.



If WinFrog is successful at establishing communication with the comm port, the device will be added to WinFrog's **I/O Devices** display list. This does not necessarily mean that the data will be correctly received, as this is still subject to correctly setting the I/O parameters, as mentioned above. This only means that the **Comm Port** has been found. Observe the **Decoded Data** portion of the **I/O Devices** window to ensure that data are being received from the device and are updating at the appropriate interval.

NovAtel PC Card

If a **NovAtel CON** device (connected through an **ISA** port) is selected from WinFrog's **I/O Devices** list, the **NovAtel PC Card** dialog box opens, as seen below.



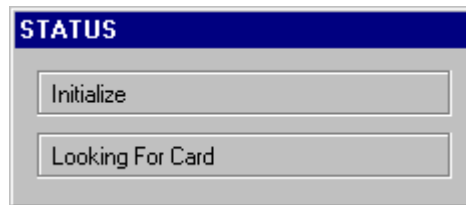
You must configure the following parameters:

Name	should be a unique name to distinguish the device from other devices
Re-Boot	This checkbox allows you to re-start the GPS card using the .BTL file
GPS Set	A computer can be configured to have as many as 3 NovAtel™ GPS cards. If there is more than 1 GPS card installed, each must have a unique identification: NovAtel™ cards can be configured to respond to GPS Sets 1, 2, and 3 (NGPS1, NGPS2, NGPS3). (Consult the NovAtel™ manual for more information on GPS sets.)
Pseudorange Format	Refers to the recording of raw measurements and tracking error information. The RNGB format is now obsolete. Unless a very old GPS Card (manufactured prior to March 1995) is used, select the default RGEB (new) option.
Program	The name of the specific .BTL file required by the installed NovAtel™ card. In all Fugro Pelagos, Inc. systems the .BTL file has been re-named to match the serial number of the NovAtel™ card.
Directory	Refers to the directory containing the .BTL file for that particular NovAtel™ card. Following a typical NovAtel™ installation, the .BTL file will be found in the C:\GPS\GPSCARD directory. If the .BTL file has been placed elsewhere, use the Browse button to navigate to that location.

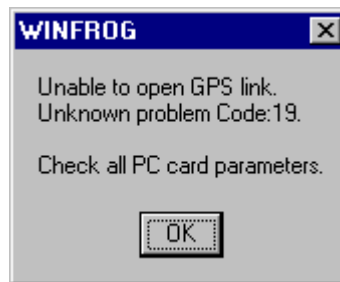
Note: The **.BTL** file is required by the **NovAtel Console GPS Card** in order to initialize the GPS card. Consult the NovAtel™ manual for more information on **.BTL** files.

Once the desired communication parameters have been set, click **OK**.

WinFrog attempts to initiate communications with the NovAtel™ device. A status window opens, as seen below.



If this attempt fails, an error message is displayed, as seen below.



This message means that WinFrog is unable to communicate with the GPS card. This may be the fault of incorrect settings in the NovAtel™ configuration or an incorrectly installed GPS Card.

Select **OK** to continue. **Note:** a **CONSOLE** device is added to WinFrog's **I/O Device** listing, but no information is actually received from the NovAtel™ receiver. Rather than add another NovAtel™ device to WinFrog, you can highlight this **CONSOLE** device, then right click and select **Edit I/O** to bring up the same configuration dialog box mentioned above. Repeat the above mentioned configuration steps, ensuring that the all entries and selections are correct.

If the connection is successful, the NovAtel™ GPS information (i.e. the **SV**'s, **Channel**, **S/N** etc.) will be visible in the **Decoded Data** portion of the **I/O Devices** dialog box.

Editing Device Input/Output Parameters

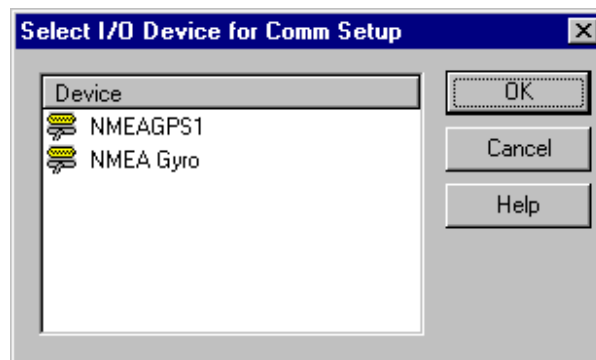
If WinFrog is not communicating correctly with a specific device or if any error message appears after configuring the parameters described above, then the input/output parameters referring to that device must be edited. The following section details editing the I/O parameters as found in WinFrog. If these

instructions do not solve the communication problems, you must examine the internal configuration of the device too.

To Edit WinFrog's Input/Output Parameters for a Device

There are two ways to edit the **I/O** parameters of devices interfaced to WinFrog. Both methods utilize the same **Edit I/O** dialog box. The only difference is how this box is accessed.

- 1A** The preferred method is to select **View > I/O Devices** to view the **I/O Devices** window. Select the desired device, then right-click and select **Edit I/O**. The **Device I/O Parameters** dialog box opens, as seen above when the device was originally added.
- 1B** Another method is to select **Configure > I/O Devices...Edit I/O**, at which point the **Select I/O Device for Comm Setup** dialog box appears, as seen below. Select the desired device and click **OK**. The **Device I/O Parameters** dialog box displays.



See the **Adding a Device** section earlier in this chapter for information concerning configuring the communication input/output parameters.

- 2** Make the changes to the input/output parameters.
- 3** When finished, click **OK** to close this dialog and activate the changes.

Configuring Generic Device Parameters

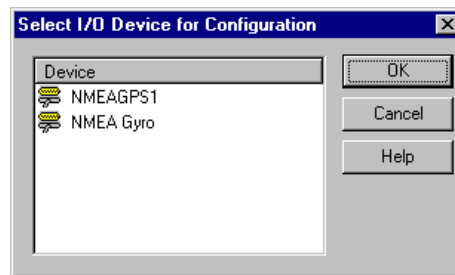
Some devices have configuration parameters that are specific to that type of device, regardless of the type of vehicle to which they are attached. These are “generic” device parameters that must be configured before the device is added to a vehicle. **Note:** most devices also require specific configuration once they have been added to a vehicle. See the **Vehicle Data Source** chapter for more information on vehicle-specific device configuration.

To Configure Generic Device Parameters

There are two ways to configure generic device parameters for all devices interfaced to WinFrog. Both methods will result in the same configuration dialog box for that device. The only difference is how this box is accessed.

Note: not all devices require this “generic” configuration. If there are no generic configuration options for a device, the following directions should not be used.

- 1A** Select **View > I/O Devices** to view the **I/O Devices** window. Select the desired device, right-click and select **Configure Device**. The configuration dialog box for that specific device opens, if there is one for that device.
- 1B** Select the main menu item **Configure > I/O Devices...>Configuration** to open the **Select I/O Device for Configuration** dialog box, as seen below.



- 2** Select the desired device and click **OK**. WinFrog opens a dialog box that allows for the configuration of parameters specific to that device.

Enabling the Timeout Warning

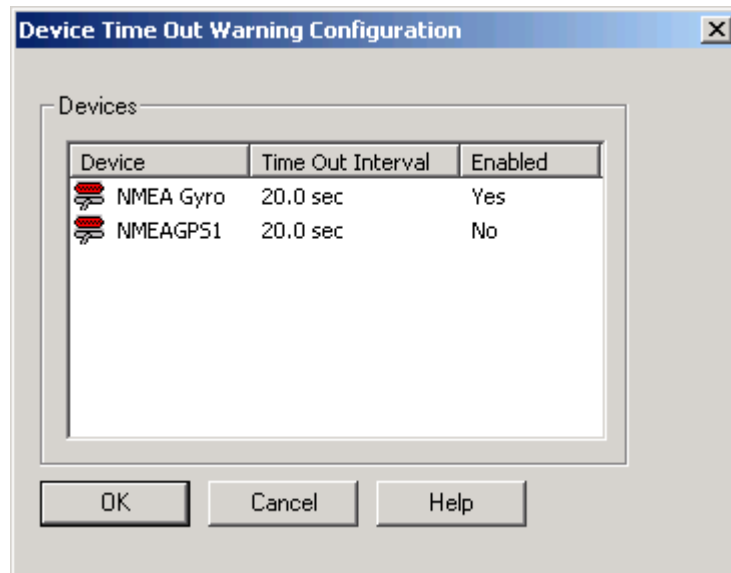
To Enable or Disable the Timeout Warning for a Device

There are two ways to configure the timeout warning for each device interfaced to WinFrog. Both methods will result in the same configuration dialog box for that device. The only difference is how this box is accessed.

Note: Not all devices support a timeout warning. Only those devices that send data to WinFrog are supported. If a device uses multiple COM ports that send data to WinFrog, each may be enabled separately. This feature does not test for eligible telegrams for the particular device to determine if the interval has elapsed or not; any character received counts as a positive indicator of communications.

- 1A** Add all the devices as described above. Select **View > I/O Devices** to view the **I/O Devices** window then right-click and select **Timeout Warning**. The timeout configuration box will open as below.

- 1B Select the main menu item **Configure > I/O Devices...> Timeout Warning** to open the **timeout configuration** dialog box, as seen below.



- 2 To toggle between enabled and disabled, click the appropriate No/Yes text beneath the Enabled column.
- 3 To change the timeout interval, click the appropriate current time to open a small edit box and enter a new time in seconds. It is not necessary to enter the word sec. The minimum timeout interval is 10 seconds.
- 4 Click OK to accept the changes or Cancel to close the dialog and ignore any editing.

Note: If a large number of devices have a short timeout interval and they all timeout at, or nearly at, the same instance, you may encounter difficulties trying to close all the message boxes. The message boxes need to be closed before other dialogs can be opened. Thus the time out intervals should be staggered and not unduly short.

Deleting a Device

To Delete a Device

There are two ways to delete devices interfaced to WinFrog.

- 1A Select **View > I/O Devices** to view the **I/O Devices** window. Select the desired device, right-click and select **Delete Device**. You must select **Yes** to confirm that you want to remove the device from WinFrog entirely.

- 1B The other method is to select the main menu item **Configure > I/O Devices... Delete**, at which point the **Select I/O Device for Deletion** dialog box appears displaying all devices currently added to WinFrog.
- 2 Select the desired device and click **OK**. Select **Yes** to confirm that you want this device to be removed from WinFrog.

Time Synchronization

WinFrog is able to synchronize to external time sources, typically a GPS receiver, including the 1PPS pulse. The time synchronization is done at the vehicle level using the TIMEDATE data item.

The following devices support time synchronization:

GPS Devices

MX 7140	\$--ZDA telegram
MX 9400	1PPS with \$--ZDA telegram
NMEA GPS*	\$--ZDA telegram and/or 1PPS with \$--ZDA telegram
NMEA GPS (Sercel)*	\$--ZDA telegram and/or 1PPS with \$--ZDA telegram
NR103 Prop(rietary)	\$--ZDA telegram
MultiFix UKOOA	Proprietary UKOOA telegram
TRIMBLE RCI	1PPS with Proprietary telegram
TRIMBLE TSIP	Proprietary telegram
NovAtel CON (Console)	\$--ZDA telegram

TIME BASE Devices

TRIMBLE 1PPS	1PPS and Proprietary telegram

Note that the TIME BASE device ODP TIME supports time synchronization, but not with the TIMEDATE data item.

* These devices also support the synchronization of WinFrog to the NMEA \$--GGA and \$--GLL telegrams. However, these are not recommended as there is an inherent latency in the UTC time included in the telegram and the time the telegram is sent out. This is typically approximately 0.7 seconds for a \$--GGA telegram.

Interfacing

If using the 1PPS...

WinFrog looks for the 1PPS pulse on the CTS line of the serial port, therefore if the 1PPS signal is to be used, this must be connected to the CTS line at the WinFrog serial port.

Some GPS receivers produce a pulse that is too short and cannot be detected by a computer serial port. The signal must be stretched and/or increased in magnitude. The Trimble 4000 is an example of this. In this case, a pulse stretcher is required. The stretched pulse needs to be connected to the CTS line of the same COM port that the GPS receiver is sending its time and navigation data to.

On many receivers, the 1PPS can be used as is, for example the Sercel NR203.

Besides the 1PPS signal, WinFrog requires a telegram defining the time of the pulse just received. Typically the NMEA \$--ZDA telegram is used unless a device specific telegram is used, for example in the case of the Trimble 1PPS device (Trimble 4000).

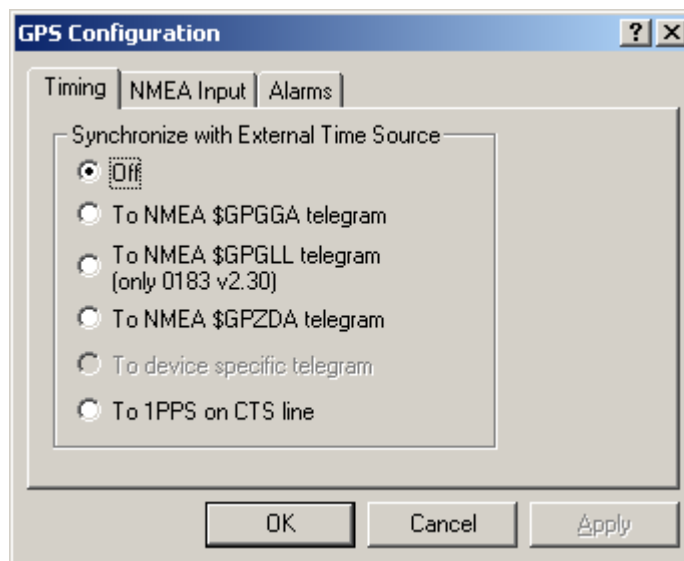
The 1PPS and associated time telegram must be input on the same port.

If using a NMEA telegram...

In the case of using a NMEA telegram such as the \$--ZDA alone to synchronize WinFrog, the reception of the starting character ('\$') of the telegram is detected and time stamped. This time stamp is used as the *pulse* detection time associated with the telegram's UTC time.

Configuration

The device must be configured to indicate which method is to be used for time synchronization. Highlight the device in the IO Device Window, right-click and select **Configure Device**. The **GPS Configuration** dialog opens.



Select the synchronization option on the Timing tab. Note that this configuration tells WinFrog what option is to be associated with the TIMEDATE data item once it has been associated with a vehicle; it does not initiate the actual synchronization.

See the specific device documentation for each device (Appendix C, PDF files on the WinFrog CD) for information on adding and configuring the TIMEDATE data item at the vehicle level.

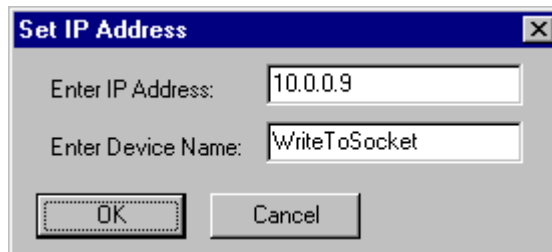
Adding I/O Socket Devices

Adding an I/O socket device to WinFrog is similar to adding a “peripheral device” connected to the computer’s serial ports. In this instance, the device is connected to the network that the WinFrog computer is on and will communicate using TCP / IP protocols. Use the same setup as described previously to select the socket I/O devices “WriteToSocket” and “ReadSocket”.

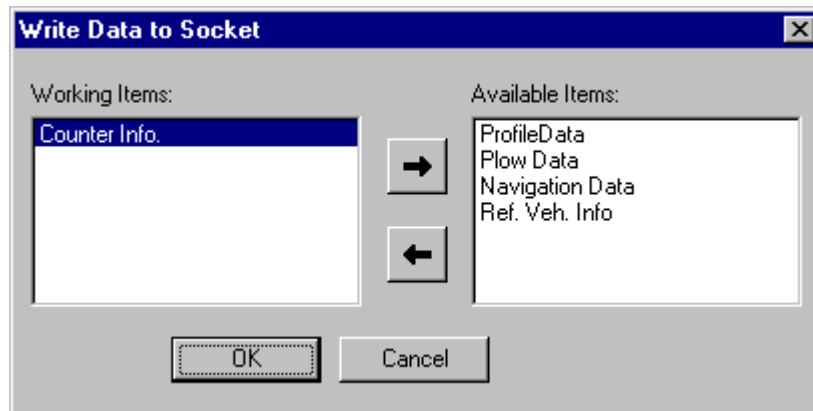
Configuring Socket Devices

To Configure the I/O device “WriteToSocket”

- 1 Set the IP number of the computer to write the data to using **Edit I/O**.



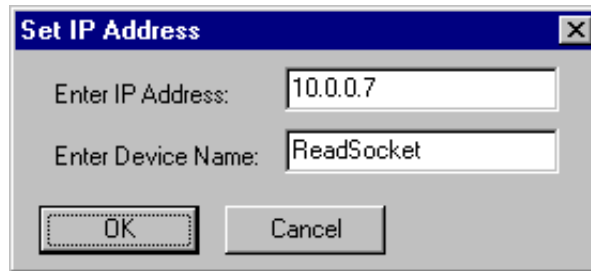
- 2 Select the data to actually be sent to the other computer using **Configure Device**.



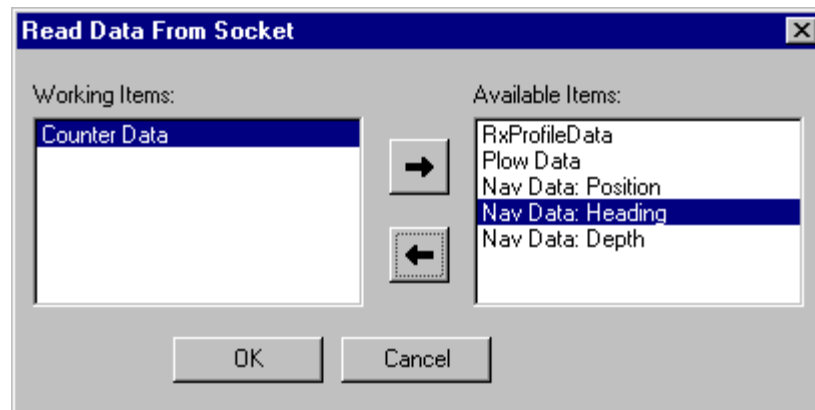
- 3 See the chapter **Vehicle Data Source** subsection **Adding a Peripheral Device to a WinFrog Vehicle** to attach this socket device to the vehicle.
- 4 See the chapter **Vehicle Data Source** subsection **To Configure the Primary System for Network Data Output Using Sockets** to setup this socket device to transmit data.

To Configure the I/O device “ReadSocket”

- 1 Set the IP number of the computer to write the data to using **Edit I/O**.



- 2 Select the data to actually be read from the other computer using **Configure Device**.



- 3 See the chapter **Vehicle Data Source** subsection **Adding a Peripheral Device to a WinFrog Vehicle** to attach this socket device to the vehicle.

Chapter 8: Operator Display Windows

This chapter examines the configuration and use of the display windows available in WinFrog.

- I/O Devices
- Graphics
- Profile
- Vehicle Text
- Acoustics
- Anchor Handling
- Alarms
- Attitude
- Auditor
- Bird's Eye
- Calculations
- Controlled Remote
- Distance Counter
- Dynamic Tracking
- Helmsman
- Level Bubble
- Numerics
- Smart Remote Control
- Tracking Offsets
- Cable Model Large Window
- Cable Model Small Window

Any of these windows can be displayed in the WinFrog work area by simply choosing them from the **View** menu.

Note: some options, such as the **Graphics**, **I/O Devices**, **Calculations**, and **Vehicle Text** windows allow for multiple displays of the same type. Each additional window opened is labeled with a number to differentiate it from the original.

The main menu item **Window** lists all of the currently enabled windows with a checkmark next to the “**active**” window. When you click anywhere within the bounds of a window to make it active, it displays in front of all other windows. You can also choose the window's name from the list under **Window** in order to make it active. Any of the windows that are user-configurable must be made active before they can be modified.

Note: because of its importance, the **Vehicle Text** window can be configured to always be on top of other displays. See the **Vehicle Text** window section below for more details.

On non-initial launches of WinFrog, the windows previously used are displayed in the same layout because window configurations are saved in the **Winfrog_3.ini** file each time you exit WinFrog.

Maximizing Available Monitor Space

Since a large number of windows can be displayed simultaneously, all available monitor display space is quickly used. Even with the most basic WinFrog configurations, the monitor becomes filled, requiring you to limit your selections. Preferred selections typically include the **I/O Devices**, **Vehicle Text**, and **Graphics** windows. A split-screen graphics card and second monitor should be added if you intend to display any of the other available views on a regular basis.

To Maximize Available Monitor Space

WinFrog has four functions to help maximize the use of the available screen space:

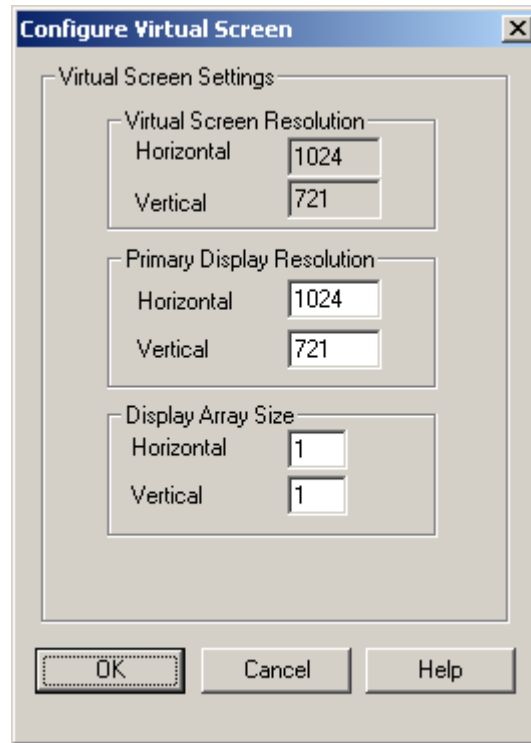
- 1 As mentioned above, the main menu item **Window** lists all of the currently enabled windows, with a checkmark located beside the **active** window. Making a window **active** will display it in front of any other window. Using this feature, you can overlap windows and quickly bring the required window to view as desired.
- 2 The main menu item **Configure > Virtual Screen** provides you the ability to configure additional “virtual screens.” Each can be individually configured for content and layout. (More on this feature in the section named **Virtual Screen Configuration** below.)
- 3 Also under the **Window** option is the **Cascade** feature. This function re-organizes all of the windows so that they are only partially overlapping. This allows for easy selection of all windows.
- 4 In the top right corner of each window are the three standard Windows™ functions: **Minimize**, **Maximize**, and **Close**. Select the **Minimize** button to shrink the window to display only the **Title bar**. You will be able to see this in the lower left corner of the WinFrog display. (**Note:** a minimized window may be hidden under the **Vehicle Text** window).

Virtual Screen Configuration

As mentioned above, WinFrog’s numerous displays are quickly able to cover all available monitor display space. To assist in efficient use of limited space, WinFrog allows you to configure up to 24 “virtual screens” and then choose which display will be viewed. The following sections detail the configuration and selection of virtual screens.

To Configure Virtual Screens

WinFrog's Virtual Screens are configured by selecting the main menu item **Configure > Virtual Screen**. The **Configure Virtual Screen** dialog box displays, as seen below.



Virtual Screen Resolution

Horizontal/Vertical

Displays the monitor's current horizontal and vertical resolution settings. This value is read from the computer's display settings and cannot be altered here.

Primary Display Resolution

Horizontal/Vertical

Enter the horizontal and vertical resolution settings desired for each virtual display. Typically, you would enter the same values as displayed above (Horizontal: 2048, Vertical: 721) in the **Virtual Screen Resolution** entry windows.

Display Array Size

Horizontal

Enter the number of virtual screen "columns" to be created. The new virtual screens are created to the **right of Display**

Vertical

Number 1 (see the next figure). For example, the drawing below depicts an entry of 4 in this window.

Enter the number of virtual screen “rows” to be created. The new virtual screens are created below the row containing **Display Number 1**. For example, the drawing below depicts an entry of 2 in this window.

Virtual Display Numbering

1	2	3	4
5	6	7	8

A shortcut button, with the number “1” on it, resides on the WinFrog toolbar for the default virtual screen. When you configure additional screens and exit this dialog, shortcut buttons are placed on the toolbar with numbers representing each virtual screen. Click a shortcut button to make that virtual screen the active window. Once the desired display number is selected, you can add or move the various WinFrog display windows to this virtual screen as desired.

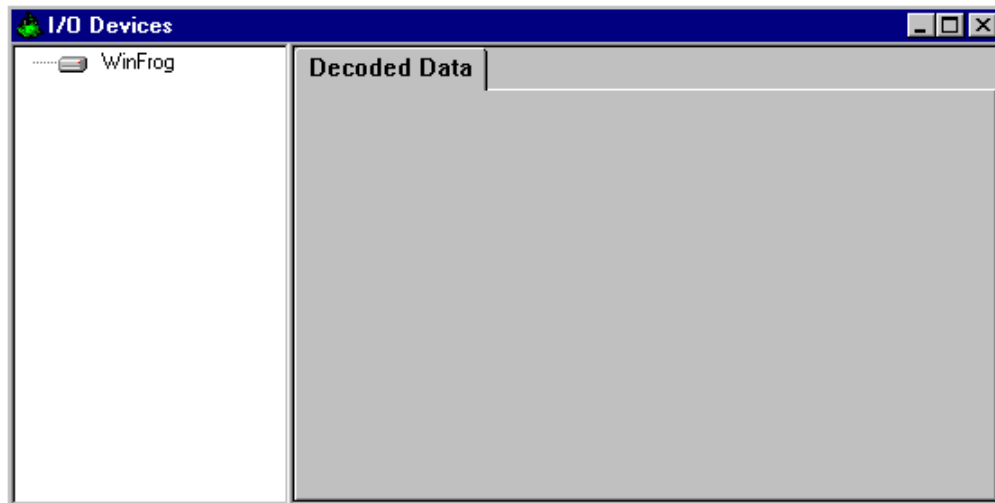
I/O Devices Window

WinFrog's **I/O Devices** window displays real-time data for all peripheral devices configured in WinFrog. This window allows you to view incoming and outgoing data, edit device interface protocols, and edit operating parameters for each device. For detailed information concerning configuring peripheral devices in WinFrog, refer to the **Peripheral (I/O) Devices** chapter.

Multiple **I/O Device** windows can be displayed at the same time, enabling you to view data from different devices at the same time. The size of each window can be altered by “grabbing” an edge or corner and dragging it “in” or “out,” as desired.

To Display the I/O Devices Window

- 1 From the **View** menu, choose **Devices**.



The **I/O Devices** window is divided into 2 sections: The left side of the window lists all devices that have been added to WinFrog, while the right side of the window displays **Decoded Data**.

To view the **Decoded Data** for a specific device, simply click on that particular device name in the left side of the **I/O Devices** window. The **Decoded Data** portion of the **I/O Devices** window updates approximately once every half second, displaying data for the chosen device.

The **I/O Devices** window also provides functions that allow you to edit, configure, add, and delete devices.

With the mouse pointer in the **left** side of the **I/O Devices** window, click the right mouse button to access the following options:

Edit I/O	Select this option to configure the input/output (I/O) parameters for the currently selected device.
Config	Select this option to configure “generic” parameters for the currently selected device, if available.
Add Device	Select this option to open the Add Devices dialog box.
Delete Device	Select this option to delete the currently selected device.

With the mouse pointer in the **right** side of the **I/O Devices** window, click the right mouse button to access the **Change Font** feature. Select **Change Font** to open a standard Windows™ **Font** configuration dialog box. Select the desired options then press **OK** to return to the **I/O Devices** window. Note: only the **Decoded Data** portion of the **I/O Devices** window uses the selected **Font** options.

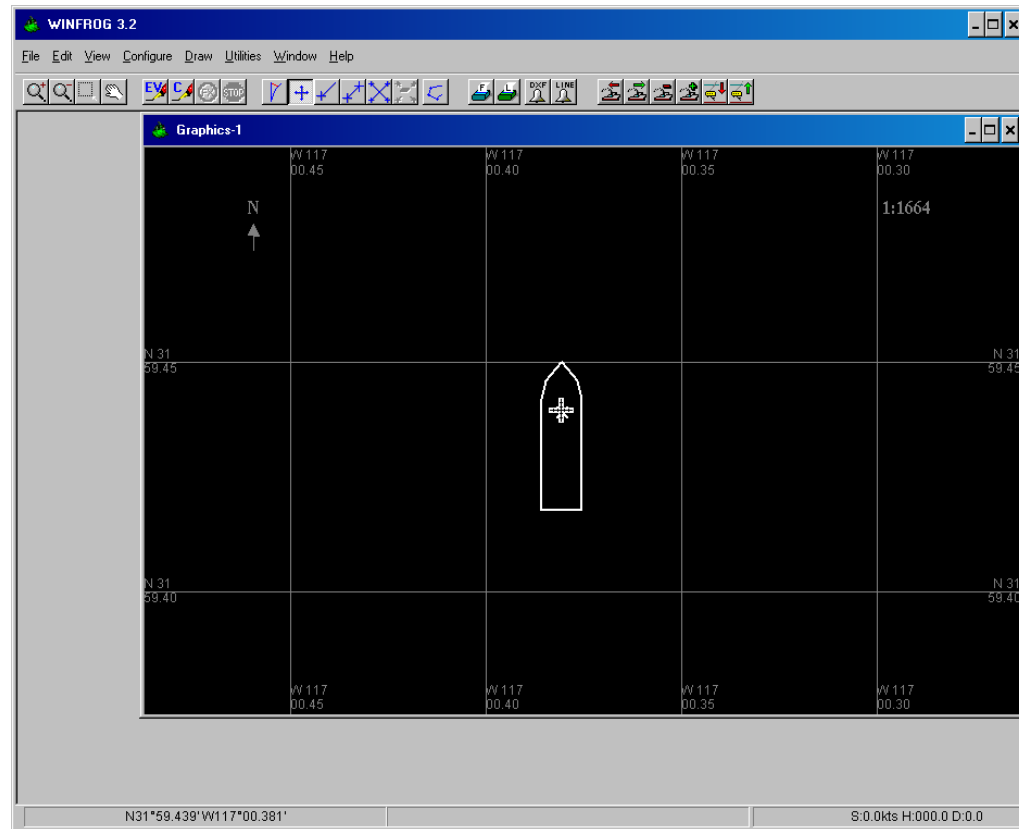
Graphics Window

The **Graphics** window is the main navigational display generated by WinFrog. The **Graphics** window can be configured to display all vehicles, survey lines, waypoints, picture file data, manual events, cable events, data logged using automatic events, xponder locations, and charts. In addition, the **Graphics** window can display latitude and longitude grid lines, Northing and Easting grid lines, a grid with an origin at the center of the **Graphics** window, a North arrow, scale, and chart information.

A feature that is useful for multi-vehicle applications is the ability to display more than one **Graphics** window. Each **Graphics** window can be independently configured to display different information.

To Display a Graphics Window

- 1 From the **View** menu, choose **Graphics**. WinFrog's default configuration will open the **Graphics** window in the top right corner of the WinFrog workspace.

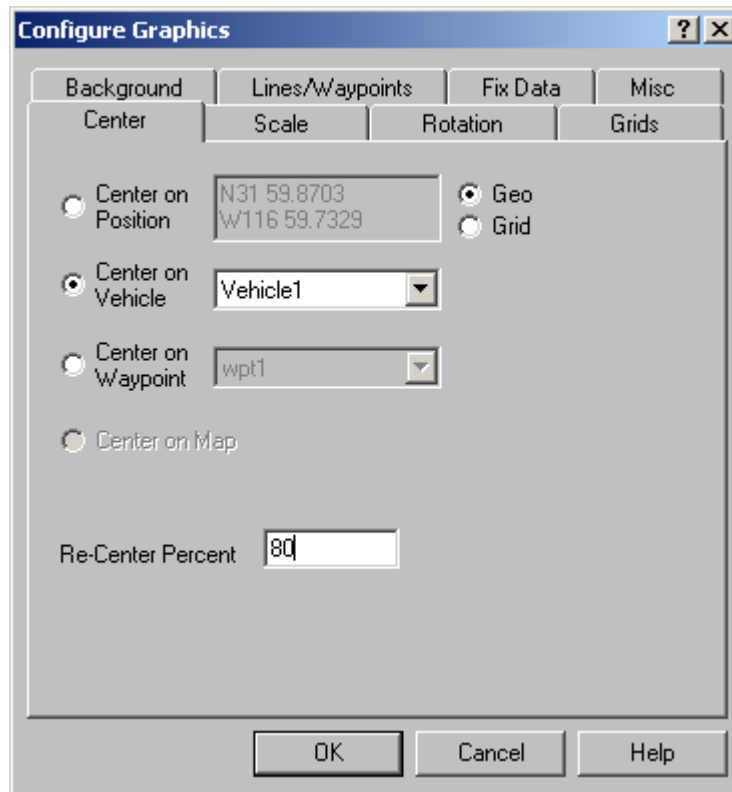


To Configure the Graphics Window

- 1 If more than one **Graphics** window is currently displayed, you must specify which one will be "active." To do so, either click the title bar of the one to be configured or select the main menu bar item **Window** and select the appropriate **Graphics** window.
 - 2a From the **Configure** menu, choose **Graphics**.Or
 - 2b Move the mouse pointer into the **Graphics** window, click the right mouse button, and select **Configure Graphics**.

The following parameters are configured using the **Configure Graphics** dialog box:

Center Tab



Center on Position/Geo/ Grid radio buttons

Select this option to center the **Graphics** window at the coordinates displayed in the box, regardless of the current vehicle position. The coordinates can be either entered in geographic latitude and longitude (if the **Geo** radio button is selected) or in grid Northing and Easting (if the **Grid** radio button is selected).

You can also manually position the center of the **Graphics** window by using the **Mouse Pan** function. To use this function you must first have the **Display Position** button enabled in the button toolbar. Now, select the **Mouse Pan** button from the button toolbar. Enabling this function changes the appearance of the mouse pointer to a “hand” icon when it is located within the limits of the **Graphics** Window. To designate a specific point as the center, simply move the “hand” to the desired location then, while holding the left mouse button down, move the “hand” to the desired location. This will re-center the **Graphics** screen to the specified point. Note that if you have a background map displayed and the **Move with Pan** checkbox in the Background tab unchecked, its position will not be updated until you have released the mouse button. This is to improve the refresh rate of the Graphics window when large files have been loaded.

Center on Vehicle radio button

Select this option to have WinFrog automatically re-center the **Graphics** screen in reference to the vehicle's current point of reference. If you decide to use the **Mouse Pan** function while in this mode, the software will automatically change to Center on Position on the point where you release the mouse button. **Note:** the **Graphics** screen may be constantly refreshing itself if the vehicle is moving and the depicted scale is quite small. This may make viewing of the **Graphics** display difficult.

Center on Waypoint radio button

Select this option to have WinFrog automatically re-center the **Graphics** screen in reference to the selected waypoint position. If you decide to use the **Mouse Pan** function while in this mode, the software will automatically change to Center on Position on the point where you release the mouse button.

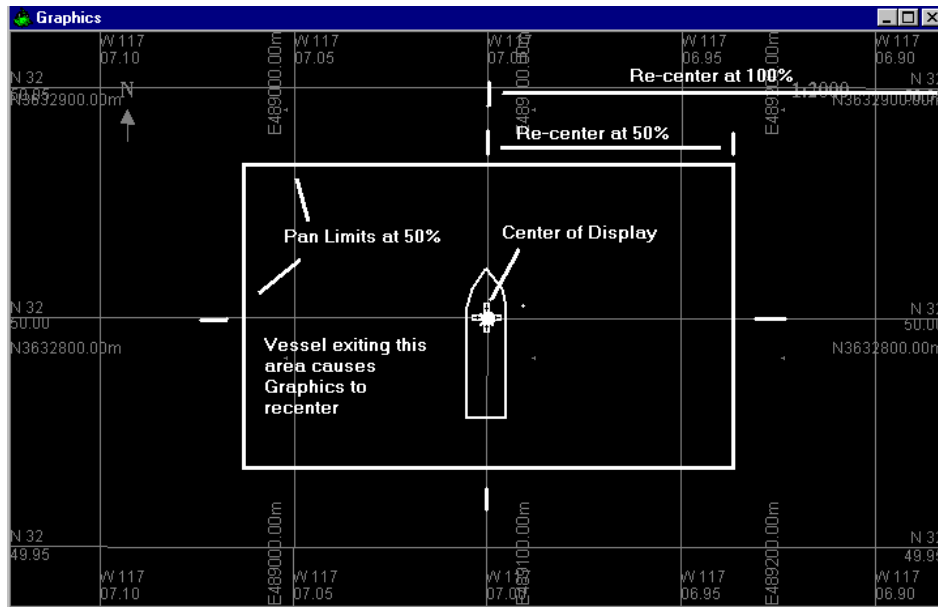
Center on Map

Select this option to center on the background map loaded from the Background tab.

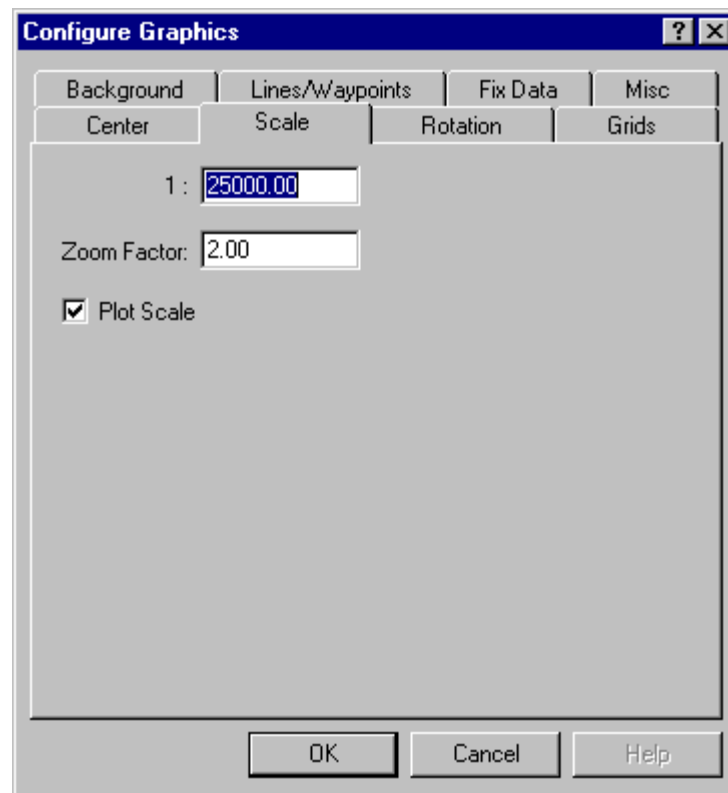
Re-Center Percent field

This field allows you to enter a value as a percentage. This is the percentage of the distance between the center and the display edge in which the current vehicle is permitted to travel before the **Graphics** window is refreshed. When the current vehicle reaches the re-center percentage limits of the **Graphics** window edge (in any direction), the **Graphics** window pans to return the current vehicle to the center of the **Graphics** window. **Note:** use this ability sparingly as too small of a percentage will cause WinFrog to refresh the screen too often, dramatically slowing system performance.

The next figure shows the permitted screen area available to the current vehicle in which to travel before a pan is performed to move the vehicle back to the center of the window.



Scale Tab



1: field

The value entered here configures the scale at which data are displayed in the **Graphics** window. One unit on the **Graphics** screen equals **X** (user-entered) units in the real world.

Zoom Factor field

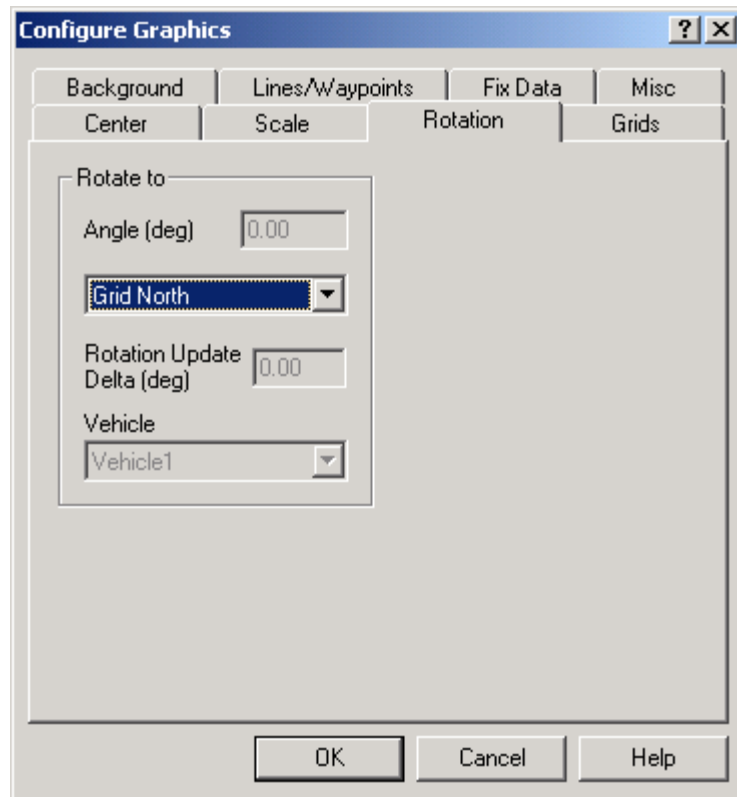
The value entered here configures the factor by which the scale of the display is increased when the display is zoomed out or decreased when zoomed in.

You can rapidly change the scale of the **Graphics** screen by selecting the **Zoom In** or **Zoom Out** buttons from the button menu bar.

Plot Scale checkbox

enable this to display the current **Scale** on the **Graphics** screen.

Rotation Tab



Rotate To Angle field

This option allows you to manually specify the Graphics display Rotation Angle. You must first select Manual from the dropdown box options, then highlight and enter the desired rotation Angle, as measured clockwise from North.

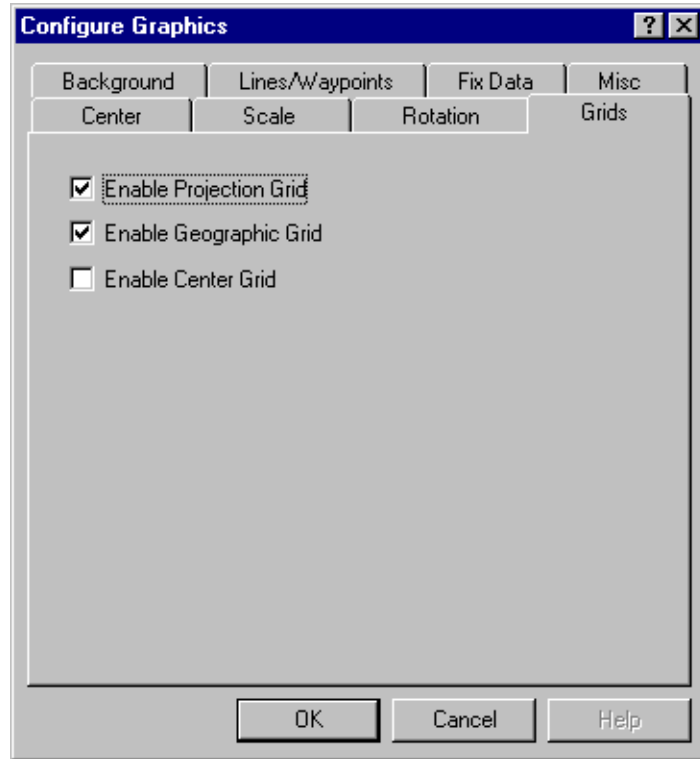
dropdown

Select from the dropdown options to have WinFrog align the **Graphics** window in accordance with one of the following provided options:

Grid North	the grid displays with zero rotation applied i.e. the North arrow will be straight “up” in the display.
Survey Line	the Graphics display is aligned with the Currently Tracked Segment of the selected Survey Line The orientation of the Graphics window will change as required so that the survey line is aligned from the bottom of the window to the top of the window. When the survey line is tracked in the forward direction, the Start of Line is at the bottom of the window. When the survey line is tracked in the reverse direction, the End of Line is at the bottom of the window.
Reverse Survey Line	rotates the Graphics display 180 degrees from the current survey line segment direction, as detailed above.
Manual	rotates the Graphics display to an angle of your preference. The value entered refers to degrees as measured clockwise from North.
Centered Vehicle Hdg	rotates the Graphics display to keep the bow of the centered vehicle pointed up. The rotation will automatically update when the heading of the vehicle the Graphics window is centered on changes by an amount equal to or greater than the amount specified in the ‘Rotation Update Delta’ field. The rotation will only update if the graphics window is centered on a vehicle. When this option is selected the ‘center grid’ display will no longer rotate with the background display.
Rotation Update Delta field	This field is enabled when the Centered Vehicle Hdg rotation option is selected. This option allows you to set the amount the heading of the centered vehicle must change before the graphics rotation angle is updated.
Vehicle dropdown	If you have chosen Survey Line or Reverse Survey Line in the Rotate To dropdown, you may select the survey line associated with a specific vehicle.

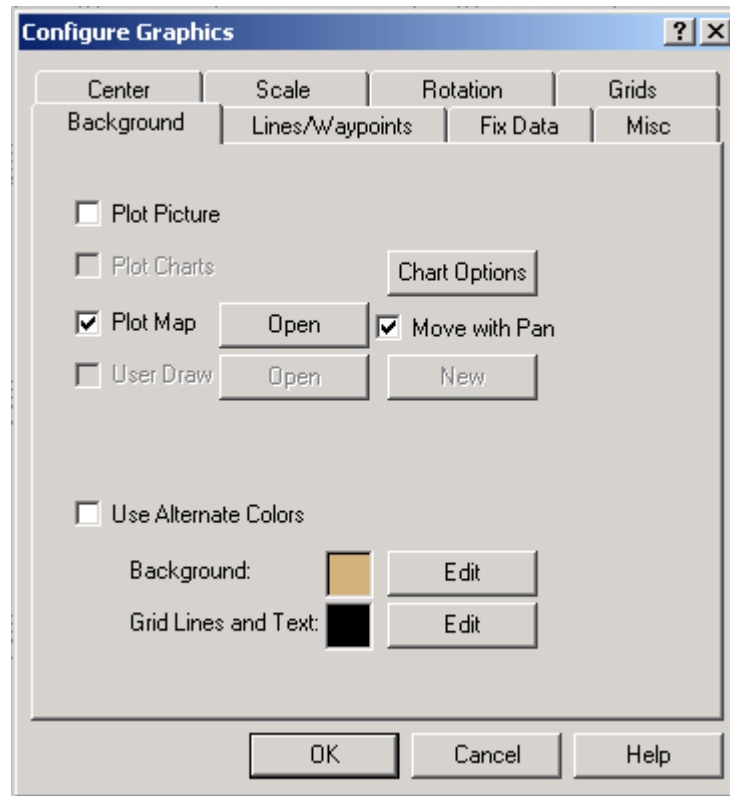
Note: Rotation options are not available when displaying a raster chart with the Blue Marble GeoView Library.

Grids Tab



Enable Projection Grid	Select this option to enable the plotting of Northing and Easting grid values at regular intervals in the Graphics window. The grid values are also drawn as ticks and crosses to show the location of grid intersections.
Enable Geographic Grid	Select this option to enable the plotting of geographic (latitude and longitude) coordinates labels and lines in the Graphics display.
Enable Center Grid	Select this option to enable the plotting of a “cross” centered in the middle of the Graphics display. The cross is also annotated at regular intervals showing the distances from the center to the North, South, East, and West limits.

Background Tab



Plot Picture

Select this option to enable the display of the contents of the **Working Picture File**. (See the **Working Picture File** section in the **Working Files** chapter for more details.)

Plot Charts

Select this option to enable the display of a raster chart. See the **Charts** section later in this chapter for more detail on chart configuration.

Chart Options button

Explained in the **Charts** section later in this chapter.

Plot Map

Select this option to enable the display of Blue Marble map (BMM) files. See the **Blue Marble Map File Support** section later in this chapter for more information.

Move with Pan

Select this option to move the background of a Blue Marble map (BMM) with the Pan action. See the **Blue Marble Map File Support** section later in this chapter for more information.

User Draw

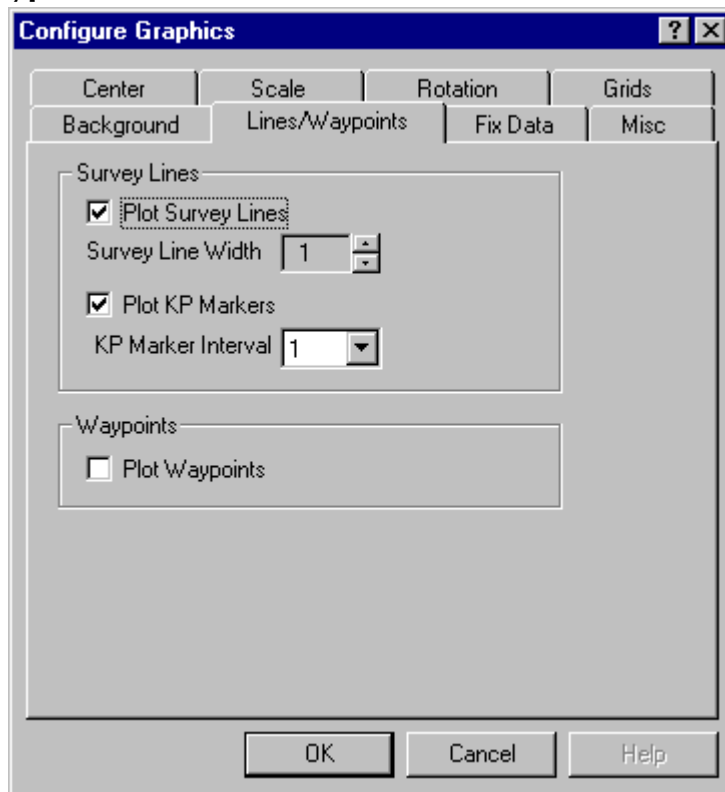
Select this option to enable the display of a Blue Marble Layer (BML) file on which to

draw graphic objects. The options available are to open an existing BML file or create a new BML file. See the **User Drawing Support** section later in this chapter for more information.

Use Alternate Colors

Select this option to configure WinFrog to use different colors for the **Background** and **Gridlines and Text** in the **Graphics** window. Use the **Edit** buttons to change the colors as desired. Note that if a background map is displayed using the Blue Marble library, no adjustment is made to avoid masking of features by the chosen background color, if the feature and the background are the same color.

Lines/Waypoints Tab



Plot Survey Lines

Select this option to display the contents of the **Working (.PTS) Survey Line** file. **Note:** if a vehicle is **tracking** a survey line, the line color will temporarily change from its original color (as defined in the **Working Survey Line File**) to the color of the vehicle.

Survey Line Width

Use the drop down menu to change the width of the survey line as seen in the Graphics and Bird's Eye displays.

Plot KP Markers

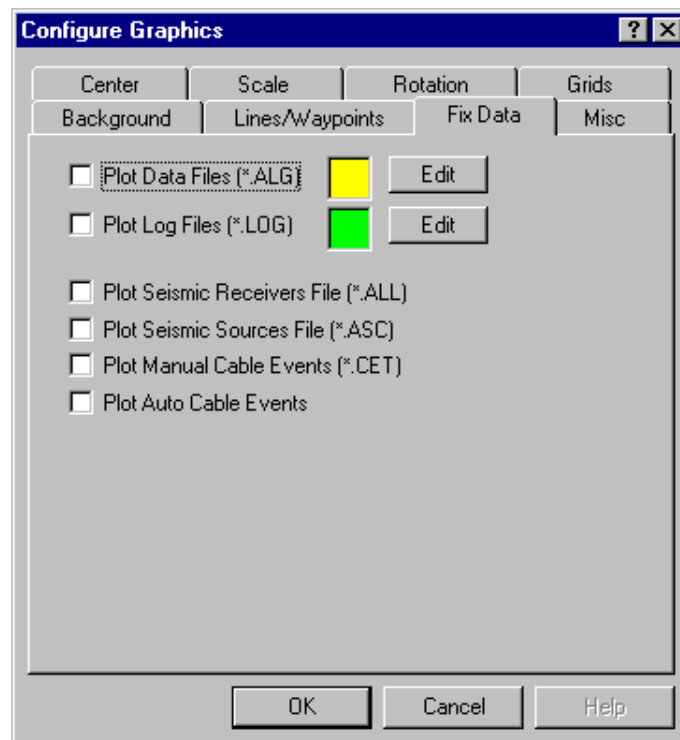
Select this option to enable display of KP Markers (as calculated on the currently tracked survey line) in the Graphics and Bird's Eye displays. Use the drop down menu to change between 0.5 km or 1 km intervals.

Plot Waypoints

Select this option to display the contents of the **Working (.WPT) Waypoint** file. Each individual waypoint can be displayed with a different color and icon, as defined in the **Edit Working Files... Waypoints > Waypoint** dialog box. See the **Working Waypoints** section of the **Working Files** chapter.

This customization helps you easily identify different types of waypoints, i.e. navigation hazards, cable events, and alter courses (A/Cs) can each be depicted differently. Similar to survey lines, a waypoint will change to the vehicle color after it is selected for tracking.

Fix Data Tab



Plot Data Files (*.ALG)

Select this option to enable the plotting of all individual automatic (.DAT) events contained in the **Working (.ALG) Data** file. Each event is shown as a fix-number-labeled X of user-defined color. A label is plotted only if the scale is greater than 1:7000.

Note: you can remove .DAT files from the **Working .ALG** file to limit the amount of data displayed on the **Graphics** screen. Likewise, you can add .DAT files back to the **Working Data .ALG** file to increase the amount of data shown.

Plot Log Files (*.LOG)

Select this option to enable the plotting of all **Manual Events** in the **Working Logs (.LOG) File** as name labeled squares of user-defined color. A label is plotted only if the scale is greater than 1:7000.

Plot Seismic_Receivers File (*.ALL)

Select this option to enable the plotting of all individual automatic **Receiver(.RCV)** events contained in the **Working Seismic_Receivers (.ALL)** file as green, fix-labeled Xs. A label is plotted only if the scale is less than 1:7000.

Note: you can remove **Receiver (.RCV)** files from the **Working Seismic_Receiver (.ALL)** file to limit the amount of data displayed on the **Graphics** screen. Likewise, you can add **Receiver (.RCV)** files back to the **Working Seismic_Receiver (.ALL)** file to increase the amount of data shown.

Plot Seismic_Source File (*.ASC)

Check this option to enable the plotting of all individual automatic **Seismic (.SRC)** events contained in the **Working Seismic_Source (.ASC)** file as red, fix-number-labeled Xs. A label is plotted only if the scale is less than 1:7000.

Note: you can remove **Seismic (.SRC)** files from the **Working Seismic_Source (.ASC)** file to limit the amount of data displayed on the **Graphics** screen. Likewise, you can add **Source (.SRC)** files back to the **Working Seismic_Source (.ASC)** file to increase the amount of data shown.

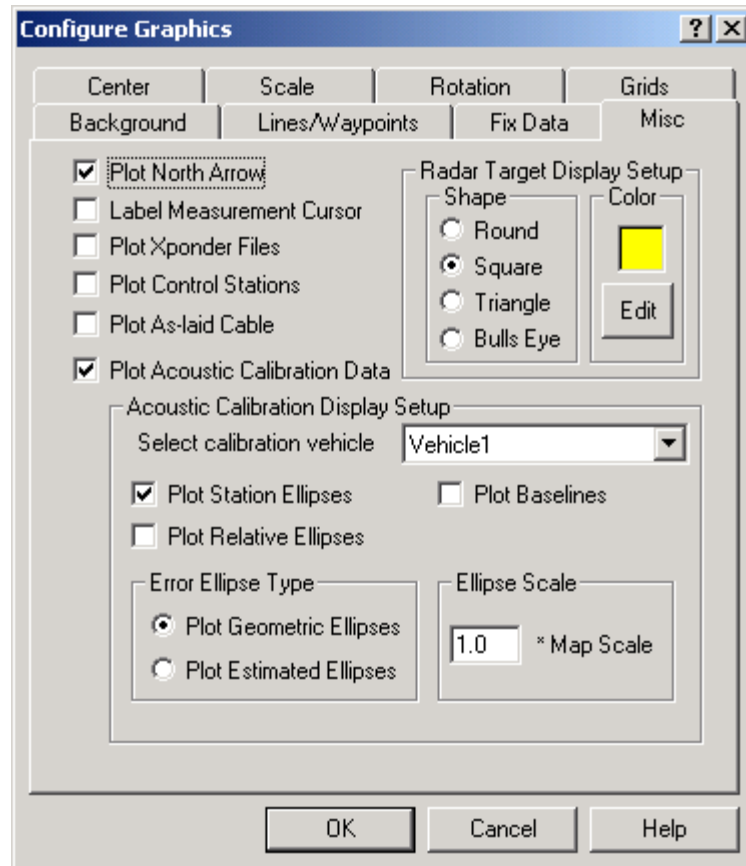
**Plot Manual Cable Events
(* .CET)**

Select this option to enable the plotting of all **Manual Events** in the **Working (.CET) Cable Events** file. A label is plotted only if the scale is less than 1:7000.

Plot Auto Cable Events

Plots all events automatically recorded in the currently open **Cable Database (.MDB)** file.

Misc Tab



Plot North Arrow

Select this option to plot a North Arrow in the top left-hand corner of the **Graphics** window.

Label Measurement Cursor

Select this option to label all measurement cursor lines with the associated range and bearing information. The information is displayed below the respective line upon completion of the measurement. The information is displayed in geographic or map projection grid terms depending upon the Units\Coordinates configuration setting. The range is displayed in the units selected

	for Units\General-Distances. The bearing is always based on the direction from the start point (large cross) to the end point (small cross) and is displayed as “ddd.dd°”.
Plot Xponder Files	Select this option to plot all fixed LBL and USBL transponders in the Working Transponders (.XPT) file as green, unfilled, name-labeled circles. A label is plotted only if the scale is less than 1:7000.
Plot Control Stations	Select this option to plot all Control Stations in the Working Control Stations (.CLS) file.
Plot As-Laid Cable	Select this option to plot the cable location as determined from the Working Cable Database (.MDB) file.
Plot Acoustic Calibration Data	Select this option to enable the plotting of the results, baselines observed and error ellipses of an LBL or USBL transponder position calibration directly from the calibration file currently in memory. Select which data to plot from the provided Acoustic Calibration Display Setup options (See Acoustic Display Setup description below). Note: A calibration file must be in WinFrog memory in order for it to be displayed.
Radar Target Display	If the Rho-Theta device RADAR Targets or NMEA RADAR is present and outputting radar targets they will be plotted on the Graphics window. This group box allows control of the plot. Select the color and shape in which to display all the targets.
Acoustic Calibration Display Setup	This section is enabled if the Plot Acoustic Calibration Data checkbox is selected. The calibration data to be displayed is taken from the acoustic calibration file currently in memory, whether loaded from file or available directly after logging and processing. Select the features to be displayed using the appropriate dropdown list and checkboxes.

Select Calibration Vehicle	The calibration data is associated with a vehicle. Select the respective vehicle from this dropdown list box. Note: Only those vehicles that have either an LBL TRANSCIEVER or USBL HYDROPHONE data item associated with them are listed since these are the only vehicles with which an acoustic calibration file can be associated.
Plot Station Ellipses	The <i>absolute</i> error ellipses associated directly with a given station can be plotted by selecting this checkbox.
Plot Relative Ellipses	The <i>relative</i> error ellipses associated with a given station pair can be plotted by selecting this checkbox.
Plot Baselines	The baselines observed for the calibration are displayed by selecting this checkbox. Note: All baselines that were observed are displayed regardless of their current weighting or validity.
Error Ellipse Type	Geometric or estimated error ellipses can be displayed based on the radio button setting. For more information on these types of ellipse, please refer to the USBL & LBL Calibrations chapter, specifically the Viewing the LBL Solution Statistics section.
Ellipse Scale	The ellipse scale field allows you to enter the display scale to be used for displaying the error ellipse. This can be different from the map scale. This allows the error ellipses to be drawn large enough to be viewable in the Graphics window. The number in the field is multiplied by the current graphics scale factor to determine the scale at which the error ellipse is drawn.

Charts

WinFrog can be configured to display either **raster** or **vector** format charts in the **Graphics** and **Bird's Eye** displays.

See the instructions in the following sections for information on displaying **Maptech's .RML, .HDR** and **.BSB** format raster charts.

WinFrog also supports the use of the **Admiralty Raster Chart System (ARCS)** with a **Skipper** license. See the **ARCS Charts** section later in this chapter for information on displaying these chart files.

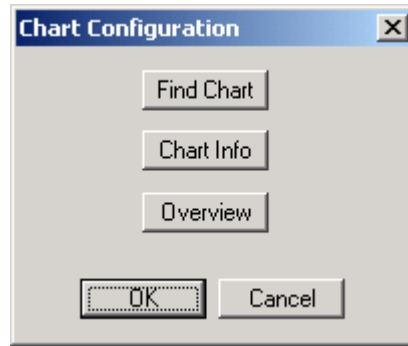
WinFrog now uses the **Blue Marble GeoView Library** to display other types of vector and raster files. The supported vector file types are DXF, DWG, SHP, MIF, DGN, and BML. The supported raster file types are JPG, BMP, TIF and GEOTIFF. See the **Blue Marble Map File Support** section later in this chapter for information on displaying Blue Marble Map (BMM) files that contain the supported file types.

Displaying a Raster Chart in WinFrog

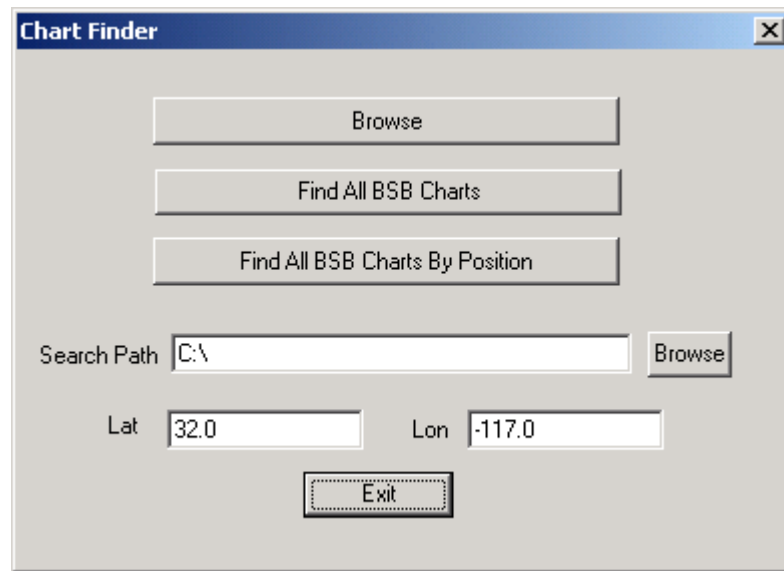
The following instructions apply to **Maptech's .RML, .HDR** and **.BSB** format raster charts. It is recommended that the charts be installed onto a local hard drive. The following sections detail the two methods available to display a RML, HDR or BSB raster chart in WinFrog.

To Display a Raster Chart - Method 1

- 1 From the **Configure** menu, choose **Graphics**.
- 2 On the **Background** tab of the **Configure Graphics** dialog box, select the **Plot Charts** checkbox.
- 3a If this is the first time you are displaying a chart, the **First Time Chart Selection** dialog box will appear. Click the **Browse for Chart** button and locate the desired chart file. Click **OK**.
- 3b If you have already displayed a chart and want to choose a different chart file, click the **Chart Options** button (on the **Background** tab of the **Configure Graphics** dialog box) to display the **Chart Configuration** dialog.



- 4 Click the **Find Chart** button. The **Chart Finder** dialog displays.



- 5 The **Chart Finder** dialog box provides three options for selecting **.BSB** charts.

Option 1: Click the **Browse** button to manually find the desired file. (This method can also be used to load **.RML** charts).

Option 2: Enter the **Search Path** in the provided entry window and select the **Find All BSB Charts** button. This will initiate an automatic search of the defined computer directories for the desired file.

Option 3: Enter a **Search Path** and the required **Latitude** and **Longitude** values in the provided entry windows, then select the **Find All BSB Charts By Position** button. This initiates an automatic search for a **.BSB** file that covers the specified coordinates.

- 6 Once the desired file is located, highlight the file name, and click **Open**.

Note: some **.BSB** files can refer to more than one chart. If more than one file is associated with the selected **.BSB** file, the **Select Chart** dialog box appears. Select the desired chart (by name) and click the **OK** button. WinFrog will briefly display a **Creating Chart** dialog box then automatically return to the **Chart**

Configuration dialog box. Click **OK** to close the **Chart Configuration** dialog box and return to the **Configure Graphics** dialog box.

See the section immediately following **Method 2** below for more information on viewing the selected chart. Also, see the section titled **Raster Chart Options in the Chart Configuration Dialog Box** below for more details on the other options found in the **Chart Configuration** dialog box.

To Display a Raster Chart - Method 2

- 1 From the **File** menu, choose **Select Working Files**.
- 2 Click the **Charts (*.RML)** radio button.
- 3 Either click **Browse** to navigate to the name of the desired chart or enter the file name and directory in the **File** and **Directory** fields at the bottom of the **Working Files** dialog box.

The **Files of Type** dropdown box in the **Browse** dialog box contains the following file types: ***.RML** (RMI Compressed), ***.HDR** (RMI PCX), and ***.BSB** (BSB/NOAA).

- 4 Click **OK** to close the window and return to the **Working Files** dialog box.
- 5 Click **OK** to close the **Working Files** dialog box.
- 6 From the **Configure** menu, choose **Graphics**.
- 7 On the **Background** tab of the **Configure Graphics** dialog box, select the **Plot Charts** checkbox. WinFrog will automatically load the specified chart.
- 8 Click **OK** to close the **Configure Graphics** dialog box.

See the next section for more information on viewing the selected chart. For more details on the other options found in the **Chart Configuration** dialog box, see the **Raster Chart Options in the Chart Configuration Dialog Box** section.

Raster Chart Viewing Tips/Hints

There are certain conditions that must be met before a raster chart can be seen in the **Graphics** display.

- 1 Obviously, the correct chart must be selected. It is preferable that the selected chart be located on the computer's hard drive rather than on a CD drive or some networked location.
- 2 If the chart is not visible, ensure that the **Graphics Display** is centered within the limits of the chart. See the section on **Chart Configuration** below for more details.

- 3 There is a limit to the scale at which raster charts can be viewed in the **Graphics Display**. This scale limit changes according to the **size** of the **Graphics Display** window. Above a certain scale, raster charts may not be visible. You may have to re-size the **Graphics Display** or change the scale to a smaller numerical value in order to view the chart.
- 4 All other selected **Graphics Display** elements display on top of the chart background. Some details may be invisible if the chart is of the same color as the selected option.
- 5 It is assumed that the chart datum is the same as configured in WinFrog's **Geodetics**. WinFrog will not adjust or convert the chart's coordinates if WinFrog's **Geodetics** are changed. This is a very important detail. The use of charts that are referenced to a different geodetic datum can cause very large positional errors. (See the **Chart Information** paragraph immediately below for details on determining the datum of a NOAA raster chart.)

Raster Chart Options in the Chart Configuration Dialog Box

The **Chart Configuration** dialog box (as seen below) contains two options that can provide you with valuable information about the currently loaded raster chart: **Chart Info** and **Overview**. (See the section above named **To Display a Raster Chart - Method 1** for details on accessing the **Chart Configuration** dialog box.)

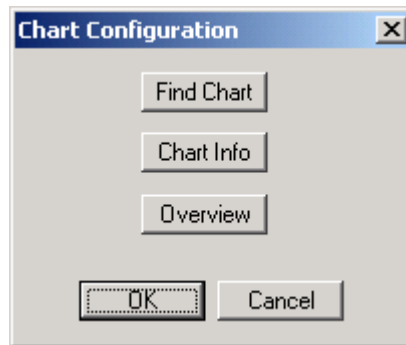
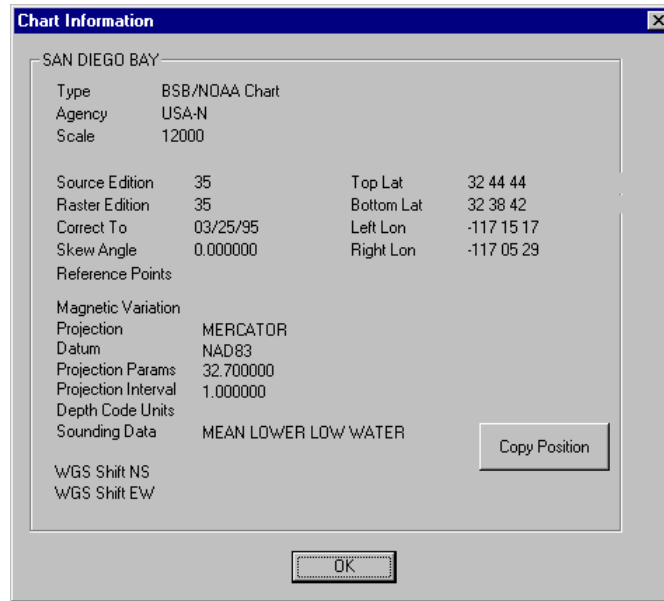


Chart Info button

displays the **Chart Information** dialog box. An example of the information provided for BSB/NOAA Raster charts is shown below.



The **Chart Information** dialog box displays a variety of important details about the loaded NOAA Raster chart including the **Geodetic Datum** that the chart refers to, as well as to which **Sounding Data** the displayed **depths** refer.

This dialog box also provides you with the geographical coordinates of the **Limits** of the chart. This information can assist you in “finding” the chart in the **Graphics** display.

Select the **Copy Position** button to have WinFrog calculate the chart’s center coordinates and copy them to the computer’s clipboard memory.

To Center the Graphics Display at the Middle of the Chart

- 1 Choose **Configure > Graphics** from the main menu.
- 2 On the **Center** tab, select the **Center on Position** radio button.
- 3 Highlight the coordinates and, with the mouse pointer still within the coordinate entry window, right-click.
- 4 Select **Paste**.

Note: the coordinates now change to the calculated chart center.

- 5 Click **OK** to close the **Configure Graphics** dialog box and enact the changes.

More options on the **Chart Configuration** dialog box:

Overview button

Click this button to display the extents of the loaded chart in a size-reduced **Overview** window. Click anywhere within the chart

limits to see that position's geographical coordinates.

Note: this option is only available when using **BSB/NOAA** charts.

Click **OK** to close this window and return to the **Chart Configuration** dialog box.

Find Chart button

Select this option to load a new chart.

Note: this feature is detailed earlier in this chapter in the section named **To Display a Raster Chart - Method 1**, with the exception of **Find All ARCS Charts**. This option is detailed below in the section named **ARC Charts**.

ARCS Charts

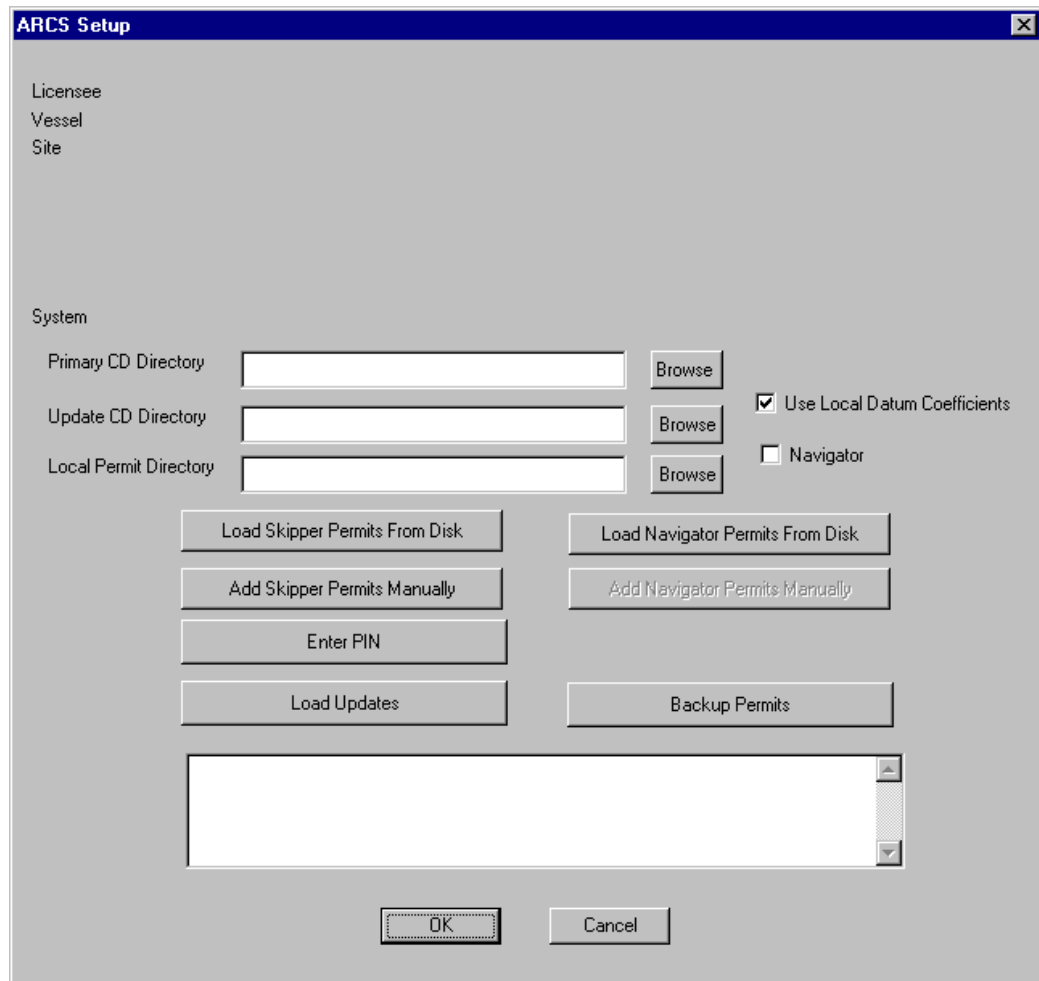
WinFrog supports the use of the **Admiralty Raster Chart System (ARCS)** with a **Skipper** license. As with **.BSB** charts, various chart options must be configured using **Configure Graphics > Chart Options**. In the case of **ARCS** charts, the various relevant parameters are accessed via the **ARCS Setup** dialog box.

Note: if you are using **ARCS** charts in WinFrog, it is advisable to purchase all **Skipper** permits for a work area at one time to synchronize the updates and to limit the number of CDs needed. Notes should be kept to maintain the correspondence between **Updates** and **Charts**.

There are three ways to use **ARCS** charts with **Updates**.

To Display an ARCS Chart Using 2 CD-ROM Drives

- 1 Insert the **primary ARCS** CD into one CD-ROM drive.
- 2 Insert the **Update ARCS** CD into another CD-ROM drive.
- 3 In the **Configure Graphics** dialog window select **Background > Chart Options**.
- 4 Select the **Setup ARCS** option to open the **ARCS Setup** window.



- 5 Click the **Browse** button to the right of the **Primary CD Directory** entry field.
- 6 Navigate to the **ChartCD** folder on the first CD-ROM and select it.
- 7 Click the **Browse** button to the right of the **Update CD Directory** entry field.
- 8 Navigate to the **UpdateCD** folder on the second CD-ROM and select it.
- 9 **Note:** do **not** shutdown WinFrog to complete this next step. Create a new directory for permit storage using a program such as **Explorer™**. This directory can be placed anywhere, but it is best if it is created at the root level of the hard drive. The new directory can have any **unique** name.
- 10 Click the **Browse** button to the right of the **Local Permit Directory** entry field.
- 11 Navigate to the newly created **Local Permit Directory** and select it.
- 12 Insert the **Permit** disk (containing the **Permits** for the desired chart) into the computer disk drive.

- 13 Click the **Load Skipper Permits from Disk** button to display an **Open** navigation dialog box.
- 14 Navigate to the desired **Permit (.SCP)** files on the disk.
- 15 Click **OK** to load the selected **Permits** and return to the **ARCS Setup** dialog box. The **Permit** files are added to the **Local Permit Directory**.
- 16 Click **OK** to return to the **Chart Configuration** dialog box.
- 17 Click **Find Charts** to open the **Chart Finder** dialog box.
- 18 Click **Find All ARCS Charts** to open the **ARC Charts Found** dialog box.
- 19 Select the chart you wish to display by double-clicking its number under the **Chart** column.
- 20 Click **Chart Info** in the **Chart Configuration** dialog box to open the **Chart Information** dialog box.
- 21 Click **Copy Position**.
- 22 Click **OK** to close the **Chart Information** dialog box and return to the **Chart Configuration** dialog box.
- 23 Click **OK** to close the **Chart Configuration** dialog box and return to the **Configure Graphics** dialog box.
- 24 Click **OK** to close the **Configure Graphics** dialog box and display the chart.

To Display an ARCS Chart by Copying the Chart CD to the Hard Drive

- 1 Insert the **Primary ARCS** CD into CD-ROM drive.
- 2 Create a new directory at the root level of the hard drive and name it **CHARTCD**.
- 3 Copy the contents of the CD to this newly created **CHARTCD** directory.
- 4 Click the **Browse** button to the right of the **Primary CD Directory** entry field.
- 5 Navigate to the newly created **ChartCD** folder at the root level of the hard drive and select it.
- 6 Remove the **Primary** CD from the CD-ROM drive and insert the **Update ARCS** CD into the CD-ROM drive.
- 7 Click the **Browse** to the right of the **Update CD Directory** entry field.
- 8 Navigate to the **UpdateCD** folder on the CD-ROM and select it.

- 9 Create a new directory for loading **Permits**.

This directory can be stored anywhere, but it would likely be stored at the root level of the hard drive. It can have any **unique** name.

- 10 Click the **Browse** button to the right of the **Local Permit Directory** entry field.
- 11 Navigate to the newly created directory for storing **Permits** and select it.
- 12 Insert the **Permit** disk which contains the **Permits** for the desired chart.
- 13 Click the **Load Skipper Permits from Disk** button to display an **Open** navigation dialog box.
- 14 Navigate to the desired **Permit** files on the disk.
- 15 Click **OK** to load the selected **Permits** and return to the **ARCS Setup** dialog box.
- 16 Click **OK** to return to the **Chart Configuration** dialog box.
- 17 Click **Find Charts** to open the **Chart Finder** dialog box.
- 18 Click **Find All ARCS Charts** to open the **ARC Charts Found** dialog box.
- 19 Select the chart to be displayed by double-clicking its number under the **Chart** column.
- 20 Click **Chart Info** in the **Chart Configuration** dialog box to open the **Chart Information** dialog box.
- 21 Click **Copy Position**.
- 22 Click **OK** to close the **Chart Information** dialog box and return to the **Chart Configuration** dialog box.
- 23 Click **OK** to close the **Chart Configuration** dialog box and return to the **Configure Graphics** dialog box.
- 24 Click **OK** to close the **Configure Graphics** dialog box and display the chart.

To Display an ARCS Chart by Copying Update Directories to the Hard Drive

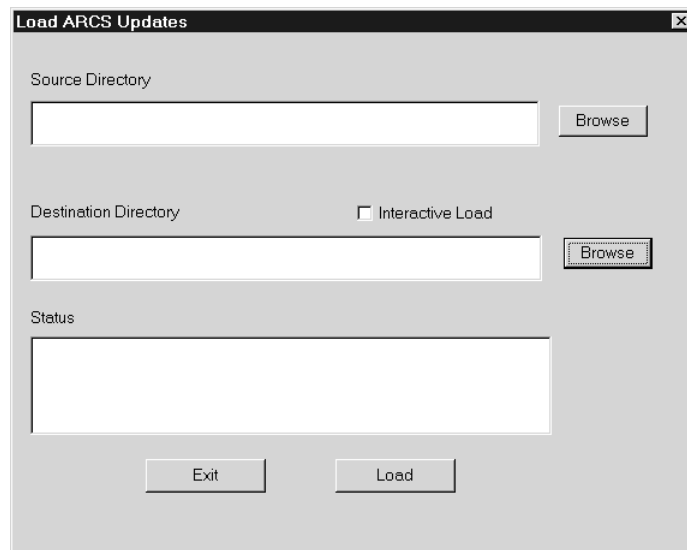
- 1 Insert the **ARCS Update** CD into the CD-ROM drive.
- 2 Create a new directory at the root level of the hard drive and give it the same name as it is labeled on the **Update** CD.

For example, **WEEKLY_11_97**.

- 3 Create a new directory for loading permits.

This directory can be stored anywhere, but it would likely be stored at the root level of the hard drive. It can have any unique name, *e. g.*, **ARCS Permits**.

- 4 Under the **System** title (mid-window area), to the right of the **Local Permit Directory** entry field, click the **Browse** button.
- 5 Navigate to the newly created directory for storing **Permits** and select it.
- 6 Insert the **Permit** diskette containing the **Permits** for the desired chart.
- 7 Click the **Load Skipper Permits from Disk** button to display an **Open** navigation dialog box.
- 8 Navigate to the desired **Permit** files on the diskette.
- 9 Click **OK** to load the selected **Permits** and return to the **ARCS Setup** dialog box.
- 10 In the **ARCS Setup** dialog box, click the **Load Updates** button.



- 11 In the **Load ARCS Updates** dialog box, click the **Browse** button next to the **Source Directory** field.
- 12 Navigate to the **ChartCD** folder on the update CD and select it.
- 13 In the **Load ARCS Updates** dialog box, click the **Browse** button next to the **Destination Directory** field.
- 14 Navigate to the directory created in Step 1 and select it.
- 15 Click the **Load** button to close the **Load ARCS Updates** dialog box and return to the **ARCS Setup** dialog box.

Updates for the licensed charts are copied from the CD to the directory on the hard drive.

- 16 Remove the **Update ARCS** CD from the CD-ROM drive and insert the **Primary ARCS** CD.
- 17 Under the **System** area, to the right of the **Primary CD Directory** entry field, click the **Browse** button.
- 18 Navigate to the **ChartCD** folder on the CD and select it.
- 19 Click **OK** to return to the **Chart Configuration** dialog box.
- 20 Click **Find Charts** to open the **Chart Finder** dialog box.
- 21 Click **Find All ARCS Charts** to open the **ARC Charts Found** dialog box.
- 22 Select the chart to be displayed by double clicking its number under the **Chart** column.
- 23 Click **Chart Info** in the **Chart Configuration** dialog box to open the **Chart Information** dialog box.
- 24 Click **Copy Position**.
- 25 Click **OK** to close the **Chart Information** dialog box and return to the **Chart Configuration** dialog box.
- 26 Click **OK** to close the **Chart Configuration** dialog box and return to the **Configure Graphics** dialog box.
- 27 Click **OK** to close the **Configure Graphics** dialog box and display the chart.

Notices button	Opens the Temporary and Preliminary Notices to Mariners dialog box to display a list of notices to mariners.
Notes button	Displays map Notes. These notes also contain Graphics window location coordinates.
Setup ARCS button	Opens the ARCS Setup dialog box.

Troubleshooting Chart Problems

Chart does not display, even when the vehicle's position is within the boundaries of the chart and the Graphics Display Scale is the same as the natural scale of the chart.

Ensure that WinFrog's **Geodetics** have been properly configured for the current position. Check the **Geographical** and **Projection Grid** lines in the **Graphics Display** and ensure that, with zero degrees display rotation, the lines run straight vertically and horizontally. If these lines are not straight, it is possible that the geodetics are configured incorrectly.

During WinFrog installation, the message "Chart.dll cannot be registered" is displayed.

Ensure that you are logged on to **WINNT** with **administrative** privileges while installing WinFrog.

Unable to open RMI PCX charts.

Ensure the correct directory is entered for the **Chart working directory**.

WinFrog runs very slowly when the charting option is selected.

Charting requires at least 32 megabytes of RAM under NT. For tight memory use, the RMI PCX charts may provide a performance improvement.

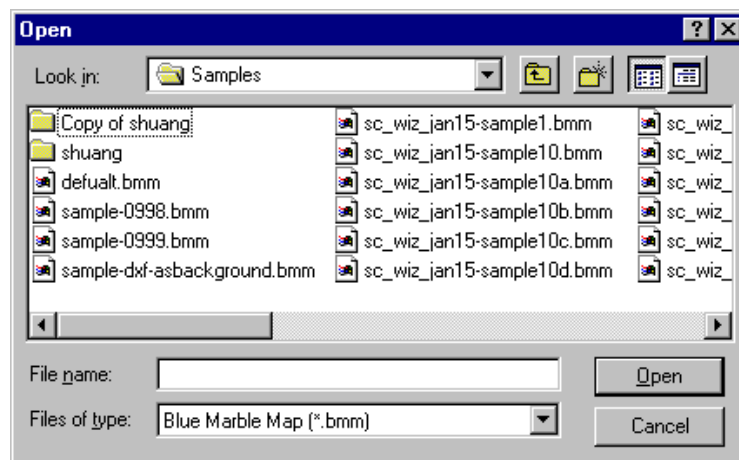
Blue Marble Map File Support

WinFrog can be configured to display a **Blue Marble Map (BMM)** file comprised of different layers of **raster** and **vector** maps. The supported raster file types are JPG, BMP, TIF and GEOTIFF. The supported vector file types are DXF, DWG, SHP, MIF, DGN, and BML.

In practical terms, the use of multiple layers of raster and vector files as background layers should be cautioned. This BMM file setup may result in performance degradation in updating the Graphics display in real time. For instructions on creating a BMM file, see the Map Wizard section in **Chapter 11 – Utilities**.

To Display a Blue Marble Map File

- 1 From the **Configure** menu, choose **Graphics**.
- 2 On the **Background** tab of the **Configure Graphics** dialog box, select the **Plot Map** checkbox to enable the display of Blue Marble Map (BMM) files. If desired, select the **Move with Pan** checkbox to allow the background of the BMM map to move with the Pan action. If you don't select this checkbox, the BMM will not move with the Pan action until you release the left mouse button. **Note:** The drawing speed of the background map varies with the size and format of the file. If dealing with a large graphics file, it may increase performance to leave this box unchecked.
- 3 Click the **Open** button to open a BMM file to display as a background image in the Graphics window. A BMM file must first be created using the Map Wizard as described in **Chapter 11 – Utilities**.
- 4 Select the BMM file to open from the File Open dialog.



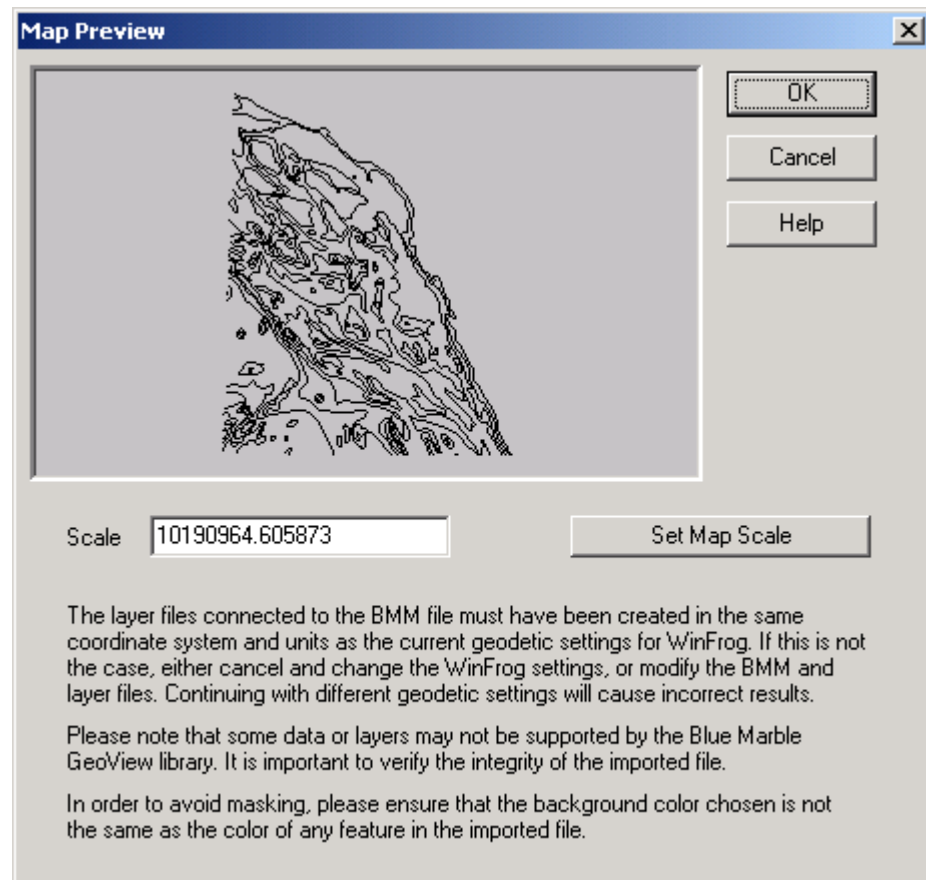
- 5 A **Map Preview** dialog opens with an overview display of the BMM file. Please ensure that the BMM file and layer files that are attached to it were

created in the same coordinate system and units as the settings in WinFrog. If this is not the case and the coordinate systems or units are not the same, click the **Cancel** button and select another BMM file or change the WinFrog geodetics configuration. Refer to **Chapter 3 – Geodetics & Units** for information on changing WinFrog geodetics. Note that if the systems differ and you open the file, the results will be unpredictable and any resulting image will be inaccurate.

Depending on the file format used, some layers and feature types may not be fully supported by the Blue Marble library. It is important to verify the integrity and completeness of the imported file. Also, care must be taken with the chosen background color. If features are the same color as the background color, they will be masked and will not be visible.

Upon previewing, if you find it is necessary to change the scale of the map view, enter a new scale and click the **Set Map Scale** button.

Click **OK** if you are at the desired map view scale.



- 6 Click **OK** on the **Configure Graphics** dialog box to use this BMM file as a background map.

When a BMM file is displayed in the Graphics window you can verify the name of the BMM file being displayed. This is done through the Graphics window pop-up menu. Right-click in the Graphics window to access the **Map File Name** option to view the name and path of the currently displayed file.

User Drawing Support

WinFrog offers the ability to draw graphic objects on the background in the Graphics window. The graphic objects can be drawn on: (1) an existing BMM file background, (2) an existing Blue Marble Layer (BML) file, or (3) a new, empty background. The following sections provide instructions for drawing objects in each of these scenarios.

User-drawn objects can be saved as a Blue Marble Layer (BML) file for use as a background layer in the Graphics window, or appended to an existing BML file. See **To Save Graphic Objects to a Blue Marble Layer File**.

The drawing options can be accessed in two ways: through the **Draw** menu, or through the drawing shortcut buttons on the toolbar. The toolbar buttons are:



- 1 Stop Drawing
- 2 Select Object
- 3 Draw Point
- 4 Draw Polyline
- 5 Draw Polygon
- 6 Draw Text
- 7 Draw Circle
- 8 Draw Arc
- 9 Draw Polyarc

Once object are drawn, certain attributes, such as line color, can be edited. See **To Edit User-Drawn Graphic Objects** later in this chapter.

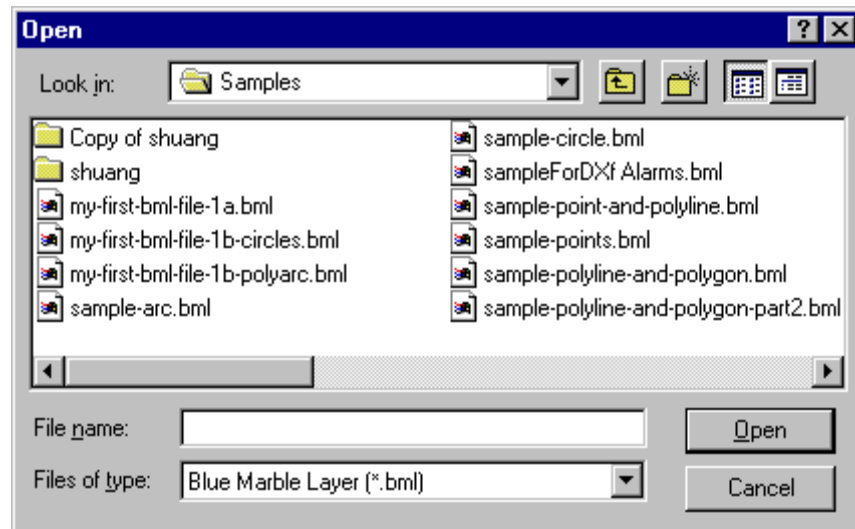
To Draw Graphic Objects When a Blue Marble Map (BMM) File is Displayed

- 1 Display a BMM file. For steps on how to display a BMM file in WinFrog, see the **Blue Marble Map File Support** section above.

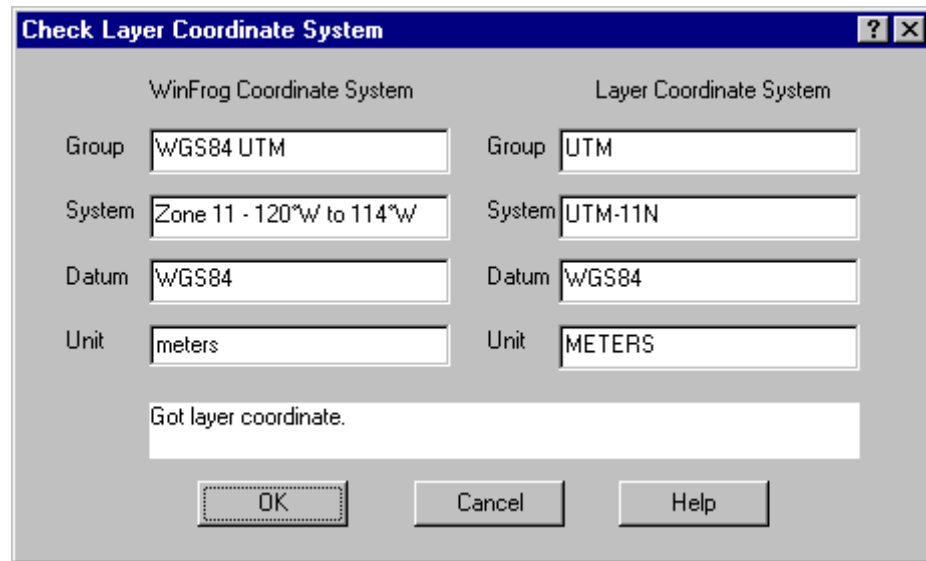
- 2 Select the appropriate toolbar button or **Draw** menu option for the graphic object you which to draw.
- 3 Position the mouse pointer on the Graphics window and click. The graphic object will be added at this position. For a Point object, a point symbol will be added at this location. For the Polyline, Polygon, Circle, Arc and Polyarc objects, the vertex of the specified object will be added. For the Text object, you will be prompted to enter the text for the specified location.
- 4 Repeat step 3 for each vertex in the Polyline, Polygon, Circle, Arc and Polyarc objects.
- 5 Once the object is drawn, select **Draw > Stop Drawing**, or click the Stop Drawing toolbar button, or right-click and select **Stop Drawing** from the pop-up menu.

To Draw Graphic Objects on an Existing Blue Marble Layer File (BML)

- 1 From the **Configure** menu, choose **Graphics**.
- 2 On the **Background** tab of the **Configure Graphics** dialog box, select the **User Draw** checkbox to enable the **Open** and **New** buttons.
- 3 Click the **Open** button to open a BML file to display as a background layer in the Graphics window.



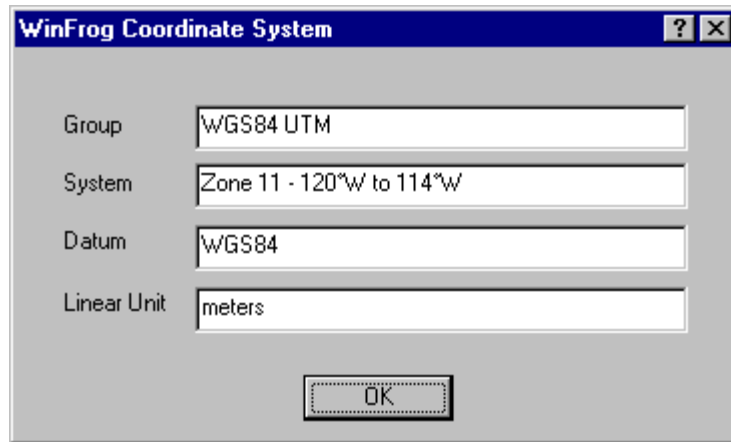
- 4 A **Check Layer Coordinate System** dialog opens with the WinFrog and BML Map file coordinate systems and units displayed. Click **OK** to proceed to the next step or **Cancel** if the displayed geodetics and units do not match. If the two geodetic systems differ, either select another BML file or change the WinFrog geodetic configuration. Refer to **Chapter 3 – Geodetics & Units** for information on changing the WinFrog geodetics.



- 5 A **Layer Preview** dialog opens with an overview display of the BML file. Click **OK** to display this file in the Graphics window or click **Cancel** to cancel this operation. Once the file is displayed in the Graphics window, you can follow the steps in the above section to draw graphic objects on this background.

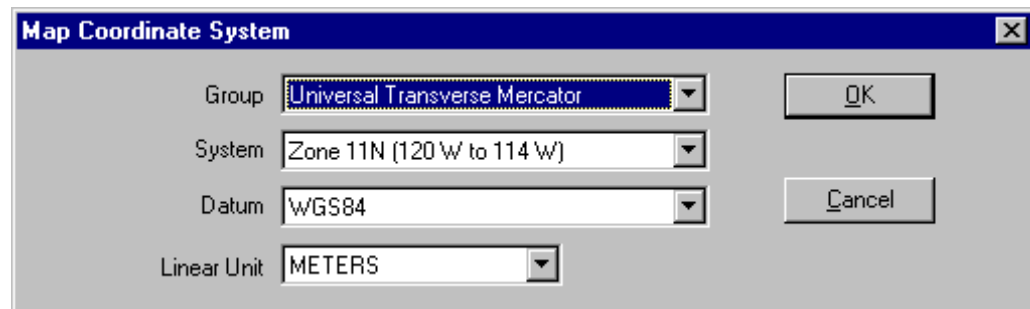
To Draw Graphic Objects on an Empty Background

- 1 From the **Configure** menu, choose **Graphics**.
- 2 On the **Background** tab of the **Configure Graphics** dialog box, select the **User Draw** checkbox to enable the **Open** and **New** buttons.
- 3 Click the **New** button to create a new background image in the Graphics window.
- 4 A **WinFrog Coordinate System** dialog box displays with the current WinFrog geodetics selected. (See **Chapter 3 – Geodetics & Units** for information on setting geodetics.) This dialog is informative only – you cannot change the settings. Click **OK** to proceed to the next step.

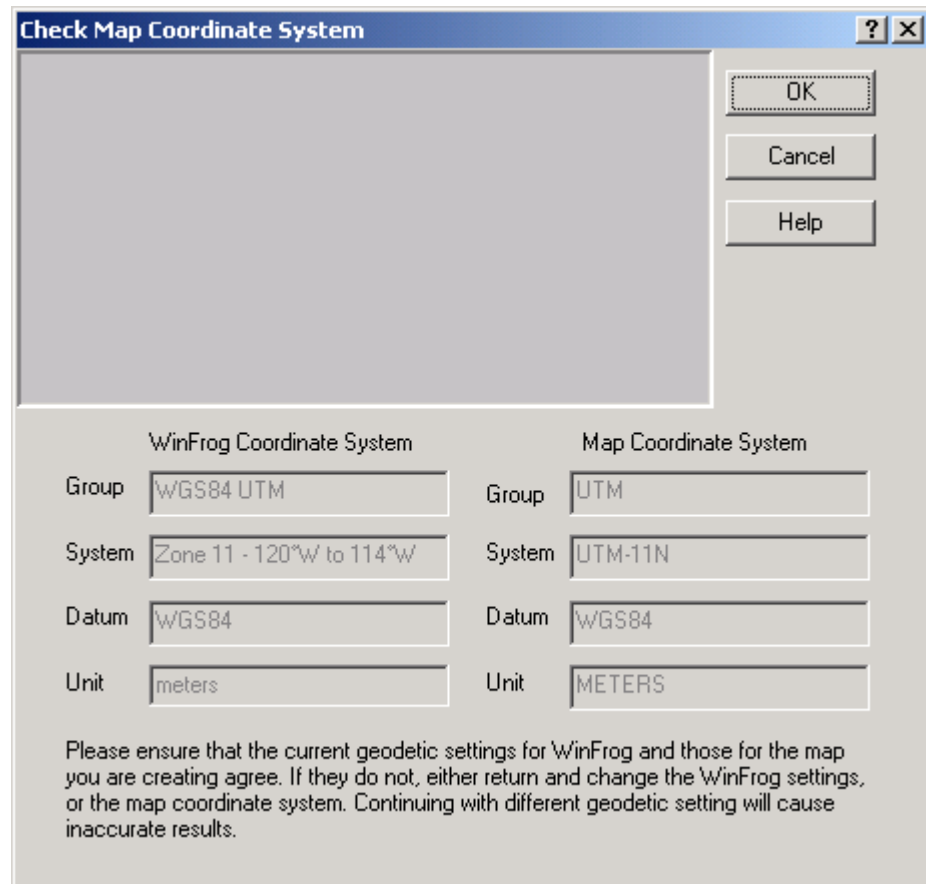


- 5 A **Map Coordinate System** dialog opens to configure the BML map file coordinate system. Set the BML file geodetics to the WinFrog geodetics from the previous step – this is very important, as incorrect settings will cause inaccurate results. Click **OK** to proceed to the next step or **Cancel** to cancel the operation.

Note: The BML file Geodetics should be set for the hemisphere that the active survey is being performed. In this example, use 11N for operations in the Northern Hemisphere and 11S for operations in the Southern Hemisphere for the UTM zone.



- 6 A **Check Map Coordinate System** dialog opens with an overview display of the newly created BML file in the top portion of this dialog and the WinFrog and BML Map file coordinate systems and units displayed in the bottom. Click **OK** to proceed if the coordinate systems and units match, or click **Cancel** to cancel this operation.



- 7 Click **OK** on the **Configure Graphics** dialog box. You can now draw graphic objects on this newly created background.

To Save Graphic Objects to a Blue Marble Layer File

- 1 When finished drawing the graphic objects you wish to create, select **Draw > Save**.
- 2 The **Save User Drawing** dialog box displays. Select the **Save** radio button.
- 3 A **Save As File** dialog box displays. Specify the name and location where the BML file will be saved.
- 4 The **Map Coordinate System** dialog box displays. Confirm that the Map Coordinate System geodetics are the same as the WinFrog geodetics. Click **OK** to create the BML file.

Creating and saving a BML file in this manner saves the file as an independent BML file, with the **.bml** file extension. Any BML files created can be displayed as a standalone background layer in the Graphics window or added as a layer into a new or existing BMM file.

Note: Saving graphic objects into an existing BML file will overwrite the file and

you will lose all previously saved objects. See the instructions in the following section for appending objects to an existing BML file.

To Append Graphic Objects to a Blue Marble Layer (BML) File

- 1 When finished drawing the graphic objects you wish to create, select **Draw > Save**.
- 2 The **Save User Drawing** dialog box displays. Select the **Append** radio button.
- 3 An **Open File** dialog box displays to select an existing BML file to which to append the additional graphic objects.

To Edit User-Drawn Graphic Objects

Certain attributes of user-drawn graphic objects can be edited, based on the type of object.

- 1 Click the **Select Object**  button on the toolbar and then click on the object you wish to edit. The object color changes to show that it is selected.
- 2 Right-click in the Graphics window and select **Edit Drawing** from the pop-up menu. A dialog will display with editing options based on the object selected.

Editing options for graphic objects:

Polyline, Polygon, Circle,

Arc and Polyarc

Color

Text

Text and text color

Point

Color, size and icon

Note: When editing the size of the Point object, a negative value indicates that the size is in pixels and the object size remains fixed when the map scale is changed; a positive value indicates that the size is in map units and the object size will change scale with the map when you zoom in or out; a size of zero (the default value) indicates that the bitmap is shown at its normal size.

- 3 Make your editing selections and click **OK** to exit.

Objects can also be deleted from the Graphics window pop-up menu. Select an object, right-click and choose **Delete Object**.

Displaying a C-Map Vector Chart in WinFrog

When you first install WinFrog, there are two installation options, **Typical** and **Custom**. Choosing a **Custom** installation provides you with the option to configure WinFrog to display **C-Map** files. You **MUST** choose this option in order to display C-Map files. If you did not initially install WinFrog using the **Custom** installation options, **WinFrog** must be **removed** and then **reinstalled**.

Note: **C-MAP** charts are purchased directly from **C-MAP**.

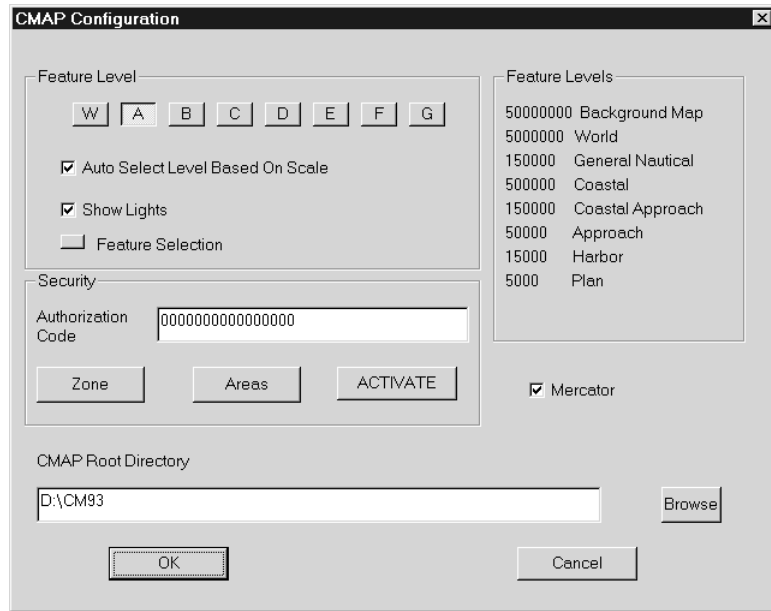
Note: WinFrog only supports **C-MAP CM-93 Edition 2**.

By default, **C-MAP** charts use a **Mercator** map projection to convert the geographical coordinates to grid coordinates. If a project requires it, the charts can be displayed using different geodetic parameters. See the section titled **To Use WinFrog's Map Projection** below.

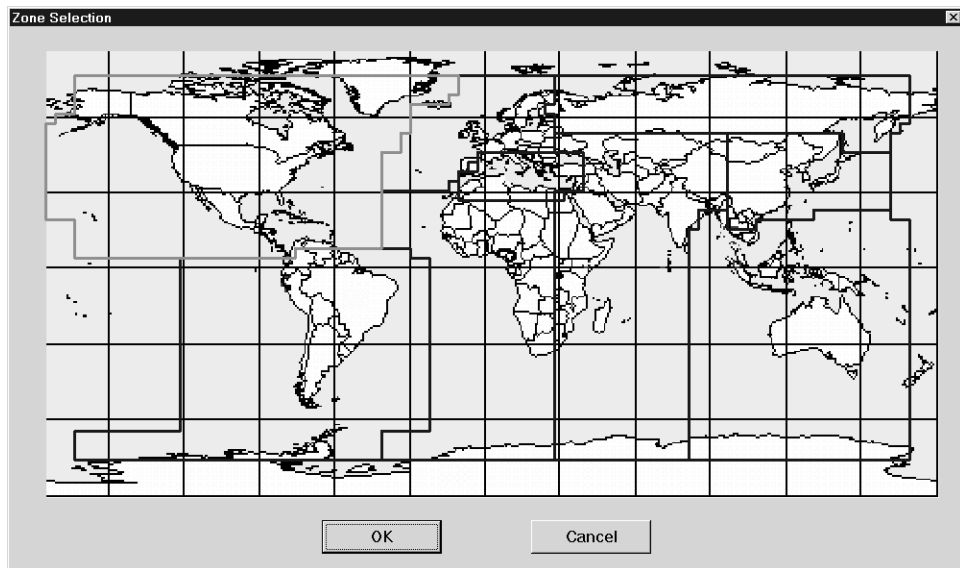
Note: **Resolution Mapping, Inc.'s .RML** and **.HDR** and **BSB/NOAA's .BSB** format raster charts, as well as **ARCS** charts **cannot** be displayed when the **C-MAP** display option is selected. **WinFrog** must be **removed** and then **reinstalled** in order to display these types of **Raster** charts. Other chart file types supported by the **Blue Marble GeoView Library** (**JPG, BMP, TIF** and **GEOTIFF** raster files and **DXF, DWG, SHP, MIF, DGN, and BML** vector files) **can** be displayed (as a layer in a **BMM** file) when the **C-Map** display option is selected.

To Display a C-Map Vector Chart

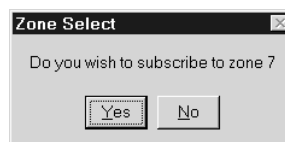
- 1 Insert the **C-Map** CD containing the region to be displayed.
- 2 Launch **WinFrog**.
- 3 From the **Configure** menu, choose **Graphics** to bring up the **Configure Graphics** dialog.
- 4 Select the **Background** tab.
- 5 Select the **Plot Charts** checkbox, then click the **Chart Options** button to display the **C-MAP Configuration** dialog as seen below.



- 6 In the **CMAP Root Directory** field (at the bottom of the **CMAP** dialog box), make sure the drive letter corresponds to the CD ROM drive containing the **CMAP** CD.
- 7 Click the **Zone** button to bring up the **Zone Selection** dialog box, as seen below.

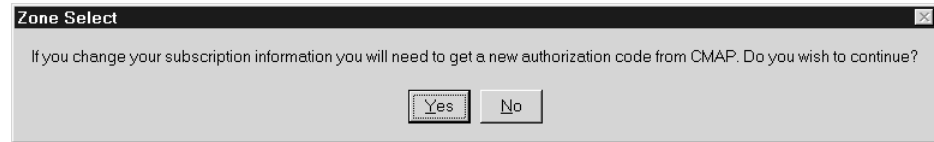


- 8 Select a **zone** by double-clicking within its boundaries.



The **Zone Select** dialog box opens, asking you to confirm the selection.

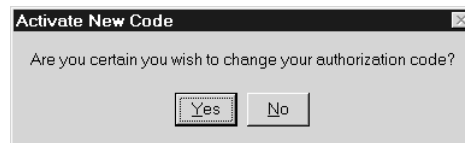
- 9 Click **Yes** or click **No** and repeat **Step 6**.
- 10 Click **OK**. Another **Zone Select** dialog box opens.



- 11 Click **Yes** or click **No** and repeat **Step 6**.

The **User Code** dialog box opens, displaying the following message: "**Your User Code is X. Contact C-MAP with this user code to receive an authorization code.**"

- 12 Click **OK**.
- 13 Once the **Authorization Code** is obtained, enter it in the **Authorization Code** entry field.
- 14 Click the **ACTIVATE** button.



- 15 Click **Yes** to confirm the change.
- 16 Click **OK** to close the **CMAP Configuration** dialog box.
- 17 Click **OK** to close the **Configure Graphics** dialog box and display the **C-Map vector** chart.

C-Map Vector Chart Feature Levels

C-Map Vector chart parameters can be modified via the **CMAP Configuration** dialog box.

When the **Auto Select Level Base on Scale** box is checked in the **CMAP Configuration** dialog box, the **precision** of the map displayed is related to the value entered by you in the **Scale 1:** entry field at the top of the **Configure Graphics** dialog box.

Scale	Feature Level	ID	Precision Values
>5,000,000	Background Map	W	not available
5,000,000	World Map	A	1500m
1,500,000	General Nautical	B	450m
500,000	Coastal	C	150m
150,000	Coastal Approach	D	45m
50,000	Approach	E	15m
15,000	Harbor	F	4.5m
5,000	Plan	G	1.5m

The letter **ID** in the **Feature Level** area of the **CMap Configuration** dialog box shows the feature level displayed in the **Graphics** window. If there is no chart available with the feature level corresponding to the user-entered scale, the **Graphics** window displays in white.

To Bypass the Default Precision Value Associated with an Entered Scale

- 1 Uncheck the **Auto Select Level Base on Scale** box in the **CMap Configuration** dialog box in order to display a desired feature level despite the entered scale.

Note: a high precision feature level displayed at a high scale can adversely affect performance while a low feature level displayed at a low scale can result in a loss of precision.

To Use WinFrog's Map Projection

By default, these charts are displayed using a Mercator map projection. You can choose to display the charts using the parameters configured in WinFrog's **Geodetics** dialog box instead.

- 1 In WinFrog, select the main menu item **Configure > Geodetics**, then configure the geodetic parameters, as required. See the **Configuring Geodetics and Units** chapter for more information on selecting the **Working Geodetics** in WinFrog.
- 2 In the **CMap Configuration** dialog box, un-check **Mercator**.

Note: **CMap** display performance is greater when the **Mercator** box is checked.

Visible Illuminations

Light sources shine a light toward the sea. However, obstacles can block the beam of light in certain directions. **Vector** maps can indicate where a vessel would be able to see a beacon of light shining from a lighthouse or other light sources.

To Indicate Illumination

- 1 Check the **Show Lights** box in the **Feature Level** area of the **CMAP Configuration** dialog box.

Profile Window

The **Profile** window displays a user-defined view of the water column and can include such information as **survey lines** and **waypoints**, as well as all WinFrog **vehicles**.

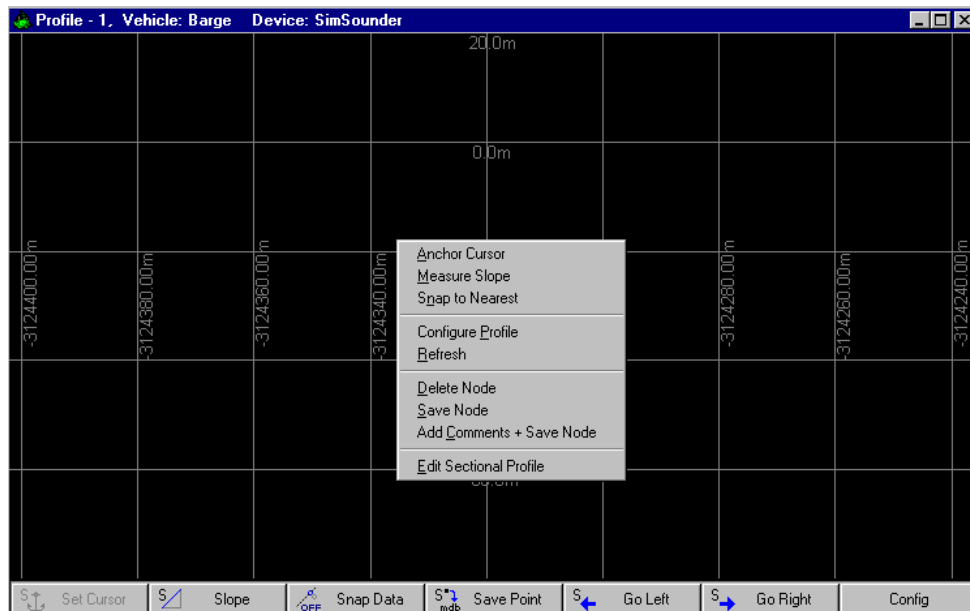
The inclusion of the above mentioned data in the **Profile** window is dependent upon the location of the various data relative to the configured location as well as the orientation of the **Profile** window. The following sections detail the configuration of the **Profile** window. See the **Working Files** chapter for more information on configuring three-dimensional survey line and waypoint data.

To Display the Profile Window

- 1 From the **View** menu, choose **Profile**. Multiple **Profile** windows can be displayed simultaneously, each with their own unique configuration. Each **Profile** window can be moved or have its size altered by “grabbing” the edge of the window and moving it as desired.

There are a variety of **Profile** window operation and configuration options presented when the mouse pointer is moved into the limits of the **Profile** window and the right mouse button is clicked. Most of these options are also presented in the **Profile** window **Toolbar** found at the bottom of the **Profile** window.

For typical, real world operations you would first configure the **Profile** window.



To Configure the Profile Window

There are three ways to access the **Configure Profile** dialog box.

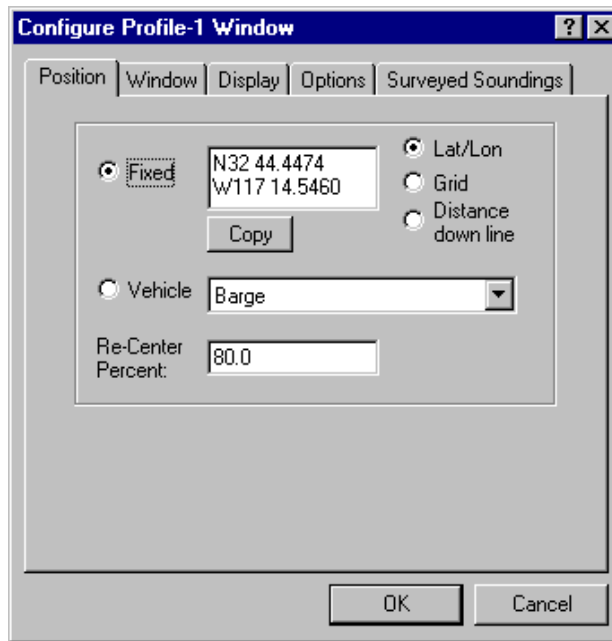
- 1 Select **Configure > Profile**.
- 2 Move the mouse pointer within the limits of the **Profile** window, right-click and select **Configure Profile**.
- 3 Select the **Config** button in the lower right corner of the **Profile** window on the toolbar.

Regardless of the method used, the result is the presentation of the **Configure Profile Window** dialog box.

The **Configure Profile** window is comprised of five different configuration categories that are accessed by selecting the appropriate tab. Each of these configuration options is detailed below.

Position Tab

The **Position** tab allows you to specify the way that the **Profile** window is centered horizontally.



Fixed radio button

Select this option to horizontally center the **Profile** window at the coordinates displayed in the box, regardless of the current vehicle position. The coordinates can be either entered in geographic latitude and longitude (if the **Geo** radio button is selected) or in grid Northing and Easting (if the **Grid** radio button is selected).

Vehicle radio button/ dropdown box

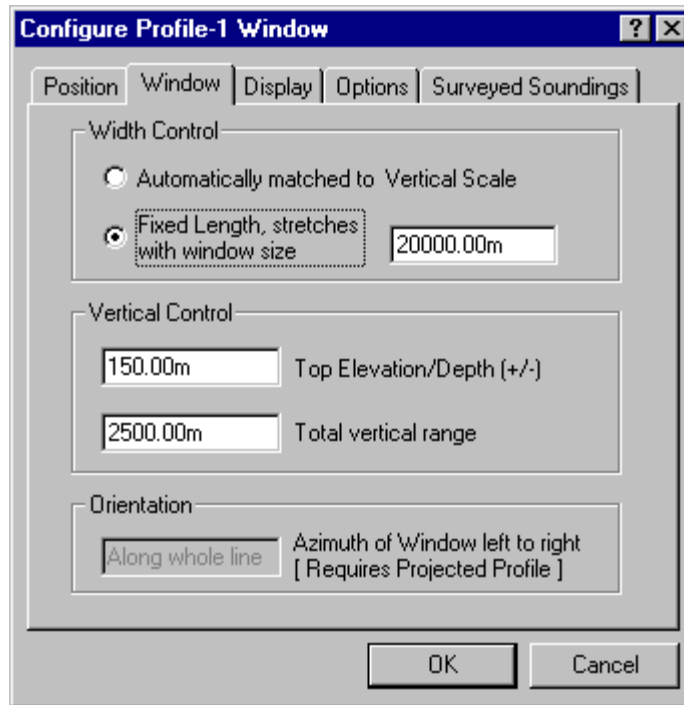
Select this radio button, then (from the dropdown box) choose the vehicle to which the **Profile** window display will be horizontally centered.

Re-Center Percent field

Enter a value in percent. This is the percentage of the distance between the center and the side edge of the display in which the current vehicle is permitted to travel before the **Profile** window is refreshed. When the current vehicle comes within the re-center percentage limits of the **Profile** window edge, the **Profile** window pans to return the current vehicle to the center (horizontally) of the **Profile** window.

Window Tab

The **Window** option allows you to control the **Horizontal Scale**, **Vertical Scale**, and **Orientation** of the data in the **Profile** window.



Width Control

**Automatically matched to
Vertical Scale**

If selected, WinFrog automatically varies the length (width) of the **Profile** window to match the **Vertical Scale**.

**Fixed Length, stretches
with window size**

If selected, allows you to manually define the length (width) of the Profile window. It is recommended that this option is selected to ensure the adequate horizontal information is visible, despite the fact that the display will not be to scale.

Vertical Control

Top Elevation/Depth

Enter a value to define the top of the water column displayed in the **Profile** window. This value designates where the top of the **Profile** window begins in relation to the surface of the water. The value **0** starts at the surface. A negative value starts below the surface. It is suggested that a value of

approximately 20 meters is entered to ensure that surface vehicles will be visible in the **Profile** window.

Total Vertical Range

Defines the total amount of the water column displayed in the **Profile** window, as measured down from the **Top Elevation** entry made above. This range is always entered as a positive value.

Orientation

Azimuth of Window

left to right

Enter the **Azimuth (horizontal bearing)** of the **Profile** display as it appears in the **Graphics** window.

To determine the **Azimuth**, visualize that you are looking straight down from high above the ocean surface and the **Profile** location. From this perspective, the **Profile** will appear simply as a thin straight line, the length as defined in the **Width Control** entry above.

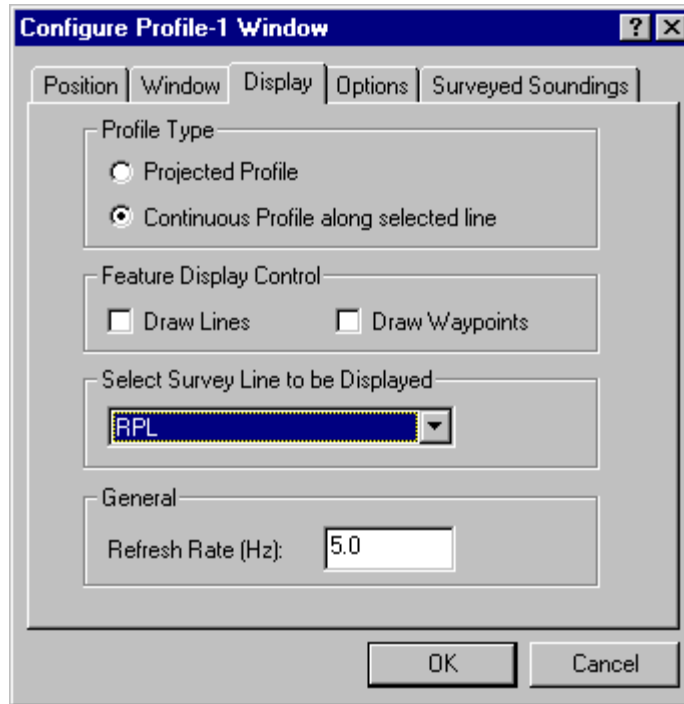
To define the **Azimuth** of the **Profile** line you must first decide from which side you wish to view the **Profile** (i.e. decide which end of the **Profile** will be to your viewing **left** and which side will be to your viewing **right** as you look **horizontally** at the mid-point of the **Profile**). The **Orientation** value entered here is the bearing of the line created by joining the left edge of the display to the right side of the display.

Typically, to view a **Survey Line** in profile view without scale distortion, the **Orientation** value will be the bearing of the **Survey Line** segment (or 180 degrees different, depending on how the **Survey Line** coordinates were entered).

Note: if **Continuous Profile along selected line** is chosen from the **Display** section (detailed in the section below), the **Orientation** entry window will display **Along whole line**, and not allow any numerical data entry.

Display Tab

The **Display** option provides you with the ability to configure various **Profile Display** features.



Profile Type

Projected Profile

Select this option to allow manual configuration of the **Window Tab** options, as detailed immediately above.

Continuous Profile along selected line

Select this option to have WinFrog automatically control the **Profile orientation** to suit the currently selected survey line, as detailed below.

Feature Display Control

Draw Lines/Draw Waypoints

Select the appropriate checkbox to draw lines and/or waypoints. These options enable the display of all contents of the appropriate **Working** file.

Select Survey Line to be Displayed

dropdown box

This selection is applied only when the **Profile Type** is **Continuous Profile along selected line**. This option allows for the

Profile display of an alternate **Survey Line**, perhaps one that contains more **downline** elevation information, such as slope changes for example.

If the real-time **Cable Model** is **not** running, this option defines the line projection for the **Profile** window. If the real-time **Cable Model** is running, the projection is defined by the survey line being **tracked** by the first vehicle. (This survey line should consist of only A/C's).

General

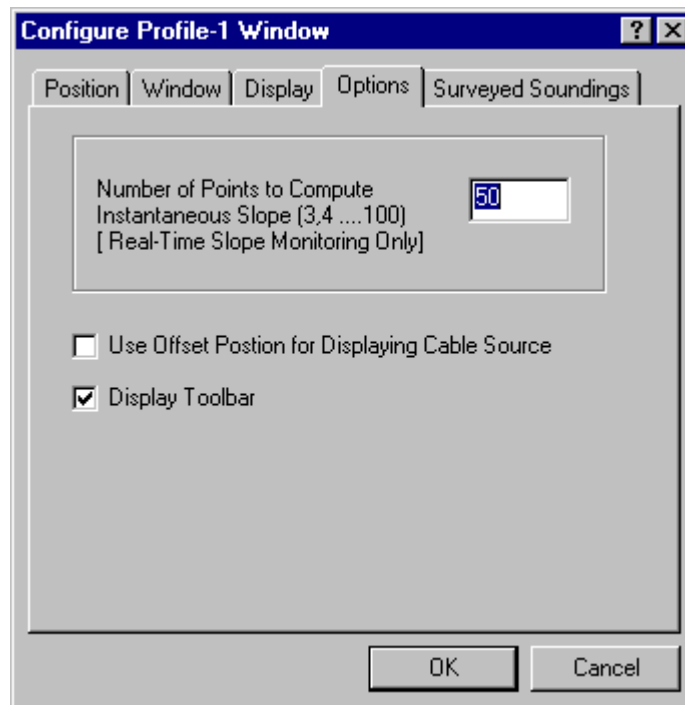
Refresh Rate (Hz)

Enter a value that configures the rate at which WinFrog will refresh the **Profile** window display. The default value of 5.0 Hz should be adequate for most applications.

Note: Do not enter too small a value, as the constant regeneration of the **Profile** window will slow the program.

Options Tab

The **Option** dialog box provides you with the ability to control three **Profile** window options, as detailed below.



**Number of Points to
Compute Instantaneous
Slope**

Enter a value (between 2 and 100) that defines the number of real-time echosounder observations (soundings) that will be used to determine the slope of the seabed. This value is applied only if **Real-Time Slope Monitoring** is enabled.

**Use Offset Position for
Displaying Cable Source**

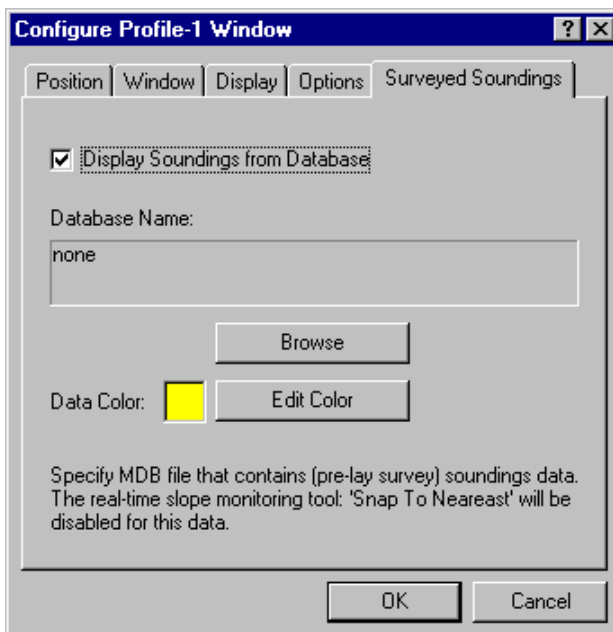
Select this option to enable a shift in the position that the echosounder data are plotted to the vessel's **Tracked Offset** position (i.e. the **Stern**, for example), as opposed to the vessel's **CRP** position. This visual adjustment to the real-time sounding data makes no notable difference to calculations in deeper water depths.

Display Toolbar

Select this option to enable the display of various **Profile** window **slope measurement** and **display movement** tools in the bottom of the **Profile** window. These toolbar options are detailed in the section below named **Profile Window Toolbar**.

Surveyed Soundings Tab

The **Surveyed Soundings** dialog box allows you to configure the display of **Pre-lay Sounding** data from a previously recorded **Database** (.mdb) file, as detailed below.



Display Soundings from Database

Select this option to enable the display of sounding data contained in a **.mdb** format file.

Browse

Select this button to navigate to the appropriate directory and select the desired **.mdb** file.

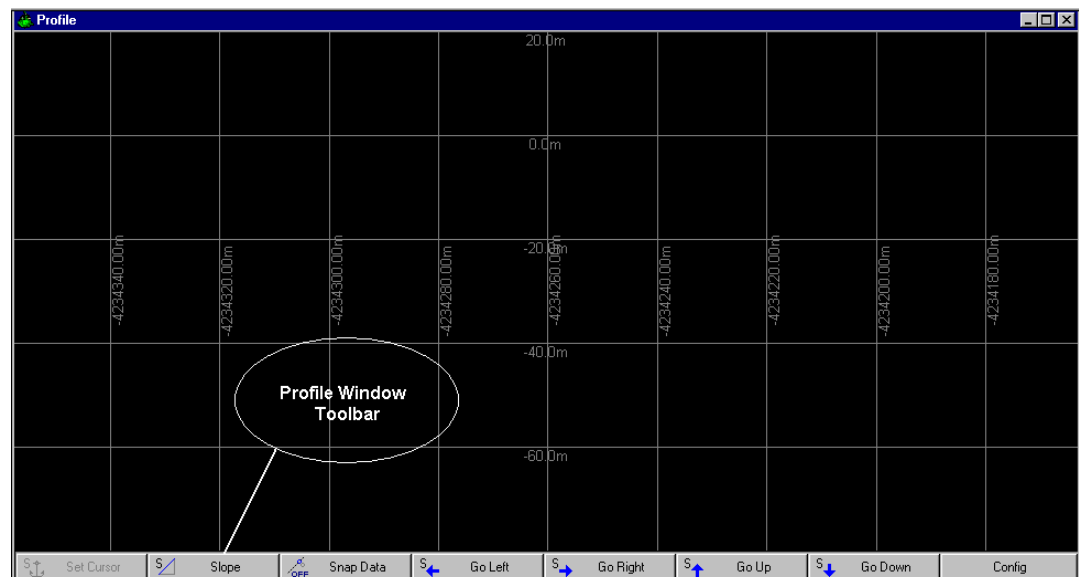
Edit Color

Select this button to change the color in which the loaded database soundings are plotted in the **Profile** window.

The Import Bathymetry utility (**Utilities > Import Bathymetry**) converts ASCII x,y,z bathymetry data into a WinFrog formatted soundings database file that can be displayed in the Profile window. To learn more about this utility refer to chapter 11: Utilities.

Profile Window Toolbar

At the bottom of the **Profile** window is a toolbar that provides you with shortcuts to seven different **Profile** window configuration and measurement functions. Several of these functions can also be accessed by right-clicking when the mouse pointer is located within the limits of the **Profile** window display. The following sections detail each of the toolbar items, in the order that they are found at the bottom of the **Profile** window.



Set Cursor

Selecting this button enables you to define the point **from** which slope measurements will be made, i.e. where the slope will be anchored. This

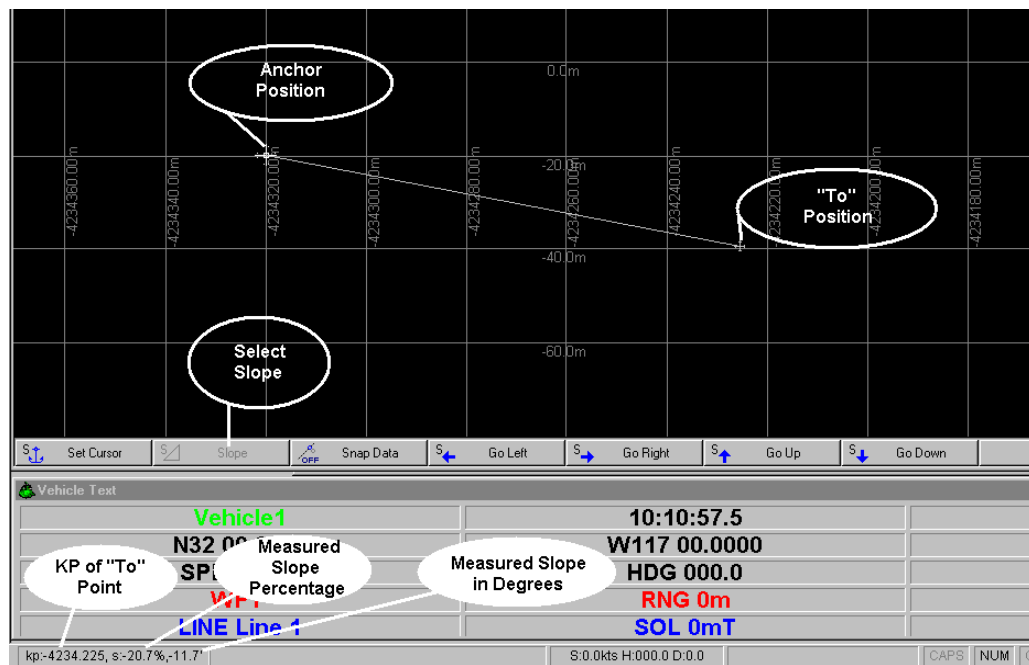
function is the same as the **Anchor Cursor** feature found in the “right-click menu” accessed while your cursor is in the **Profile** window.

To set the cursor, select this button (“graying” out the button text), then move the mouse pointer to the desired location in the **Profile** window and click. A “cross” will appear in the **Profile** window at the specified location.

Slope

Select this button to define the point **to** which slope measurements will be made, i.e. from where the slope was anchored (see above) to this new location. This function is the same as the **Measure Slope** feature found in the “right-click menu” accessed while your cursor is in the **Profile** window.

To measure slope, select this button (“graying” out the button text), then move the mouse pointer to the desired location in the **Profile** window and click the left mouse button. A line will now appear, connecting the previously set “anchor” position to this new point. WinFrog displays a variety of information related to this measurement in the bottom left corner of the display area below the **Vehicle Text** window.



As shown above, WinFrog calculates and displays the **To Point** KP value, the slope measured in degrees, and the measured slope percentage.

Snap Data

Select this button to instruct WinFrog to “snap” to an existing plotted sounding **to** which slope measurements will be made. This selection precludes the manual definition of a “To” point as defined above.

Go Left

Select this button to instruct WinFrog to move the viewer's perspective of the **Profile** window to the left, i.e. moves the contents incrementally to the right.

Go Right

Select this button to instruct WinFrog to move the viewer's perspective to the right, i.e. moves the **Profile** window contents incrementally to the left.

Go Up

Select this button to instruct WinFrog to move the viewer's perspective "up", thus moving the **Profile** window contents incrementally "down."

Go Down

Select this button to instruct WinFrog to move the viewer's perspective "down", thus moving the **Profile** window contents incrementally "up."

Config

Select this button to access the **Configure Profile** window dialog box, as detailed at the start of the **Profile Window** section.

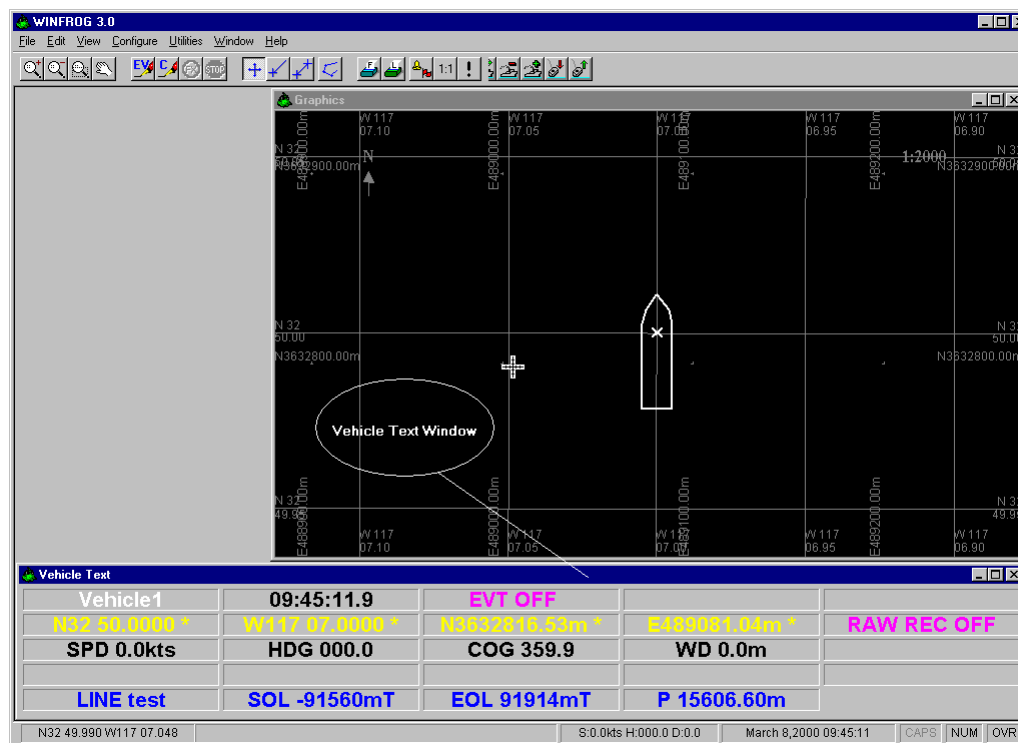
Vehicle Text Window

The **Vehicle Text** window displays real-time information for all vehicles in text form. This information can include the vehicle's **Name**, **Position**, **Heading**, and **Speed**, as well as a host of other data. You can display more than one **Vehicle Text** window at a time, with each **Vehicle Text** window configured differently than the others.

As well as displaying navigation data, the **Vehicle Text** window provides quick access to several commonly used WinFrog setup and configuration menus, including **Line Tracking**, **Waypoint Tracking**, **Automatic Event Configuration**, **Vehicle Offset** selection, and **Vehicle Configuration** options.

To View the Vehicle Text Window

- 1 From the **View** menu, choose **Vehicle Text**. The **Vehicle Text** window opens at the bottom of the WinFrog work area, as seen below.



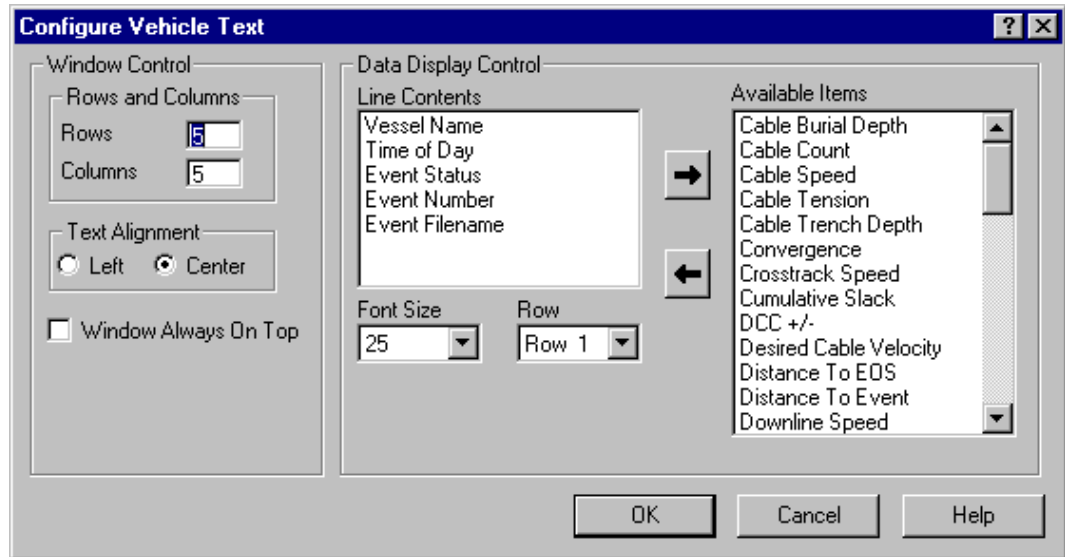
WinFrog carries a default configuration of the **Vehicle Text** window contents for the initial start up. The data displayed in this window (and the location of data items in the window) is configurable as detailed below. All modifications to the Vehicle Text window are saved in the **Winfrog_3.ini** file when the program is exited correctly.

To Configure the Vehicle Text Window

- 1a Select the main menu item **Configure > Vehicle Text**.

Or

- 1b Move the mouse pointer into the **Vehicle Text** window and click the right mouse button. Select **Configure Vehicle Text** from the presented menu options.



This window allows you to select which data items are displayed in the **Rows** and **Columns** of the **Vehicle Text** window, as well as the Font Size and Alignment of the selected data text.

Note: Row 1 refers to the top **row** of the **Vehicle Text** window.

Window Control

Rows/Columns

Enter the number of rows and columns (1 to 5) that you want to display in the **Vehicle Text** window.

Text Alignment

Left/Center radio buttons

Select the desired alignment option.

Window Always on Top

Select this option to ensure that the **Vehicle Text** window always displays on top of any overlapping windows. This ensures that the more important information found in the **Vehicle Text** window is always visible.

Data Display Control

Row dropdown

Use the dropdown menu to select the **row** that you want to modify.

Line Contents box

Lists the items currently displayed in the selected **row** of the **Vehicle Text** window. To add items to this list, first ensure that the desired row is selected. Next, select the desired item listed in the **Available Items** box and click the **left** arrow. This adds the

selection to the **Line Contents** box and removes it from the **Available Items** list. To remove contents from the **Line Contents** box, select the desired item and click the **right** arrow. This removes the item from the **Line Contents** box and adds it (in alphabetical order) to the **Available Items** list. Each item can be listed only once in the **Vehicle Text** window.

Note: some items may appear as blank boxes in the **Vehicle Text** window until valid data exists for that field. For example, by default, **Row 4** is configured to display waypoint tracking data (**Wpt Name**, **Wpt Range**, **Wpt Bearing**). If no waypoint is being tracked, these three data items will remain blank.

Font Size

Select the size of the font used to display items in the row number shown in the **Row** dropdown list.

Available Items

The items available for display in the **Vehicle Text** window are described below.

Item Name	Sample Entry	Text Color
ACOUSTIC - Velocity Filename	VEL: Filename.VEL	Black
ACOUSTIC - Xponder Filename	XPDR: Filename.XPT	Black
ATTD - Pitch	PITCH 0.0	Black
ATTD - Roll	ROLL 1.0	Black
CM - Cumulative Slack	Cum Slack 0.0	Blue
CM - Desired Cable Velocity	C dSPD 50.0 m/m	Black
CM - Expected Tension	dTen 3.5	Black
CM - Observed Ship Slack	SLACK 0.5	Black
CM - Slack	SLACK 0.2	Blue
EVENT - Distance To Event	DTE 322.2m	Red
EVENT - Filename	File: line1.dat	Magenta
EVENT - Number	FIX#: 103	Magenta
EVENT - Status	EVT: Enabled	Magenta
EVENT - Raw Filename	270-1428.RAW	Magenta
EVENT - Raw Record Status	Raw Record Off	Magenta
GRAPHICS - Convergence	45.0	Black
GRAPHICS - DXF Filename	DXF: filename	Magenta
LINE - Bearing	LN BRNG 065.0T	Blue
LINE - Crosstrack Speed	XTRK 0.5 kts	Black
LINE - DCC +/-	DCC 16.85m	Black
LINE - Port/Starboard	P 1.7m	Blue
LINE - Left/Right Indicator	R 3.20m	Blue
LINE - Distance To EOL	EOL 322.2mT	Blue
LINE - Distance To EOS	EOS 262.6m	Blue

Item Name	Sample Entry	Text Color
LINE - Distance To SOL	SOL 322.2mT	Blue
LINE - Downline Speed	DWNL SPD5.6 kts	Black
LINE - FP	STA 11 +13.45	Blue
LINE - KP	KP 001.224T	Blue
LINE - Name	LINE line 1	Blue
LINE - Segment Number	LINE SEG# 3	Blue
MAGNETOMETER Altitude	MAG Alt: 0.0m	Black
MAGNETOMETER Depth	MAG D: 0.0m	Black
MAGNETOMETER Mag Field	MAG: 0.000nT	Black
MISC - Reserved 1	blank	blank
MISC - Reserved 2	blank	blank
NAV - Course Over Ground	45.0	Black
NAV - ETA	ETA 00:00	Black
NAV - Heading	HDG 110.0	Black
NAV - Layback	LBK 100.00m	Blue
NAV - Offset Name	TO: bow	Black
NAV - Req'd Layback HDG	REQD HDG 110.0	Blue
NAV - Speed	SPD 3.00 kts	Black
NAV - Speed Through Water	STW 0.0kts	Black
NAV - Tide	Tide 0.00m	Black
NAV - Time of Day	12:00:00.0	Black
NAV - Vessel Name	Vehicle1	Vehicle color
NAV - Water Depth	WD 0.00m	Black
NAV - R Wind Direction	RWD 45.0	Black
NAV - R Wind Speed	RWS 8.0 kts	Black
NAV - T Wind Direction	TWD 45.0	Black
NAV - T Wind Speed	TWS 8.0 kts	Black
POS - Easting	E356789.0	Black
POS - Northing	N3456789.0	Black
POS - Latitude	N25 35.0000	Black
POS - Longitude	W116 59.8245	Black
POS - Elevation Above MSL	ELEV 0.00m	Black
POS - Standard Error/HDOP	HDOP 0.00m	Black
POS - Time of Position	12:00:00.0	Black
ROV - Altitude	ROV Alt 20.00m	Black
ROV - Depressor Angle	Dep Angle: 0.00000	Black
ROV - Depth	ROV D 0.00m	Black
ROV - Jet Knife Angle	KNFANG	Black
ROV - Jet Knife Depth	SNF D	Black
ROV - Stinger Angle	Stngr Ang: 0.00000	Black
ROV - Trench Depth	DOT 1.20m	Red
SEISMIC - Shotpoint Distance	SP DIST: 10.00m	Black
SEISMIC - Shotpoint Error	SP ERR: 0.20m	Black
TENSION - LCE(Ch3)	LCE TEN 5.33t	Black
TENSION - CDE1(Ch4)	CDE1 TEN 1.44t	Black
TENSION - CDE2(Ch5)	CDE2 TEN 0.22t	Black

Item Name	Sample Entry	Text Color
TEL CABLE - Angle	C angle: 0.0	Red
TEL CABLE - Burial Depth	DOB 0.00m	Red
TEL CABLE - Count(Ch1)	C cnt 1122.0 m	Red
TEL CABLE - Speed(Ch1)	Csped 1.5 m/s	Red
TEL CABLE - Tension(Ch1)	C ten 6.25 tn	Red
TOW CABLE – Count(Ch2)	T Cnt 0.00m	Red
TOW CABLE – Speed(Ch2)	TOW SPD 25m/m	Red
TOW CABLE – Tension(Ch2)	TOW TEN 0.00tn	Red
WPT - Bearing	BRG 346.7T	Red
WPT - Name	WPT Anode1	Red
WPT - Range	RNG 531m	Red
WPT - Vertical Range	vRng 0m	Red
WPT - Direct Range	dRng 531m	Red

To Remove a Vehicle's Data from Display in the Vehicle Text Window

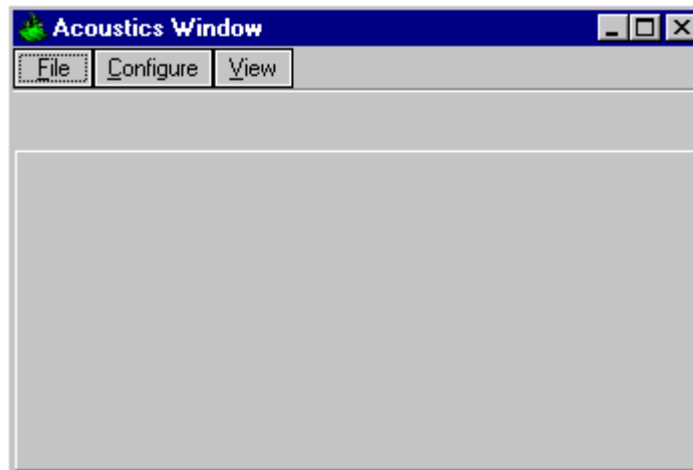
- 1 Select the main menu item **Configure > Vehicles > Vehicle Presentation > Vehicle Window Data > Off**.

Acoustics Window

The **Acoustics Window** provides you with the means to configure and monitor all aspects of the WinFrog acoustic operation. This window supports multiple sub-windows that provide these features for different parts of the acoustic operation.

To Display the Acoustics Window

- 1 From the **View** menu, choose **Acoustics**



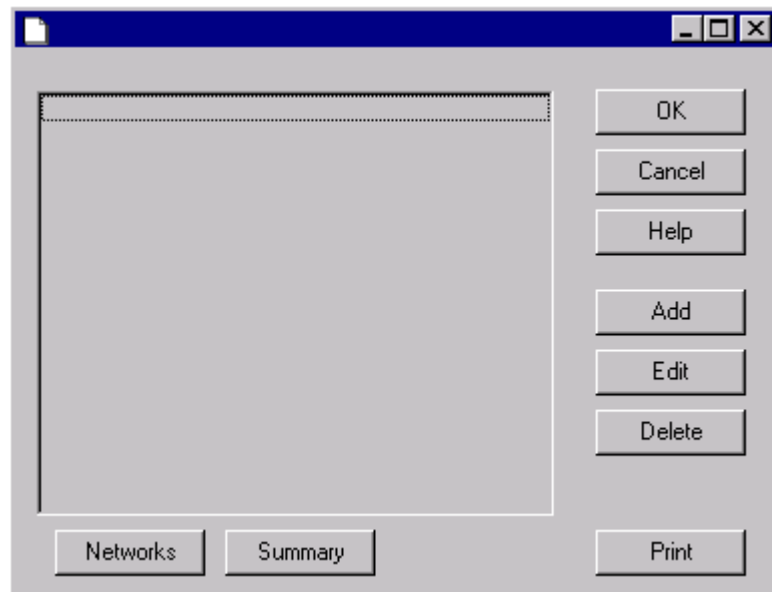
This window provides access to the configuration options and sub-windows from the three menu buttons located at the top of the window.

Working Files Options

You are able to work with **transponder** and **velocities** files directly from the **Acoustics Window** using the **File** menu item. This is a more efficient process than using the WinFrog main menu **File** item.

New

Click the **File** item, select **New** and you are able to select either **Xponders** or **Velocity**. Choosing either one moves you directly to the new Xponders or Velocities window.



Proceed from this point as described in the **Working Files** chapter for Xponder and Velocity files.

Set To Working

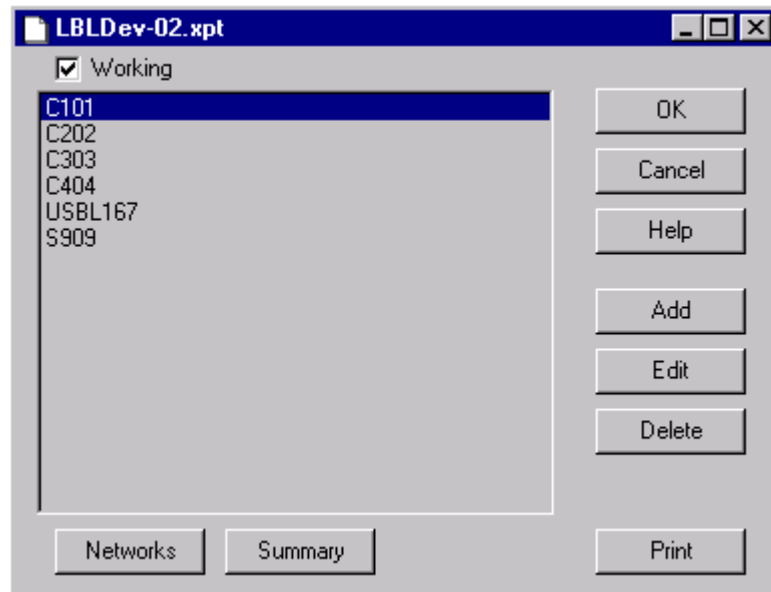
This option allows you to directly set a selected Xponders or Velocities file to be the Working version.

Click the **File** item, select **Set to Working** and then select either **Xponders** or **Velocity**. Choosing either one moves you directly to the browse dialog showing only the appropriate file types. Select the desired file and click **OK**. The selected file is automatically set to be the Working copy.

Note: If there is currently a **Working Xponders** file, you are alerted to this and the operation is aborted. If this occurs, you must open the current Working Xponders file and un-check the Working checkbox and exit with OK. Now a new Working Xponders file can be set. This check is not currently implemented for the **Working Velocities** file.

Edit

This option allows you to directly access the current **Working Xponders** or **Velocities** files for editing. Click the **File** item, select **New** and you are able to select either **Xponders** or **Velocity**. Choosing either one moves you directly to the Xponders or Velocities window.



Proceed from this point as described in the **Working Files** chapter for Xponder and Velocity files.

Direct Configure Options

From the **Configure** menu item, you are able to select the vehicle with which to associate the acoustic calibration features and configure and control the acoustic calibration.

Select Vehicle for Calibration

This option allows you to select the vehicle with which the window will associate all acoustic calibration control and monitoring.

Click the **Configure** item, select **Select Vehicle for Calibration** and you are able to select from a pop up list of all vehicles with either an **LBL TRANSCEIVER** or **USBL HYDROPHONE** data type attached to it. Select the appropriate vehicle.

In subsequent repeats of the aforementioned steps, the selected vehicle is displayed with a checkmark beside its name.

Note: This setting is not saved when the Acoustics Window is closed.

Calibration

This option provides direct access to the **Calibration** dialog for the selected vehicle. If a calibration vehicle has not been selected, you are so informed and the **Calibration** dialog is not accessed.

Click the **Configure** item, select **Calibration**.

Calibration for Survey 2

Data Collection/Control

☒ Off ☐ On Apply Data Collection Setup Now

☐ LBL Ranges

☐ II Ranges C101 Clear

☐ USBL Data

Min Interval (seconds) 1

Graphics ☐ On ☒ Off

☐ LBL Baselines Setup

☐ Depths Setup

Data Load/Save

Current File

Load Save AutoSave AutoSave Off

Calibration Calculations

Edit Data Recalc LBL Xpdr Report

Calculate Reset USBL USBL Report

Statistics Edit Xponder

OK Cancel Help

Proceed from this point as described in the **Acoustic Calibration** chapter.

Viewing Windows

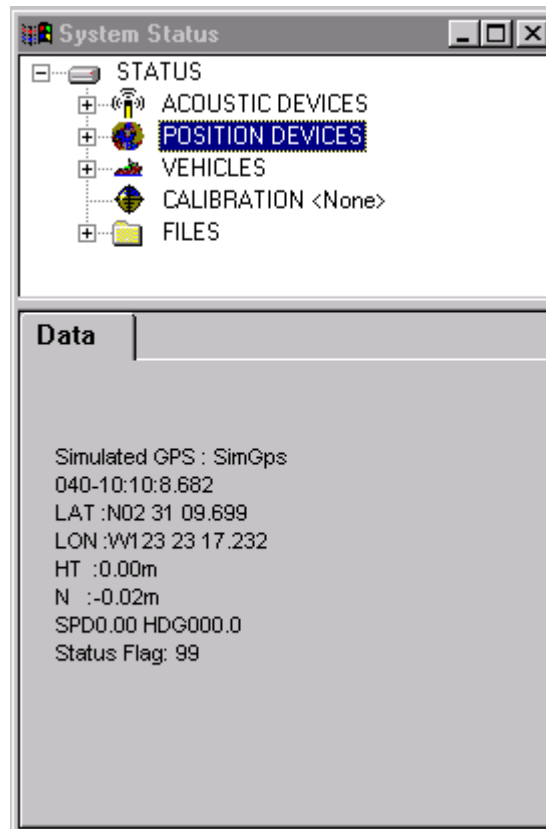
The **Acoustics Window** allows you to access several windows that provide the means to monitor the WinFrog system and operation as it pertains to acoustics. Some of these support direct access to the configuration of the WinFrog components they are monitoring.

These windows are accessed from the **View** menu item. The following sections detail each available window.

System Status

This window presents a summary of the WinFrog system as it relates to acoustic operations. The information is constantly updated and reflects the current respective configurations and information.

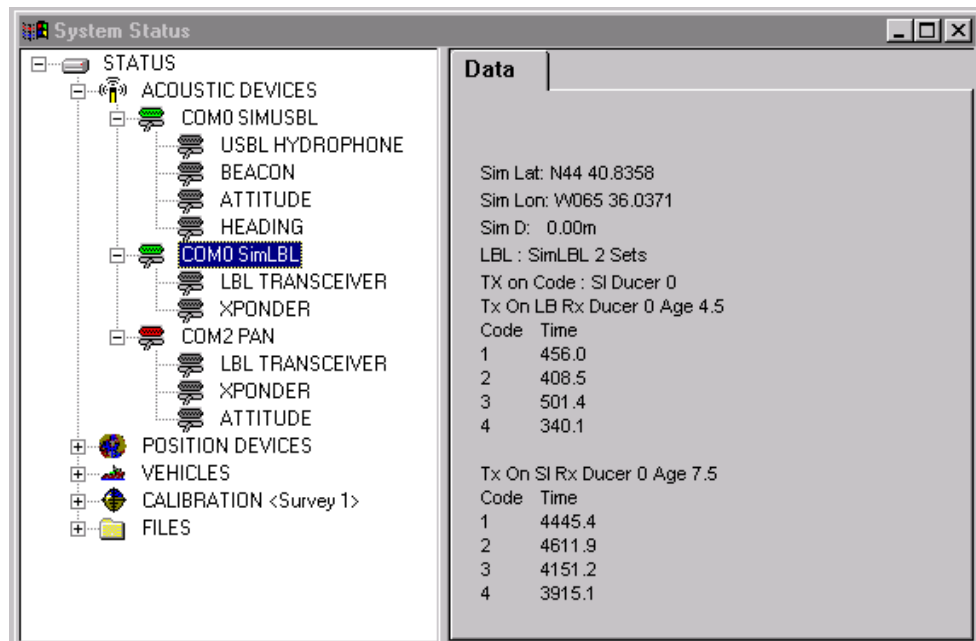
Click the **View** item and select **System Status**.



This split window presents the configuration of WinFrog in a tree format in one panel and data in the other panel. The split can be configured to vertical or horizontal via a pop-up menu using the right mouse button in the tree section. The font used in the data section can be modified via a pop-up menu using the right mouse button in the data section.

The tree nodes include icons to indicate an appropriate status.

ACOUSTIC DEVICES Node



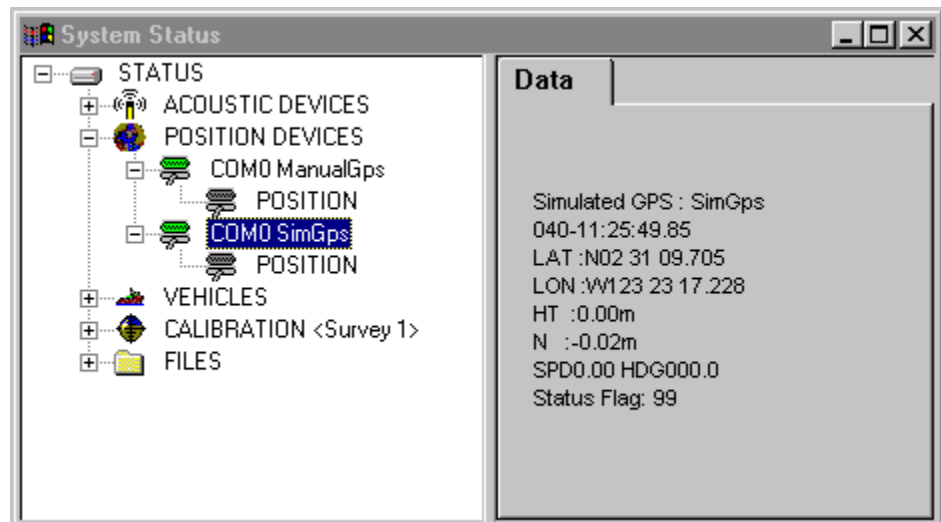
This node lists all the LBL and USBL acoustic devices that have been added to WinFrog. The devices are listed with an icon indicating the status of the serial port. Each device node can be expanded to list the data types associated with it.

Select a device and click the right mouse button to open a pop-up menu that presents direct access to the selected devices configuration.

Note: Devices can not be added to WinFrog from this window.

For more details, see the **I/O Devices Window** section in this chapter.

POSITION DEVICES Node

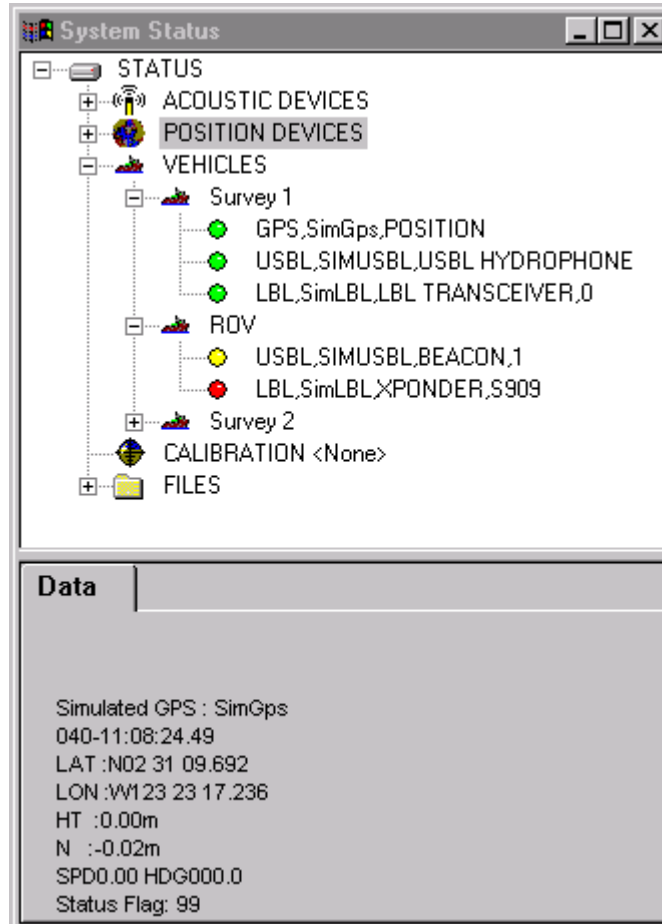


This node lists all the position type devices (GPS) that have been added to WinFrog. The devices are listed with an icon indicating the status of the serial port. Each device node can be expanded to list the data types associated with it.

Select a device and click the right mouse button to open a pop-up menu that presents direct access to the selected devices configuration.

For more details, see the **I/O Devices Window** section in this chapter.

VEHICLES Node



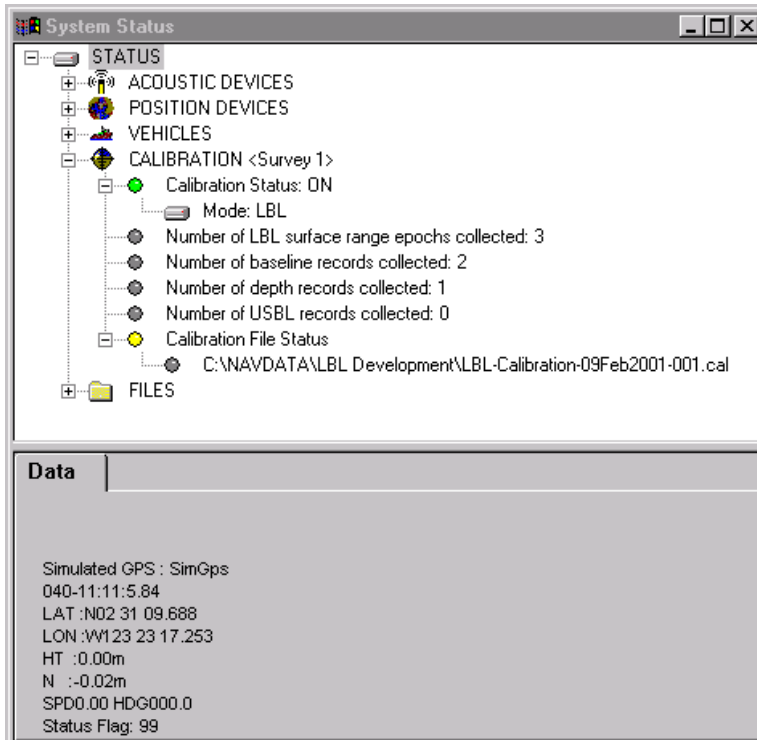
This node lists all the WinFrog vehicles that have an acoustic data type attached to them. These nodes can be expanded to list the POSITION, LBL and USBL data types attached to the respective vehicle. Note that only these data types are listed.

The data type nodes include an LED indicating the status of that data type's position calculations. A yellow LED indicates that the status is unknown or the position calculation was successful but the result was gated. A red LED indicates that the position calculation failed. This failure may be due to insufficient data. A green LED indicates that the position calculation was successful and accepted.

Select a data type and click the right mouse button to open a pop-up menu that presents direct access to the selected data type configuration.

For details on configuring the data types, see the **Vehicle Data Source**, **LBL Operation** and **USBL Operation** chapters.

CALIBRATION Node



This node summarizes the calibration status for the vehicle selected for the calibration for the window (see **Select Vehicle for Calibration**). The primary node caption includes the name of the vehicle selected or None if one has not been selected.

The node can be expanded to provide details on the calibration. For details on the information displayed here, see the **Acoustic Calibration** chapter.

Calibration Status

This node shows the current status of the calibration data collection, both with an LED (green, collection is on, red, collection is off) but also with an **ON** and **OFF** statement. In addition, this node can be expanded to show the current collection mode.

Mode This states the current calibration data collection mode, either LBL, II, USBL, Baselines or Depths. In addition, it includes the status if the collection is Paused or Aborting.

Number of LBL surface range epochs collected

This lists the total number of surface position and LBL range data records in the current calibration data set.

Number of baseline records collected

This lists the total number of baseline observation records in the current calibration data set.

Number of depth records collected

This lists the total number of depth observation records in the current calibration data set.

Number of USBL records collected

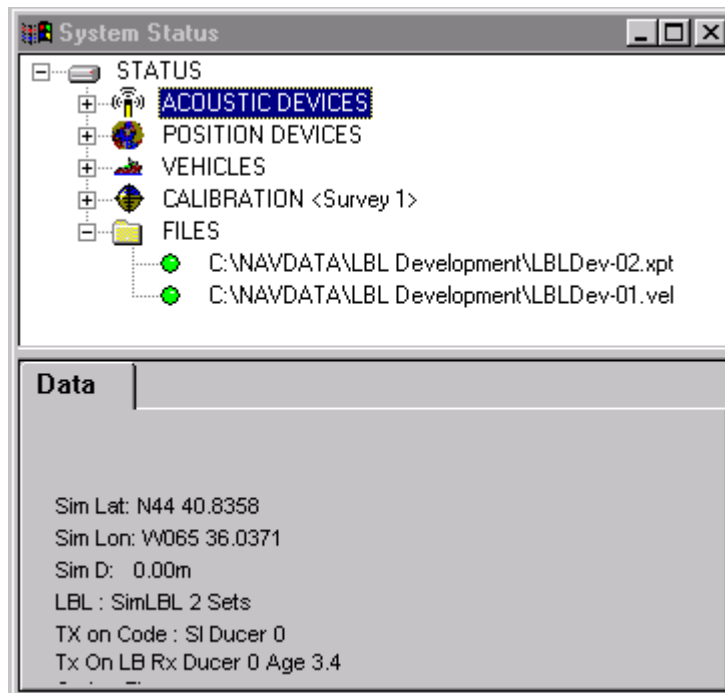
This lists the total number of surface position and USBL range data records in the current calibration data set.

Calibration File Status

This node shows the current status of the calibration data file with respect to actually being saved to disk. The node LED is red if the file has not been saved once. It is yellow if the file has been saved at least once but there is new data in the data set and the file should be saved again soon. The LED is green if the file has been saved and is current, that is, there are no new data points.

Name This lists the name of the current calibration data set file.

FILES Node



This node expands to summarize the associated **Working Xponders** and **Working Velocities** file status.

The names of the current **Working Xponders** and **Working Velocities** files are listed with a green LED associated with each indicating that the file is loaded and set to Working. In either case, if a Working file is not present, the LED flashes between yellow and red and the message **>>>LOAD AN XPONDER FILE<<<** or **>>>LOAD A VELOCITY FILE<<<** is shown in place of the file name.

Calibration Status

This window presents a summary of the current calibration data set for the selected calibration vehicle, whether loaded from a file, or currently being collected or any combination of these. The window is constantly updated and represents the current status of the calibration data set.

Click the **View** item and select **Calibration Status**.

Acoustic Calibration Status Window

Data Collection Mode: Baselines (Active)

Calibration File: \\Aholman-nt\share\geoff\SummaryTest0001-USBL-

Created: January 09, 2004 20:05:34

Last Saved(UTC, System): December 31, 2003 14:49:08

Calibration Start Time: January 19, 2004 15:15:49

Last Observation Epoch:

Current Time(UTC, System): January 19, 2004 19:15:59

Surface Range Summary:

Station	Type	Tx	Address	Total # Ranges	# Weighted Ran...	
Test1	LBL	1	101	153	99	
Test2	LBL	2	202	152	112	
Test3	LBL	3	303	153	133	
Test4	LBL	4	404	153	108	
			---	---	---	

BaseLine Summary:

From Station	To Station	# Fwd Su...	# Fwd Fail...	# Fwd W...	# Rev Su...	# Rev Fail...	# Rev W...	Mean Ra...	Mean Sca...	Expected ...
Test1, 101	Test2, 202	4	4	4	2	3	1	307.054	228.058m	228.333m
Test1, 101	Test3, 303	4	1	3	3	2	3	485.351	360.229m	359.758m
Test1, 101	Test4, 404	1	4	1	2	3	2	493.235	366.081m	366.851m

Depth Summary:

Station Name, Address	# Succ...	# Failed...	# Weig...	Mean Raw ...	Mean Scale...	Expected D...	
Test1, 101	4	1	4	101.450	100.540	101.000	
Test2, 202	4	1	4	102.775	101.865	102.000	
Test3, 303	4	1	2	104.050	103.140	103.000	
Test4, 404	4	1	4	104.925	104.015	104.000	

Current Collection Process: BaseLine Data

Started: January 19, 2004 15:15:49 Elapsed Time: 00:00:10

From Station	To Station	# Attempts	Raw BL (TWTT)	Reduced BL	
Test1, 101	Test2, 202	2	306.461	227.859m	

The information is presented in a header followed by four list windows.

Header

This section summarizes the overall calibration data information.

Data Collection Mode

This displays the current data collection mode and its status.

The possible modes are as follows:

- LBL Standard Surface Range
- LBL II Surface Range
- USBL Surface Range
- Baselines
- Transponder Depths

In the case of the first three, the only status is **(Active)**, in the case of the last two the status could be **(Active)** or **(Paused)**.

Calibration File	This gives the path and name of the file used for the current calibration data set.
Created	This is the date and time the file was created (WinFrog clock).
Last Saved	This is the time the file was last saved (computer clock).
Calibration Start Time	This is the time the calibration was started (WinFrog clock).
Last Observation Epoch	This is the time the timestamp of the last data epoch (WinFrog clock).
Current Time	This is the current time (computer clock).

Surface Range Summary

This list window summarizes the surface based observations. This includes both surface position and LBL range data records and surface position and USBL range data records. They are listed by type, name and address/beacon code.

Station Name	The stations that have been ranged to as part of the calibration data set.
Type	The data type, either LBL , USBL (XYZ) or USBL (TWTT) .
Tx	The LBL transmit channel or the USBL beacon ID.
Address	The LBL address or the USBL beacon ID.
Total # Ranges	The cumulative total of the ranges for the associated station.
# Weighted Ranges	The cumulative total of the ranges for the associated station that are weighted in the solution.

Baseline Summary

This list window summarizes all the observed baseline station pairs. Any pair is only listed once in the list and includes the forward and reverse observations. For a given pair, the From

station is assigned to the station of the pair that is detected first in the calibration data set station information list.

From Station	The From station in the baseline pair by name and transponder address.
To Station	The To station in the baseline pair by name and transponder address.
# Fwd Successful	The total number of successful forward baseline observations.
# Fwd Failed	The total number of failed forward baseline observations.
# Fwd Weighted	The total number of forward baseline observations weighted in the solution.
# Rev Successful	The total number of successful reverse baseline observations.
# Rev Failed	The total number of failed reverse baseline observations.
# Rev Weighted	The total number of reverse baseline observations weighted in the solution.
Mean Raw BL	The mean of all the weighted raw baseline observations.
Mean Scaled BL	The mean of all the weighted scaled baseline observations.
Expected BL	The expected baseline distance.

Depth Summary

This list window summarizes all the depth observations.

Station Name, Address	The stations that have had depth observations made to them.
# Successful Depths	The number of successful depth observations.
# Failed Depths	The number of failed depth observations.
# Weighted Depths	The number of weighted depth observations.

Mean Raw Depth	The mean of all the weighted raw depth observations. Note that this is the raw depth observation and therefore in the case of a digiquartz sensor, will be the frequency count, not an actual depth.
Mean Scaled Elevation	The mean of all the weighted depth observations reduced to a station elevation.
Expected Elevation	The respective station elevation as a reference for the observations.

Current Collection Process Summary

This list window summarizes the current collection process. The associated header states the current process type, start time and elapsed time.

The list window itself provides the columns that relate to the respective current process.

LBL Ranging

Station Name	This column lists the station name and address of the occupying transponder.
Data Time	This column gives the epoch of the current observation.
Observed Range (TWTT)	This column gives the current raw range, that is, the two-way-travel-time in milliseconds.
Red. Range	This column gives the current reduced range.

USBL Ranging

Station Name	This column lists the term USBL and the beacon code.
Data Time	This column gives the epoch of the observation.
Obs. X	This column gives the current raw observed X value of the USBL data.

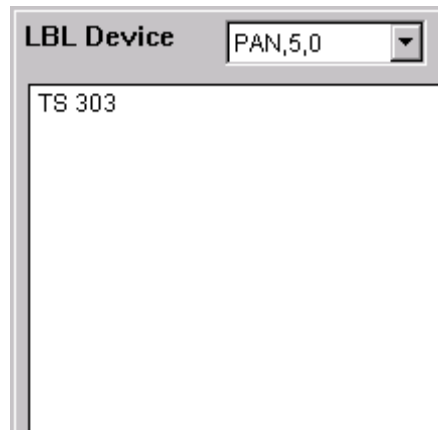
Obs. Y	This column gives the current raw observed Y value of the USBL data.
Obs. Z	This column gives the current raw observed Z value of the USBL data, except that the sign convention has been changed to represent the local ship based coordinate reference frame in that this Z term is a negative.
Baseline Data	
From Station	This column lists the From station in the baseline pair by name and transponder address.
To Station	This column lists the To station in the baseline pair by name and transponder address.
#Obs collected	This is the number of forward and reverse baseline observations collected.
Depths	
Station	This column lists the station by name and transponder address.
#Obs collected	This is the number of depth observations collected.
Raw Obs	This column lists the current raw depth observation. Note that this is the raw depth observation and therefore in the case of a digiquartz sensor, will be the frequency count, not an actual depth.
Reduced Elevation	This column lists current depth observation reduced to a station elevation.

Terminal

This window enables you to communicate directly with a selected LBL acoustic device using a **Terminal Window**.

To view, click the **View** item and select **Terminal**. While open, this item is displayed in the View menu with a checkmark.

To close, click the **View** item and select **Terminal**.



From the drop down list of available LBL acoustic devices, select the one to communicate with.

Click the mouse in the terminal section of the window. Enter the command to send to the device and hit **Enter**. While waiting for the response, the terminal section is set to read only. When the response is received it is displayed in the terminal section and this section becomes active again.

If a response is not received after 30 seconds, the terminal section is updated to display a TIME OUT message and re-activated.

If the appropriate devices are not available, an appropriate message is displayed in the terminal section.

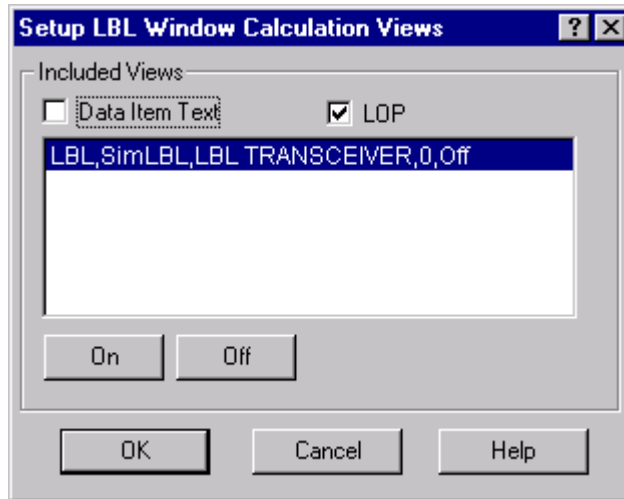
Calculations

This window provides similar functionality to the **Calculations Window** (see section earlier in this chapter) modified to reflect the needs for monitoring the acoustic operations.

To view, click the **View** item and select **Calculations**.

To configure, select the vehicle from the dropdown list of vehicles (this list contains only those vehicles with acoustic data types attached to them).

Then click the **Setup** button to access the configuration dialog.

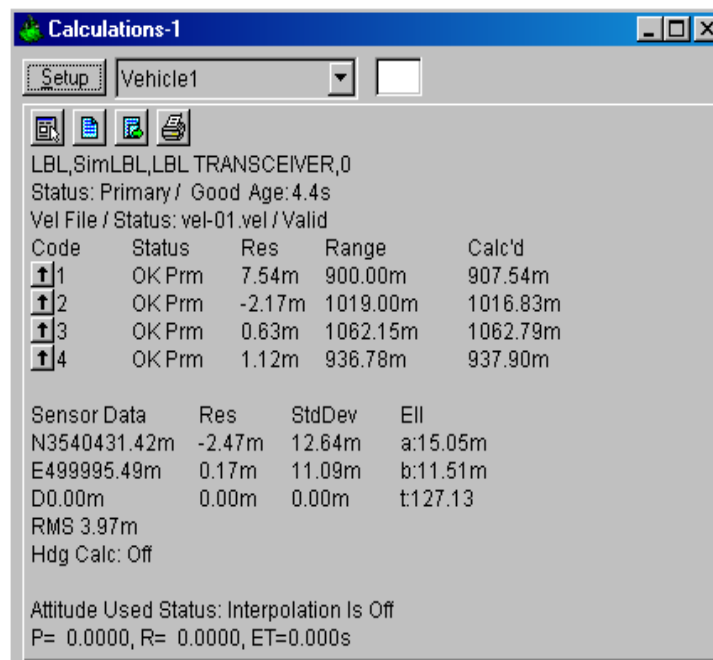


Only acoustic related data types are listed. The presentation options are **Data Item Text** and **LOP**.

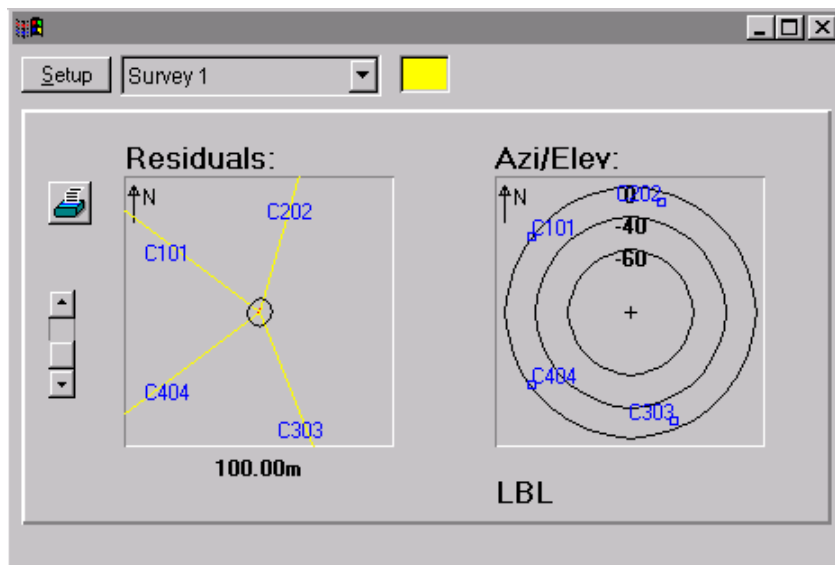
To enable the display of a data type for viewing, select the desired data type and click the **On** button. To disable, repeat this process but click the **Off** button.

Then select one or both display options and click **OK**.

The following figure is an example of an **LBL TRANSCEIVER** data type using the **Data Item Text** option.



The following figure is an example of an **LBL TRANSCEIVER** data type using the **LOP** option.

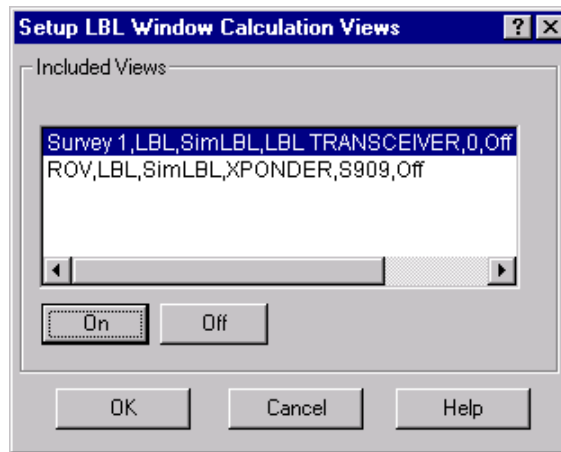


For more details on the windows presented, refer to the **LBL Operations** and **USBL Operations** chapters.

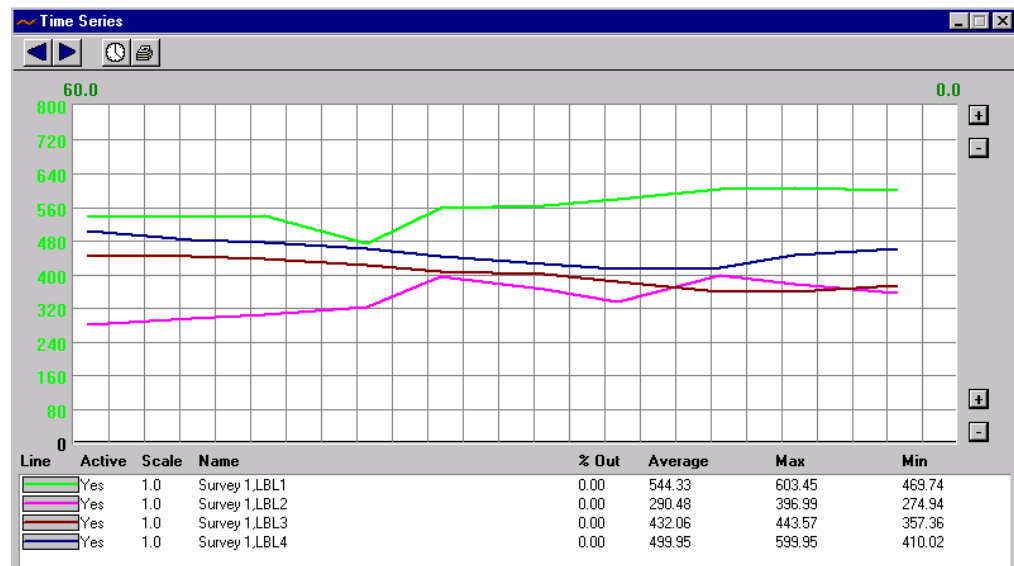
Time Series

This window provides a time series view of the data associated with the acoustic data types.

To view, click the **View** item and select **Time Series**. Immediately, the configuration dialog pops up.



All data types available for viewing using the time series window are listed in the list box. They are given by vehicle name, device type, device name and data type name. Select one and click the **On** button. If you wish to view more than one, select another and click the **On** button again. Note that the window will become cluttered and difficult to interpret if too many data types are displayed. Click **OK** to exit this dialog and view the time series window.

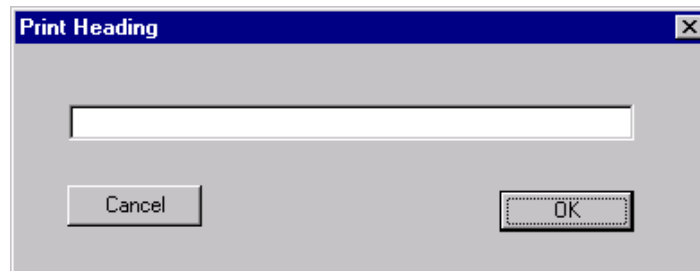


The window provides a comprehensive time series display of the pertinent data and includes a legend and button control for changing the viewing window.

The left and right arrows in the tool bar control the length of the time series. The +/- buttons on the right side of the window control the respective top and bottom limits of the time series.

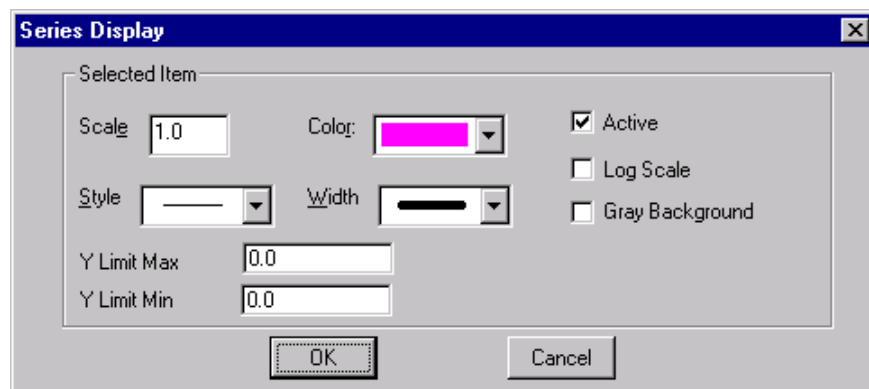
Clicking the **Clock** button in the tool bar toggles between freezing and unfreezing the time series plot.

Clicking the **Printer** button in the tool bar generates a printout of the time series window. When this is clicked, you are prompted for a heading for the printout.



This is followed by the typical Windows printer setup dialog box.

To configure the individual data plot lines, double click on the respective data in the legend to access the configuration dialog.



From this dialog, the line color and width can be selected. The plot for the respective data can also be enabled or disabled by checking or un-checking the **Active** checkbox. In addition, the background can be toggled between gray and white by checking or un-checking the **Gray Background** checkbox.

To reconfigure the data type selected for display, go to **View** and select **Time Series**. The configuration dialog pops up. Re-configure as required.

Extended Status

This window provides a view of the extended status of Sonardyne transponders.

To view, click the **View** item and select **Extended Status**.

The screenshot shows a window titled "Compatt Status" with a dropdown menu at the top left displaying "C202,202". The window is divided into several sections with read-only fields:

General	
Address	N/A
Firmware Ver	
Jitter	N/A
Tilted	NO
Enabled	NO
Sim Rx Card	N/A

Battery	
Type	Unkwn
Current Count	0
Maximum	
Voltage	0.00
Override	NO
Low Alarm	NO

TXPower	
LBL Ranging	LOW
Telem Start Pulse	LOW
Telem Data	LOW

Rx Status	
Channel	N/A
Gain	
TAT	0.00
CIF Rx	OFF
IIF Rx	OFF
USBL Rx	OFF
IIF reply	

Waits	
Before Interrog	0.00
For Reply	0.00
Between telem	0.00

Last Update:

A dropdown list box at the top left of the window presents a list of the transponders available for viewing in this window. When selected, the extended status information is displayed in the appropriate read only boxes.

For details on the information presented in this window, see **Working Xponders** in the **Working Files** chapter.

Anchor Handling Window

The **Anchor Handling** window displays navigation and anchor handling data for use in anchor placement tasks. This window generically refers to the vehicle that is attached to the anchors as a “**Barge**.” It allows you to monitor and record all anchor handling operations including picking up anchors off of a **Barge**, navigating toward a defined **Target** location, and dropping the anchor’s **On-Bottom** coordinates. The **Barge** vehicle, **Tug** vehicles, and **Anchors** can be selected from dropdown menus in the **Anchor Handling** window. It is also possible to view multiple **Anchor Handling** windows, if required. The size of each window can be altered by “grabbing” an edge or corner and dragging it “in” or “out” as desired.

You must configure the **Barge** vehicle and its **Anchors** before this window can be used. Any WinFrog vehicle that has been configured as **Fairlead Possible** is considered to be a **Barge**. Onboard anchor positions (i.e. **Fairlead** positions) are configured under the vehicle’s **Fairlead** option. **Fairleads** are defined as the physical location on the barge where the anchor lines lead to the **Anchors**.

To Configure a Vehicle as a Barge Vehicle

- 1 Select the main menu item **Configure > Vehicles**.
- 2 Highlight the barge vehicle (i.e. the vehicle that has the anchors onboard) and select the **Vehicle Presentation** option.
- 3 In the **Anchor Fairleads** category, select **Possible** then click **OK** to return to the **Configure Vehicles** dialog box.
- 4 Now, with the same vehicle name still highlighted, select the **Setup Fairleads/Anchors** option.

The **Fairleads** dialog box is used to configure up to **16 Fairleads** (i.e. the **onboard** positions of up to **16** anchors), as seen in the next figure.

On	Name	Fore/Aft	Port/Stbd	Northing	Easting	Status
☒	Anchor1	49.00m	-20.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor2	50.00m	-19.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor3	50.00m	19.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor4	49.00m	20.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor5	-49.00m	20.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor6	-50.00m	19.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor7	-50.00m	-19.00m	N0.00m	E0.00m	ON BOARD
☒	Anchor8	-49.00m	-20.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD
☐		0.00m	0.00m	N0.00m	E0.00m	ON BOARD

Static Color

Edit

Active Color

Edit

OK

Cancel

Help

5 Enter a **Name** and the **Offsets**, as measured from the vehicle's CRP, for each anchor.

6 Check the **On** box to enable plotting of that anchor on the **Graphics** screen.

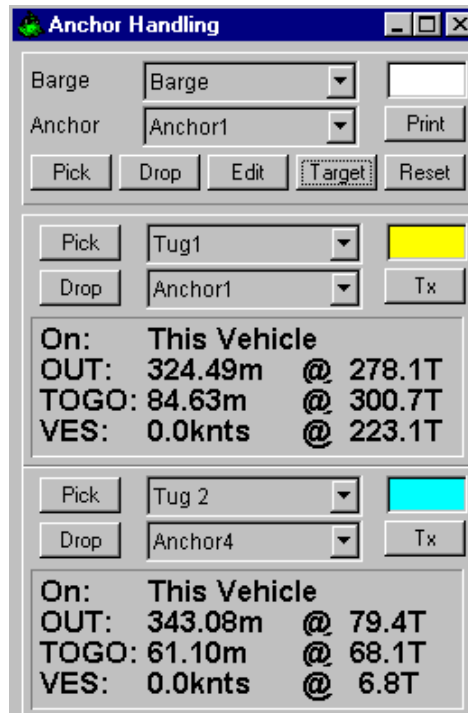
Note: do not enter any values into the **Northing**, **Easting**, or **Status** windows. These windows will update as the anchors are picked up by other vehicles or as they are dropped on the bottom.

Select the appropriate **Edit** button at the bottom of the **Fairlead** dialog box to change the colors of the **Fairleads** in the **Graphics** screen. The **Static Color** is for when the anchor is not being handled (i.e. onboard the barge or on the bottom). The **Active Color** is used when the anchor has been picked up.

Once all Fairleads are configured as desired, select **OK** to close the **Fairleads** window and return to the **Configure Vehicle** window.

To Display and Configure the Anchor Handling Window

- 1 Choose the main menu item **View > Anchor Handling**.



Top Area - Barge Vehicle Buttons

Barge dropdown	lists all of the vehicles that have been configured as Anchor Fairleads Possible . Typically, only one vehicle should be designated Fairleads Possible .
Anchor dropdown	lists all anchors that have been configured on the vehicle selected in the Barge menu above (Configure > Vehicles > Fairleads).
Color box	shows the color of the selected barge vehicle.
Print button	prints a summary of anchor locations; can be directed to the printer and/or an .rtf file.
Pick button	changes the selected Anchor Status to On Board the selected barge vehicle at its configured fairlead location (i.e. the barge picks up the anchor).
Drop button	changes the selected Anchor Status to On Bottom and updates the Anchor Target position to the anchor's current position (i.e. the anchor has been dropped to the bottom directly from the barge, rather than being

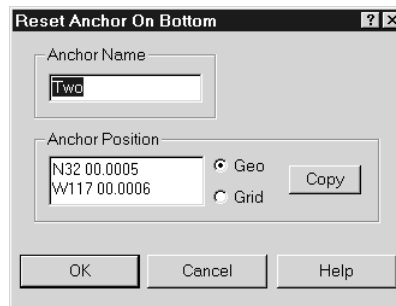
first handled by a **Tug** vehicle).

Target button

When selected, causes a blue square, labeled as per the selected anchor, to appear at the drop target coordinates. To remove the blue target square from the **Graphics** screen, choose the appropriate anchor and select **Target** again.

Reset button

Opens the **Reset Anchor on Bottom** dialog box to allow you to relocate the anchor on the bottom, if it has moved. The position that shows in the **Reset Anchor on Bottom** dialog box is the last known bottom position for the anchor. Enter a new position as desired.



Edit button

Select this button to open the **Anchor** dialog box, as seen below. This window allows you to edit the selected anchor's (i.e. Fairlead's) previously entered **Name** and onboard **Location** and also define a **Target** position.

Anchor dialog box

Plot checkbox

Select this option to enable plotting of this anchor in the **Graphics** display.

Name

Entry field

Highlight this window and change the **Name** of the selected anchor as required.

Fairlead

Fore/Aft and **Port/Stbd**

Highlight the **Fore/Aft** or **Port/Stbd** entry field and change the previously configured **Anchor/Fairlead** location.

Anchor to MidBuoy

Entry fields

MidBuoys are buoys placed along an anchor cable to lift the cable off of the bottom. Midbuoys are used when the anchor line is knowingly placed across an existing pipeline or cable to prevent damage to the existing structure. Highlight the appropriate window and enter the desired **Anchor to Fairlead** distance.

Target Location

Position and Range/Bearing

You can enter anchor **Target Location** information as either a **Position** (grid or geographical coordinates) or as a

Range/Bearing relative to the barge's location and heading.

If **Position** is selected, you can enter the coordinates manually or click the **Copy** button to copy the coordinates from WinFrog's temporary clipboard memory. (For example, if you click on the **Graphics** screen with the **Display Position** option enabled, the coordinates are written to the "clipboard.")

If **Range/Bearing** is selected, you must enter a **Range** (distance) from the (onboard) fairlead position and the **angle** from the **Vehicle's Bow**. **Note:** this is a relative angle measured **clockwise from the vehicle's bow**, **not** an absolute bearing from North.

Note: if the target position is altered with the anchor on the bottom, the anchor's position is overwritten by the new target position. Any changes made within this dialog box are entered directly into the **Fairleads** dialog box. (See the **To Configure Fairleads and Anchors** section of the **Vehicles** chapter.)

Bottom Areas - Anchor Handling Vehicles

The three areas repeated immediately below the barge vehicle buttons are for the display of **Anchor Handling Vehicle** (i.e. "tugs") data. The buttons and dropdown menus are repeated in each area so that the three vehicles/anchors can be tracked and viewed at the same time.

If there are more than three vehicles being handled at one time, you will need to view another **Anchor Handling** window and configure each sub-window area for a different vehicle/anchor.

Upper Untitled dropdown	lists all of the Anchor Handling Vehicles ("Tugs")- i.e. those vehicles that have been configured Not Anchor Fairleads Possible . (Configure > Vehicles > Vehicle Presentation).
Lower Untitled dropdown	lists all of the anchors (fairleads) that have been configured on the barge vehicle.
Color box	shows the color of the selected Anchor Handling Vehicle (i.e. Tug).
Pick button	Click this button to tell WinFrog that this vehicle has picked up the anchor displayed just below. (It will be picked up at the

Tracked Offset on this vehicle). This results in several changes:

The **On:** line, just below, will indicate that the anchor is now on this vehicle.

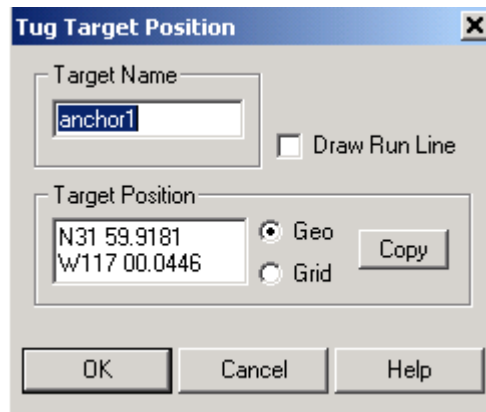
The **Graphics** display will draw a line from the original onboard (barge) location to the (tug) vehicle's present location. WinFrog changes the selected anchor **Status** to **On Board** the selected anchor handling vehicle at its tracked offset. This also generates an event that is written to the **Working Logs (.LOG)** file and output to the printer. See the Eventing chapter for more details on the **Working Logs** file.

Drop button

changes the selected anchor's **Status** to **On Bottom** and updates the anchor's **Target** position to the anchor's current position and turns off the anchor run line drawing and tracking. This also generates an event that is written to the **Working Logs** file and output to the printer.

Tx button

opens the **Tug Target Position** dialog box to enable you to transmit the **Target** position to a Tug Vehicle and to draw and track an **Anchor Run Line** (see section below). This obviously requires a telemetry system to be in place and operational.



On: displays the anchor state, i.e. whether it is on a vehicle or **On Bottom**.

OUT: displays the **distance** and **bearing** from the **fairlead** location on the barge to its present location.

TOGO:	displays the distance and bearing from the present anchor location to its target location.
VES:	displays the tug's present speed and heading . Again, this requires telemetry hardware to be in place to provide the barge with the tug's positioning information.

Anchor Events

When the **Pick** and **Drop** buttons are clicked, WinFrog generates an event. This event is automatically logged to the current **Manual Log** file. In addition, the event can be printed to the printer. You can control whether or not the events are printed in real-time. The default when a window is opened is to print the events. This setting is saved to and loaded from the .ini and .cfg files.

To Configure the Anchor Event Printing

- 1 Move the cursor to a point in the Anchor window where it is not over one of the buttons or data entry fields and then right-click.
- 2 The pop-up menu lists one option, **Print Event**. Click this item to toggle the setting on and off. If it is on, the item is listed with a checkmark beside it.

Anchor Run Lines

The **Draw Run Line** checkbox in the **Tug Target Position** dialog box allows you to draw and track run lines between the fairlead and the target anchor positions.

This option allows you to display locally and transmit to controlled and smart remotes, a run line from the fairleads to the target anchor positions. Because multiple anchors may be ran at the same time, the users at the master and at the smart remotes (i.e., winch operators) may want to view run lines for more than one Fairlead/Anchor. The users at the controlled remotes would likely only be concerned about the run line for their particular anchor.

The anchor run lines are survey lines and set as the tracked line for the corresponding vehicle in the Graphics windows, and as line data in the Vehicle Text window.

The checkbox allows you to turn on/off the drawing of the anchor run line at the corresponding controlled remote. Only the run line pertaining to the specified tug should be drawn at the corresponding controlled remote. When the run line is drawn the run line tracking is on, and when the drawing turns off the run line tracking is off too.

The **Drop** button in **Bottom Area – Anchor Handling Vehicles** changes the selected anchor's **Status** to **On Bottom** and turns off the anchor run line drawing and tracking.

Alarms Window

WinFrog's **Alarm** feature provides you with the ability to configure alarms to respond to almost any real-time condition. The **Alarms** window displays the real-time (instantaneous) conditions of the various alarms with the use of standard "status colors"; **green** indicating a **good** status, **yellow** for **caution**, and **red** for **full alarm**. **Note:** the **Alarm** window remains blank until you configure the required alarms. This section details both the configuration and display of alarms.

To Display the Alarms Window

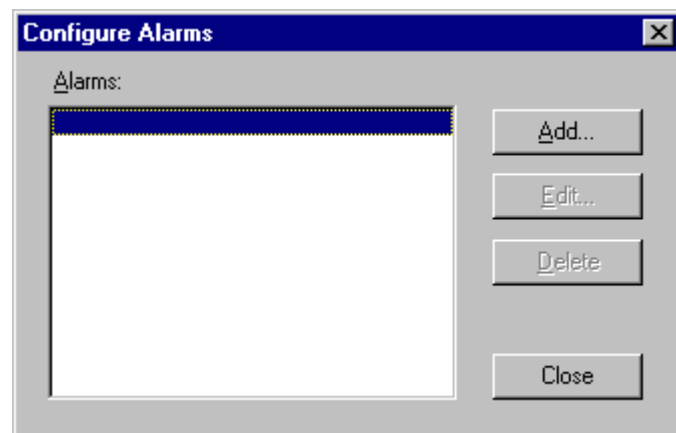
- 1 From the **View** menu, choose **Alarms**.

An empty **Alarms** window displays. The **Alarm** window can be changed in size or moved by "grabbing" the display window edges (or title bar) with the mouse pointer and moving it as desired.

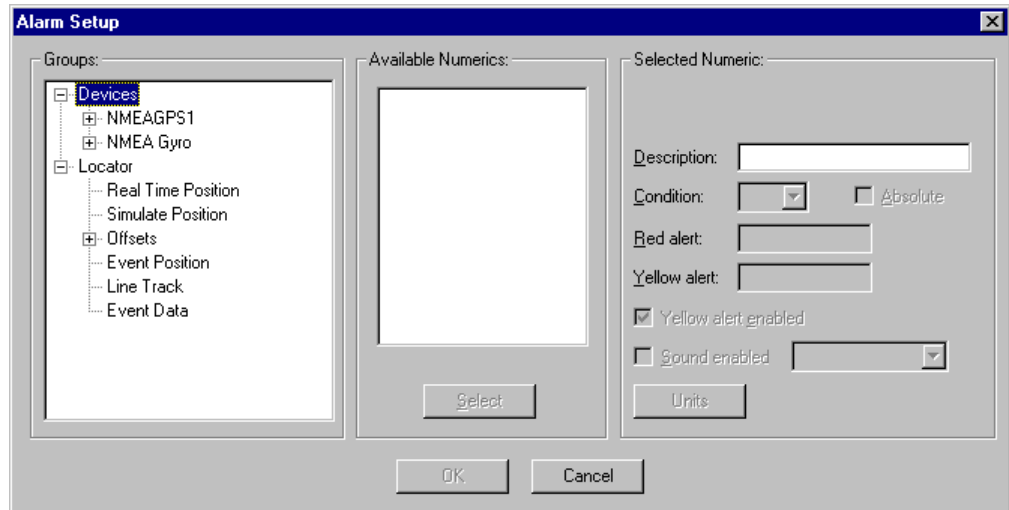
To Configure Alarms

- 1 Select the main menu item **Configure > Alarms**.

An empty **Configure Alarms** window appears, as seen below.



- 2 Click on the **Add** button to bring up the **Alarm Setup** window, as seen below.



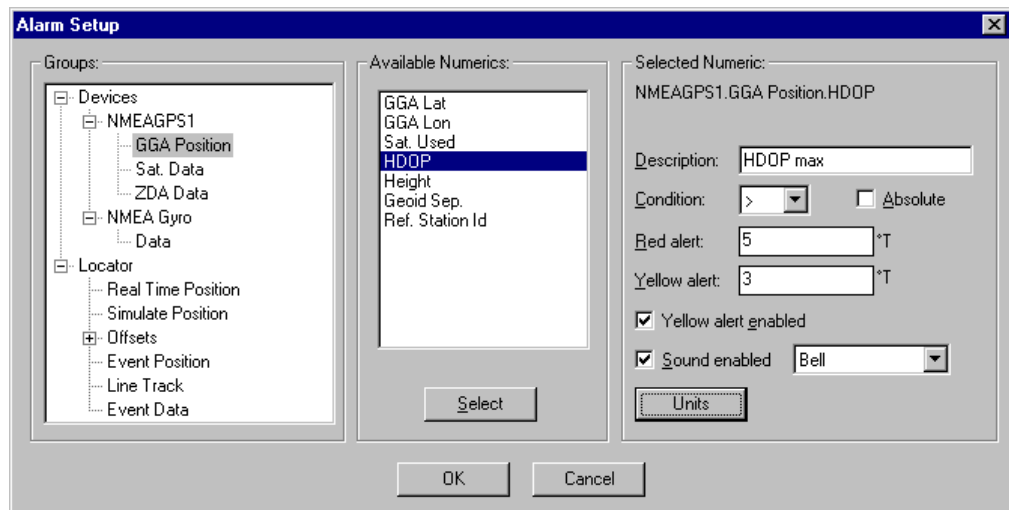
Click on the “+” symbol beside a **Device** or **Vehicle Name** to expand the list of items that can be added to the **Alarm** list. All items which can be selected for a particular **Vehicle** or **Device** are listed in the **Available Numerics** portion of the **Alarm Setup** window.

- 3a Double-click on the desired item in the **Available Numerics** window to select it and have it displayed in the **Selected Numeric** portion of the window.

Or

- 3b Highlight the desired item and click on the **Select** button.

In the display seen below, the **GGA Position HDOP** value has been selected.



- 4 Type in a description for the device in the **Description** entry window.
- 5 Select the appropriate condition from the **Condition** dropdown box.

Note: ensure that the correct units are being used for the alarm. Select the

Units button in the bottom of the **Selected Numeric** portion of the **Alarm Setup** window to change units as required.

- 6 Enter the appropriate **Red Alert** and **Yellow Alert** values.
- 7 Enable the **Yellow Alert** (optional).
- 8 Enable the **Sound Alert** and choose the desired option from the dropdown menu (optional).
- 9 Repeat steps 3 through 8 to configure additional alarms. Select **OK** to return to the **Configure Alarms** window once all desired alarms are added.
- 10 Select the **Edit...** button to change a configured alarm, if required.
- 11 Select **Close** from the **Configure Alarms** dialog box to close the window and save the changes.

The **Alarms** display window now shows the configured alarms and the current status of each.

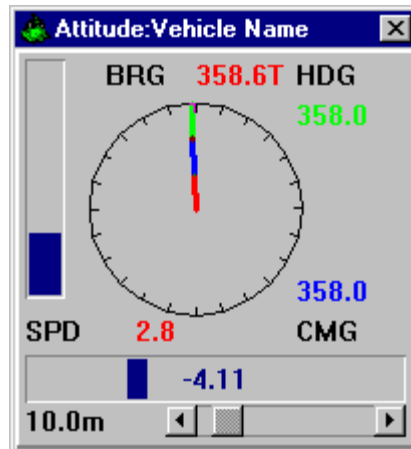
Attitude Window

The **Attitude** window graphically displays a variety of navigation information relating to the **current** vehicle. (The **current** vehicle is the one that is displayed in the **Vehicle Text** window). The information displayed in the **Attitude** window can also be simultaneously displayed in text form in the **Vehicle Text** window. However, in time critical operations, the information can be seen much easier and quicker using the **Attitude** window.

Note: only one **Attitude** window can be displayed at a time and the window size is not configurable.

To Display the Attitude Window

- 1 From the **View** menu, choose **Attitude**.



The following information is found in the **Attitude** window, clockwise from the top.

BRG	displays (in red) the bearing of the survey line segment currently being tracked by the current vehicle. If a survey line is not being tracked, BRG represents the bearing to a tracked waypoint. If neither are being tracked, BRG will show the last BRG value used. The BRG value is also graphically represented in red on the “compass” in the center of the display.
HDG	displays (in green) the heading of the current vehicle. The HDG value is also graphically represented in green on the “compass” in the center of the display.
CMG	displays (in blue) the Course Made Good of the current vehicle. The CMG is the inverse bearing between the last two filtered positions. The CMG is also graphically represented in blue on the “compass” in the center of the display.
SPD	On the left side of the Attitude window is the Speed (SPD) Indicator bar. As the current vehicle’s speed increases, the blue bar will grow to reflect the increase in speed, ranging from 0 to 10 knots.
Slide bar	Along the bottom of the Attitude window, the blue Cross Track Error Indicator bar moves from side to side as the vehicle crosses the currently tracked survey line segment. If

the vehicle is to the **Port** of the currently tracked survey line segment, the “tab” is to the left of center.

The numbers in this section of the **Attitude** window also indicate whether the vehicle is to the left or right of the currently tracked survey line segment. A **negative** offset value means the vehicle is to the **Port** of the line segment (in terms of the direction that the line coordinates were entered and the direction that the line is being tracked).

Use the adjustable bar at the bottom of the window to change the **Scale** of the **Cross Track Indicator**. The value shown in the bottom left corner is **one half** of the **entire** width of the **Cross Track Indicator**.

Auditor Window

WinFrog’s **Auditor** Window allows you to keep track of all significant operations that have occurred in the current WinFrog session. **Note:** the term “significant operations” is used to refer only to those items that have some affect on the overall configuration of the program. These are noted in the **Auditor** display. For example, operations such as enabling or disabling displays, zooming in or out, or enabling or disabling waypoint or survey line tracking are not considered significant and are **not** noted in the **Auditor** display window.

Items that are included in the **Auditor** window include any changes to the **Working Geodetics**, **Working Files**, or **Working Units**.

To Display the Auditor Window

- 1 From the **View** menu, choose **Auditor**.

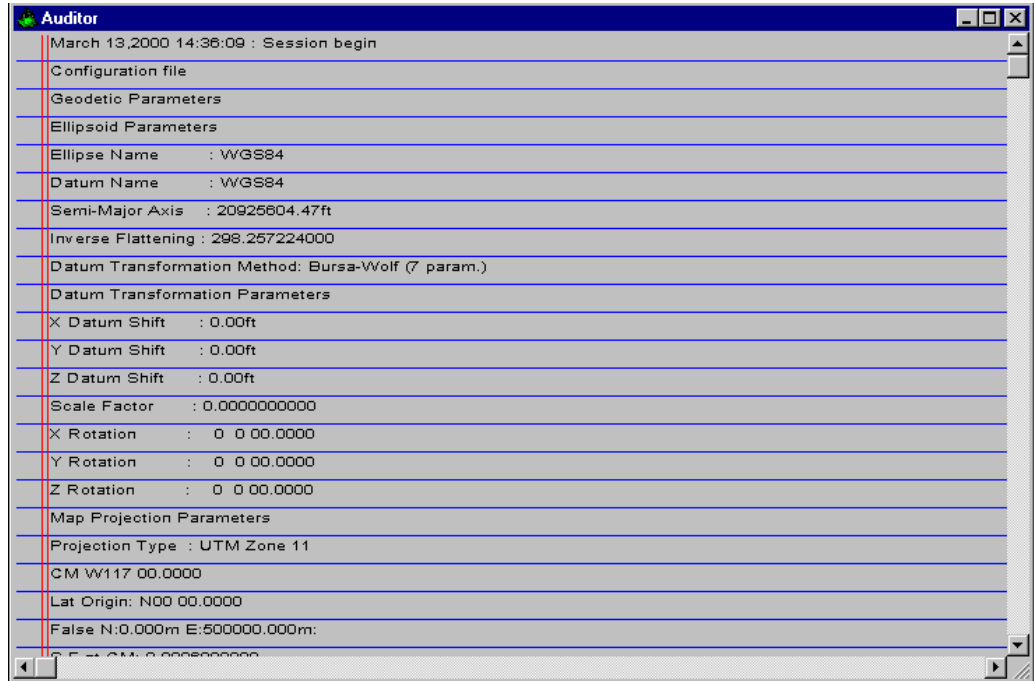
An empty **Auditor** window appears. The **Auditor** window can be changed in size or moved to a new location by “grabbing” the display window edges (or title bar) with the mouse pointer and moving the mouse as desired.

If the **Auditor** window was enabled when WinFrog was last shutdown, you can simply re-open it rather than display a new window.

To Re-Open the Auditor Window

- 1 Select the main menu item **Window**, then select **Auditor**.

The **Auditor** window will now appear in the size and location that it was last configured, with the significant items displayed, as per the example seen below.



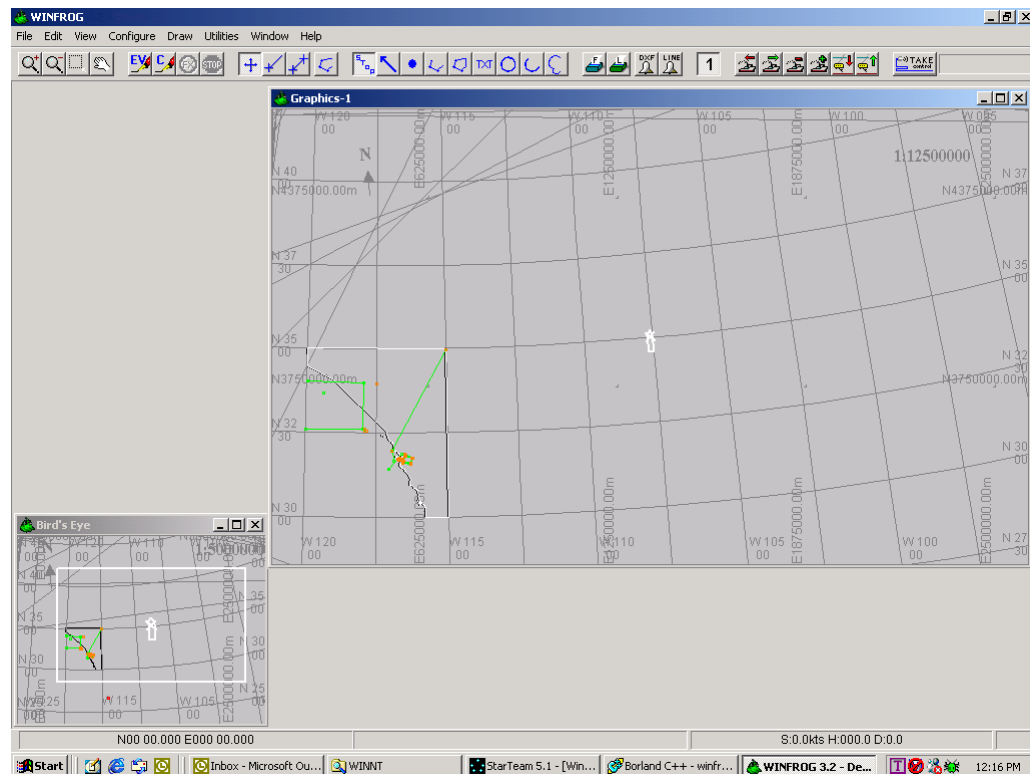
Bird's Eye Window

The **Bird's Eye** window provides all of the same display options and functionality available in the **Graphics** display. In addition to these features, the **Bird's Eye** display also plots a “box” that depicts the location and limits of the **Graphics** window. This box always remains correct in scale, even as the **Bird's Eye** and **Graphics** display scales are changed. Although WinFrog can display several **Graphics** windows, only one **Bird's Eye** window can be displayed. The **Bird's Eye** window is configured in the same way as the **Graphics** window.

To Display the Bird's Eye Window

- 1 From the **View** menu, choose **Bird's Eye**.

By default, the **Bird's Eye** display is located in the lower left corner of the WinFrog display space. The location and size of the **Bird's Eye** display can be changed by simply clicking and dragging the edges of the display box.



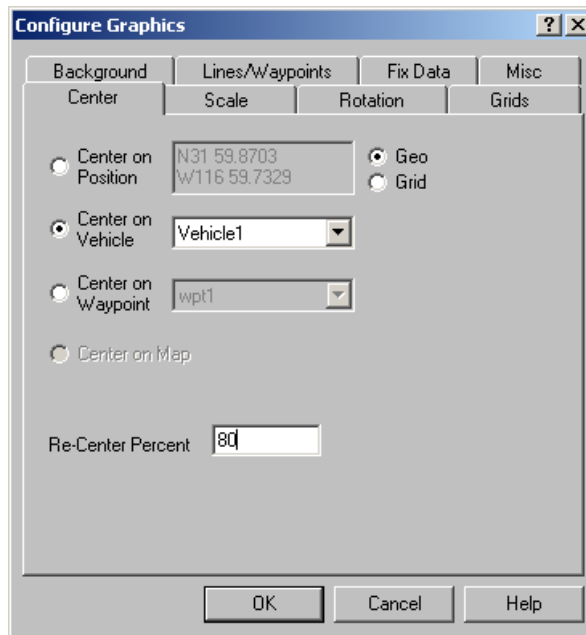
A white box is drawn on the **Bird's Eye** window to represent the area currently displayed in the related **Graphics** window. **Note:** the white box may not be visible if the **Bird's Eye** window is zoomed in very close or is centered on a different point from the **Graphics** window.

To Configure the Bird's Eye Window

1a With the **Bird's Eye** window selected, choose the main menu item **Configure > Bird's Eye**.

Or

1b Move the mouse pointer into the **Bird's Eye** display box limits, right-click and select the **Configure** option.



The display parameters that can be configured for the **Bird's Eye** window are identical to, but independent of, those for the **Graphics** window. This allows you to display the same (or different) information as the **Graphics** window.

Refer to the **Configure Graphics** window section earlier in this chapter for information describing the various configuration options for the **Bird's Eye** window.

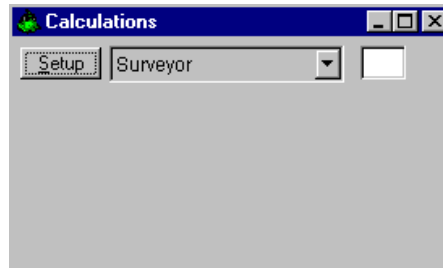
Calculations Window

The **Calculations** window displays real-time **Data**, **Statistics**, and **Quality Control** information for any device that has been added to a WinFrog vehicle. Several **Calculations** windows can be displayed at once, giving you the capability to simultaneously display information for several vehicles and devices.

Note: each **Calculations** Window can display data for any number of devices, but for organizational purposes it is recommended that you open a new **Calculations** window for each device.

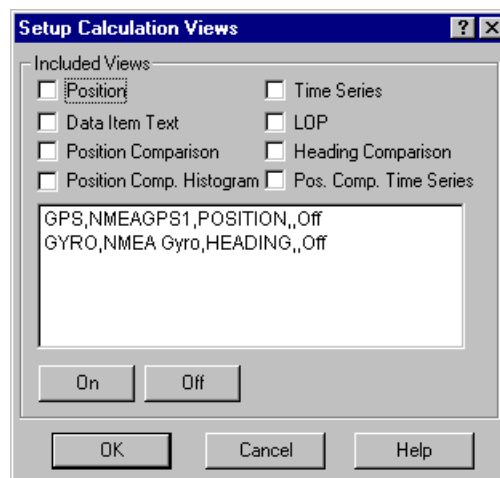
To Display a Calculations Window

- 1 From the **View** menu, choose **Calculations**.



To Configure the Calculations Window

- 1 If there is more than one **Calculations** window currently displayed, click the title bar of the one to be configured to make it the **active** window.
- 2 Select the appropriate vehicle from the dropdown menu list.
- 3 Click the **Setup** button to bring up the **Setup Calculation Views** window, as seen in the next figure.



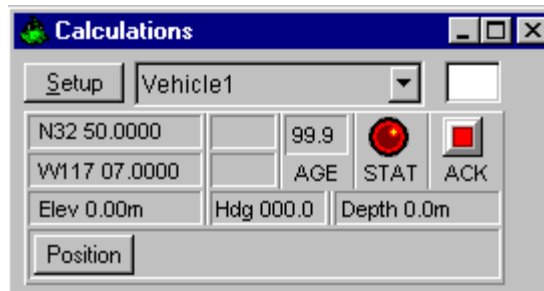
All of the devices that have been added to that vehicle's position are displayed in the white window area.

- 4 Choose the device for which you wish to see data displayed.
- 5 Click the **On** button.
- 6 Check the desired box in the **Included Views** area at the top of the **Setup Calculation Views** dialog box. Each of these options will enable a different data display in the **Calculations** window, as defined below.

Position box

Displays **Position** data in the top of the **Calculations** window, as seen below. (This option is the only one that does not require

any devices to be turned on in the **Calculations** window as described in Steps 3 and 4 above).



The selected vehicle's current **Latitude**, **Longitude**, **Elevation**, **Heading**, and **Water Depth** are updated every program cycle.

AGE box displays the age of the WinFrog position.

STAT button is a visual cue that indicates the status of the filtered position. A **green** cue indicates the position is **good**, a **yellow** cue indicates the position is **degraded** (the position calculation has failed for more than 15 seconds), and a **red** cue indicates the position is **invalid** (the position calculation has failed for more than 30 seconds). If the cue turns red, an alarm sounds, which can be silenced by clicking the **ACK** button.

ACK button	used to silence the status alarm
Position button	(located below the Elev. information) This button is a shortcut to the selected vehicle's Configure Vehicle-Devices window. This provides you quick access to edit any devices that have been added to the vehicle's position calculations.

Data Item Text box	Select this option to display the latest data from all devices that have been turned On in the Setup Calculation Views dialog box. Typically, this option is just used to display information for GPS device(s), particularly for GPS Pseudorange Calculations and Multi-Ref solution data.

Three buttons are displayed in a device's **Data Item Text** window, directly above the device information, four if the selected data item supports the fix print option. The

functions of each button from the left are as follows:

The first button provides a shortcut to the configuration menu for that particular device, as used by that vehicle.

The second button is not used.

The third button is used to toggle through different information pages for that device, if available.

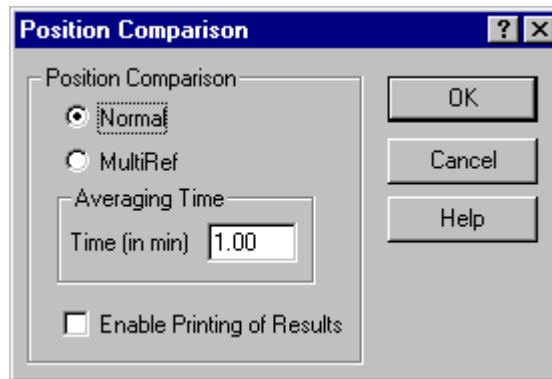
The fourth button prints a fix report for the epoch displayed when the button is clicked. You are then prompted for print options – print directly to the printer and/or print to an rtf file.

Position Comparison box

Select this option to display the coordinates of all **Primary** and **Secondary** positioning devices as well as real-time comparisons between their positions. **Survey Line** and **Waypoint** tracking data averaged over time can also be displayed. This comparison is user-configured and can be written to file for subsequent viewing and QC analysis.

To Perform a Position Comparison

- 1 Select the **Position Comparison** checkbox in the **Setup Calculation Views** dialog.
- 2 Turn **On** the **Primary** and **Secondary** devices.
- 3 Select **OK** to return to the **Calculations** window.
- 4 Select the **Edit** button.



There are two **Position Comparison** options available: **Normal** and **MultiRef**.

Normal	displays the comparison information between the Primary and Secondary positioning devices.
MultiRef	displays the comparison information between the weighted mean multi-reference position and the individual (single reference station) solutions.

An **Averaging Time** must be entered for either of these options.

- 5 Choose **Normal** or **MultiRef** and enter an **Averaging Time**.

When you return to the **Calculations** window, your **Averaging Time** input displays as **Time Remaining** and counts down to zero. The comparison, which will automatically repeat itself, can also be manually controlled by using the **Start** and **Stop** buttons. These data are not recorded to any files.

Position Comparison Display

The first line of the **Position Comparison** section of the **Calculations** window lists the **Primary Positioning Device** with its user-assigned name.

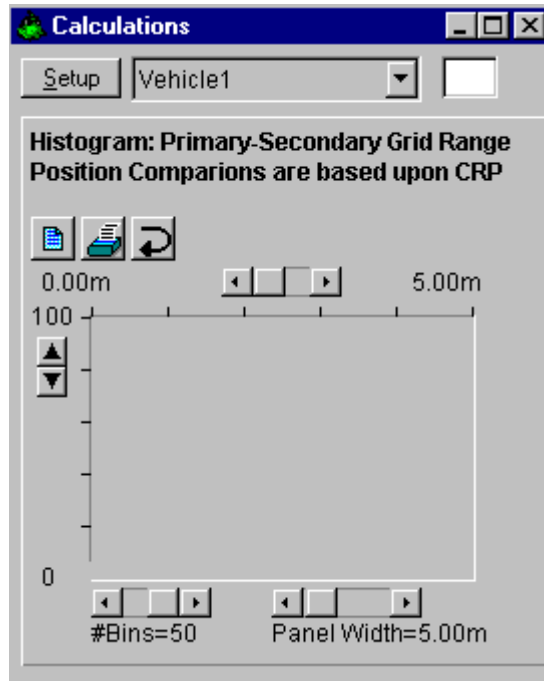
The second line displays that device's position in grid Northing and Easting.

The third and fourth lines display the same information for the **Secondary Positioning Device**.

The fifth line displays the instantaneous differences in the Northings and Eastings between the two devices.

Below that information is the **Average Position Comparison**. By default, the average is based on a one-minute time period. If there is another **Secondary** positioning device, the same information appears for it as it does for the first secondary. The bottom line displays the time remaining (in minutes) for the **Comparison Average**.

Position Comp. Histogram	Select this option to enable a Calculations window display that plots a real-time histogram of the Position Comparison between the Primary and Secondary Positioning devices. Note: this window does not require any devices to be turned On in the Calculation window's Config option.



To Configure a Position Comparison Histogram

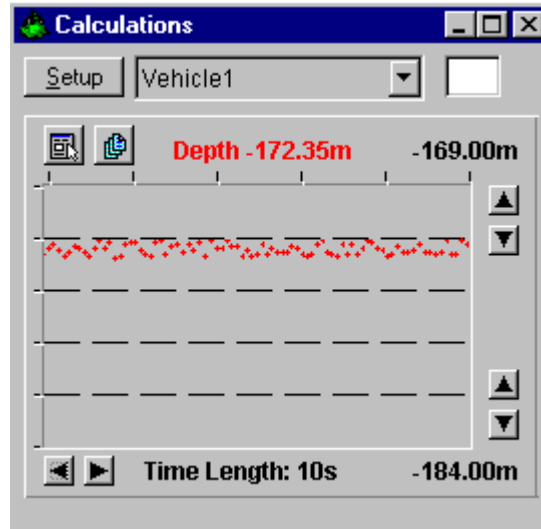
- 1 Click and move the sliding bar above the display window to set the **Center of the Plot**. (This is the absolute value of combined Northing and Easting errors).
- 2 Click on the radio buttons on the left of the display window to set the overall **Height** of the display to see changes in data more clearly
- 3 Select and slide the bar at the bottom left corner of the window to set the **Number of Bins** that are displayed.
- 4 Select and slide the bar at the bottom right corner to set the **Horizontal Panel Width** (range) of the window.

Note: the **Center** value will change as you change the **Width** value at the bottom of the screen. This may cause your data to “disappear” from the display window, requiring you to re-center the data to a realistic value.

Time Series

Select this option to display a graphical representation of a device’s **Data relative to Time**. This can be used to view how the position, water depth, etc. change over time. The data displayed in the **Time Series** graph are for the selected device, set to **On**. Only one data item can be graphed in each window at a time, but you can simultaneously display multiple **Time Series**

windows in the same **Calculations** display. A new window will be created for each device turned **On** in the **Calculations** window **Setup**. This window is typically used for the display of sounder depth data.



To Configure the Time Series Graph

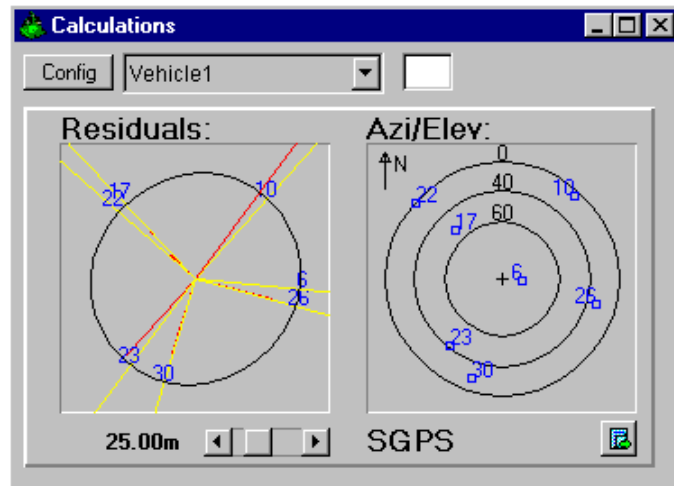
- 1 Select the adjustment arrows on the right side of the time series window to change the **Top** and **Bottom** limits of the data display (in the same units as the device data).

This is used to set both the vertical scale of the display as well as the center of the data.

- 2 Select the adjustment arrows found at the bottom of the display window to set the time range (i.e. the horizontal scale) of the plot in seconds.

LOP

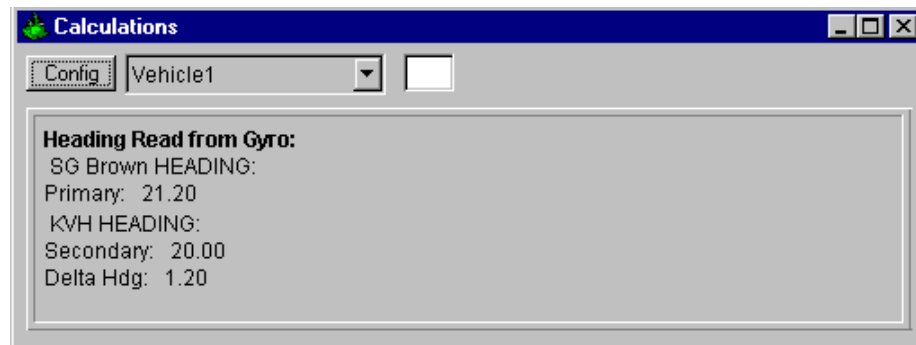
This **Setup Calculations Views** window option is used to display “Lines of Position”. This term is derived from the time when shore-based ranging systems were the primary method of vehicle positioning, before GPS. The term “Line of Position” refers to a range used in the position determination. The **LOP** display in the **Calculation** window can be used to display “ranges” from range/range, LBL acoustic, and GPS pseudorange devices. The example below shows the ranges from GPS satellites used in the pseudorange solution.



The azimuth and elevation of the GPS satellites used in the pseudorange solution are displayed too.

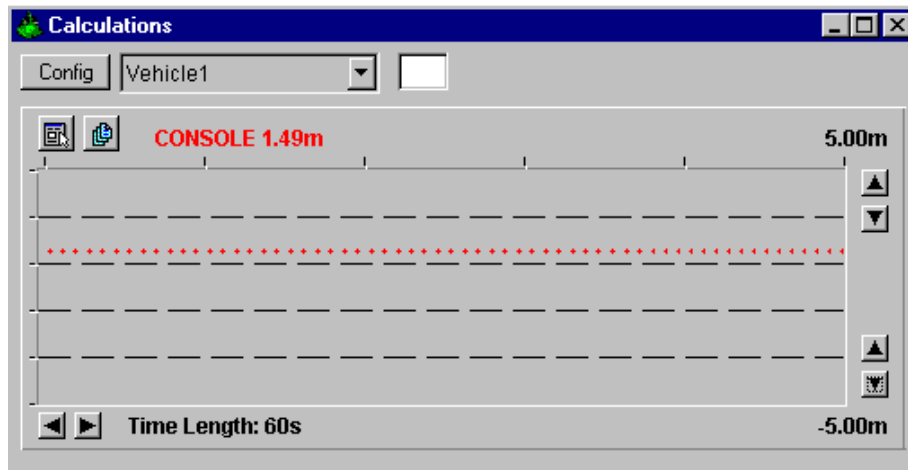
Heading Comparison

This **Setup Calculations View** window option is used to present a comparison of the data from a vehicle's **Primary** and **Secondary** heading devices, as seen in the next figure.

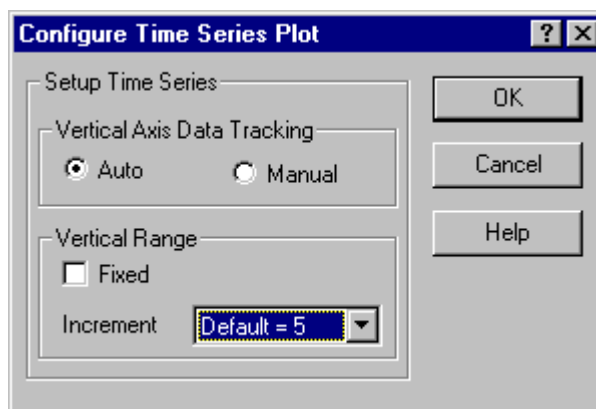


Pos. Comp. Time Series

This option is used to present a graphical time series comparison of the data from a vehicle's **Primary** and **Secondary** positioning devices, as seen in the next figure.



Use the **Up** and **Down** arrows on the right side of the window to change the center value and the width of the display window. Click on the left “page” icon to access the **Configure Time Series Plot** dialog window, as seen below.



Use the **Configure Time Series Plot** dialog window to configure **Automatic** or **Manual** control of the **Vertical** (distance) **Axis** mid-point and the total range of the vertical data displayed.

Controlled Remote Window

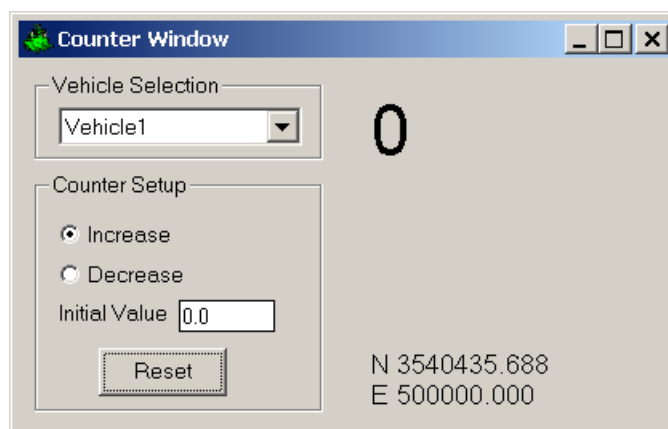
WinFrog’s **Controlled Remote** window allows you to configure a “remote” WinFrog system and display real-time data for that vehicle. A **remote** WinFrog system is a WinFrog system connected to another WinFrog system via a token ring telemetry network. See the **Controlled Remote Tug Telemetry** chapter for complete details on the use of the **Controlled Remote** window.

Distance Counter Window

WinFrog's **Distance Counter** feature is used for calculating and displaying an incremental counter of the distance between a selected **Offset** point on a vehicle from a specified starting location. The initial value of the counter can be set to an arbitrary value and can be set to increase or decrease as the vessel moves to or from the start.

To Display the Distance Counter Window

- 1 From the **View** menu, choose **Distance Counter**.



Vehicle Selection	Select the vehicle from the drop down list that you wish to use with the counter.
Counter Setup	
 Increase	Causes the counter value to increase as the vessel moves away from the initial position, or decrease as it moves towards the position.
 Decrease	Causes the counter value to decrease as the vessel moves away from the initial position, or increase as it moves towards the position.
 Initial Value	Enter the desired initial value of the counter at the start position. The counter will start to increment or decrement from this value.
 Reset	Click this button for any changes you have made to take effect. No changes are made to the counter settings until this button is clicked.
Counter Value	The counter value is displayed in the top right corner of the window. The counter displays the grid distance in the current distance units between the selected start location and the current location of the vehicle or specified offset.

Start Location

At the bottom right corner of the window is the start location where the counter started to increment/decrement. The start location is selected whenever the **Reset** button is clicked.

Note also that the font, size and color of the counter and start position can be changed by right-clicking on the window to display the font popup menu. Select either **Change Counter Font** or **Change Start Position Font** to open a standard font selection dialog.

When the window is closed but WinFrog is not shut down, all settings for the initial counter value, direction and start location are lost and need to be reset when the window is opened again.

Dynamic Tracking Window

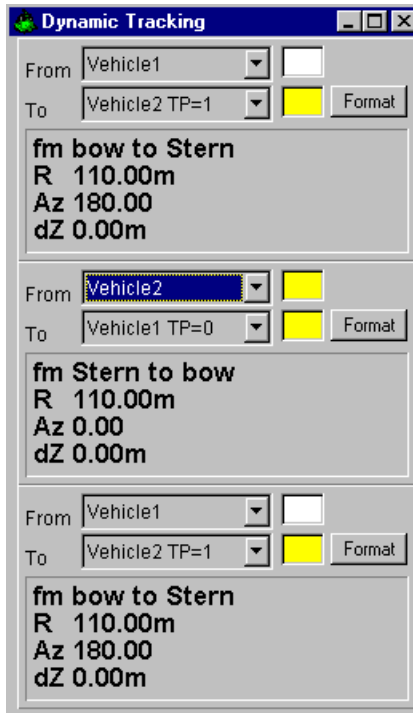
WinFrog's **Dynamic Tracking** feature is used for calculating and displaying the positional difference from a **Tracking Offset** point on one vehicle to a **Tracking Offset** point on another vehicle. The positional difference can be displayed in four different formats:

- 1 **Range, Bearing, and Difference in Depth**
- 2 **Difference X, Y, and Z**
- 3 **Difference North, East, and Depth**
- 4 **Range, Relative Bearing and Difference in Depth**

Each combination of **Tracking Offsets** is referred to as a **Track Pair**. The **Dynamic Tracking** window displays the positional differences of up to three **Track Pairs**. **Track Pairs** are configured using the main menu item **Configure > Vehicles > Setup Dynamic Tracking**. This option displays the **Setup Dynamic Tracking** dialog box. For more details about configuring **Track Pairs**, see the **Dynamic Tracking** section in the **Vehicles** chapter.

To Display the Dynamic Tracking Window

- 1 From the **View** menu, choose **Dynamic Tracking**.



The **Dynamic Tracking** window displays information for a maximum of three different enabled Track Pairs. For more details about using this window, see the **To View the Dynamic Tracking Information** section in the **Vehicles** chapter.

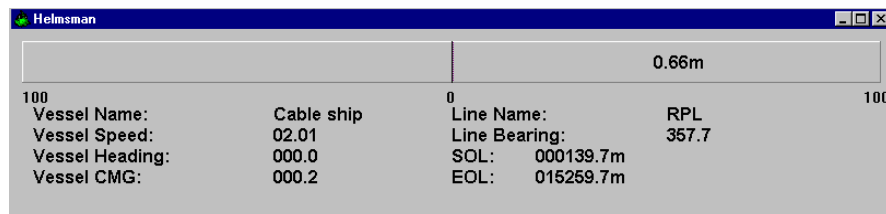
Helmsman Display

The **Helmsman** display shows **survey line tracking** and **navigation** information in both graphic and text formats, specifically intended for quick reference by the helmsman. Only one **Helmsman Display** can be viewed at a time, displaying information for the currently active vehicle (i.e. the vehicle that appears in the **Vehicle Text** window).

Note: the size and shape of the **Helmsman** display can be altered by “grabbing” an edge or corner and dragging it “in” our “out” as desired.

To View the Helmsman Display

- 1 From the **View** menu, choose **Helmsman**.



The following information is found in the **Helmsman** display window:

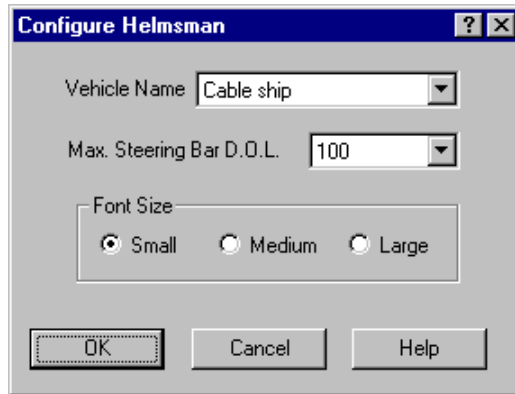
Steering Bar	The top portion of the window graphically displays the amount that the vehicle's currently tracked reference point is perpendicularly Offtrack from the current Tracked Survey Line Segment . The bar will "grow" in size from the center to the appropriate side as the vehicle moves further offtrack. The Offtrack distance is also displayed numerically in this portion of the window. Note: the numerical value is always positive , regardless of which side of the line the vehicle is on.
Vessel Name	the Name of the current vehicle.
Vessel Speed	the calculated Speed of the vessel.
Vessel Heading	the vessel's heading (as received from a gyro or other interfaced directional device, plus any user-configured offset).
Vessel CMG	the vessel's calculated Course Made Good .
Line Bearing	displays the bearing of the current segment of the survey line being tracked.
Line Name	displays the name of the survey line being tracked.
SOL	displays the distance to the Start Of Line .
EOL	displays the distance to the End Of Line .

The numbers in the moving bar will change to reflect the distance from the center of the display to the edge. Select the main menu item **Configure > Units > Distances** to change the units displayed.

If no **Survey Line** is currently being tracked, **0.0** is displayed and no changes will occur in this part of the display.

To Configure the Helmsman Display

- 1 Move the mouse pointer to within the limits of the **Helmsman** display, then press the right mouse button. The **Configure Helmsman** dialog box displays.



Vehicle Name dropdown

Choose the appropriate vehicle from the options presented in the dropdown box.

Max Steering Bar D.O.L.
dropdown

Select from the options presented in the dropdown box to change the maximum horizontal **Distance Off Line** (D.O.L.) to be depicted in the **Steering Bar** section of the **Helmsman** display.

Font Size radio buttons

Select the desired **Font** size.

- 2 Adjust the **Vehicle Name**, the **D.O.L.**, and the **Font Size** options accordingly.
- 3 Click **OK**.

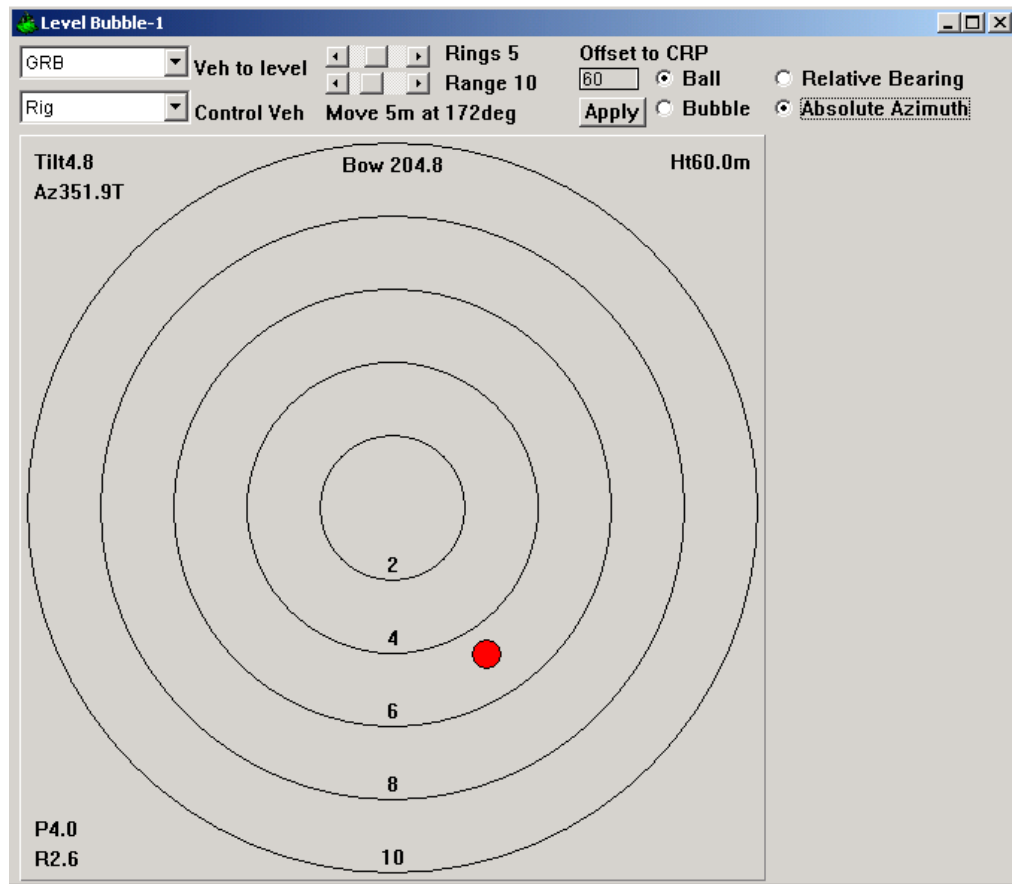
Level Bubble Window

This window displays the pitch and roll of a vehicle using a bull's eye display. If desired, it can also estimate the approximate amount of movement a surface vehicle would need to move, and its direction, in order to bring a subsurface vehicle to the level position. This assumes the surface vehicle is overtop the subsurface vehicle and is attached by some semi-ridged structure such as a drill stem. The vehicles' CRP elevations are used to determine the vertical distance between the vehicles. If there is casing below the bottom vehicle the operator may enter an offset to the fulcrum point.

Up to five Level Bubble windows may be displayed.

To Display a Level Bubble Window

- 1 From the **View** menu, choose **Level Bubble**.



To Configure the Level Bubble Window

- 1 Select the vehicle whose attitude is to be monitored from the top dropdown list box (Veh to level).
- 2 Using the slider bars, select the number of rings and the total range (1° to 50°) desired. Depending upon the number of rings selected, the full range may not be displayed; either change the number of rings or the range to display the full range.
- 3 The red circle indicates the levelness of the vehicle. The circle may simulate either a bubble (air in oil) or a ball (steel in oil). The two radio buttons, Ball and Bubble, determines the mode. If Bubble is selected and the vehicle has positive pitch (bow up) the red circle will move towards the bow. If in the same situation Ball was selected, the red circle would move towards the stern.
- 4 The top of the bull's eye is always considered the bow of the vehicle being leveled.
- 5 In the top left corner of the bull's eye is the total tilt of the vehicle. Below this is either the azimuth or bearing relative to the bow of the tilt. The remaining

two radio buttons, Relative Bearing and Absolute Azimuth, determine which is displayed. If the Relative Bearing is chosen, the angle is measured from the bow to the red circle. If the Absolute Azimuth is chosen, the angle is measured from true north to the red circle.

- 6 Displayed in the lower left of the bull's eye is the pitch and roll in degrees. Positive pitch is bow up; positive roll is starboard down.
- 7 If there is a leveling vehicle as described above, select it from the lower dropdown list box (Control Veh).
- 8 To level the lower vehicle use the display "Move 25 m at 323 degrees" located below the slide buttons. The distance to move uses the tilt angle and difference in the CRP elevations; the angle is the true azimuth indicating the direction to move the rig. To correct the height difference for a section of casing which will act as the pivot point or to correct this difference for any other offset, enter a value in the Offset to CRP edit box and click the **Apply** button. This value will be added to the elevation difference and displayed in the upper right corner of the bull's eye. This elevation difference is always considered positive.

Numerics Display

The **Numerics** display provides you the ability to view various user-selected real-time **Device** and **Vehicle** data items. This display expands on the data presented in the **I/O Devices** and **Vehicle Text** windows. See the appropriate sections found earlier in this chapter for more information on these other windows.

To View the Numerics Display

- 1 From the **View** menu, choose **Numerics**.

A blank **Numerics** window displays. As with most WinFrog windows, the **Numerics** window can be moved by "grabbing" the top bar of the window and dragging the window to the desired location. The window can also be changed in size by "grabbing" any edge of the window and "dragging" it as desired.

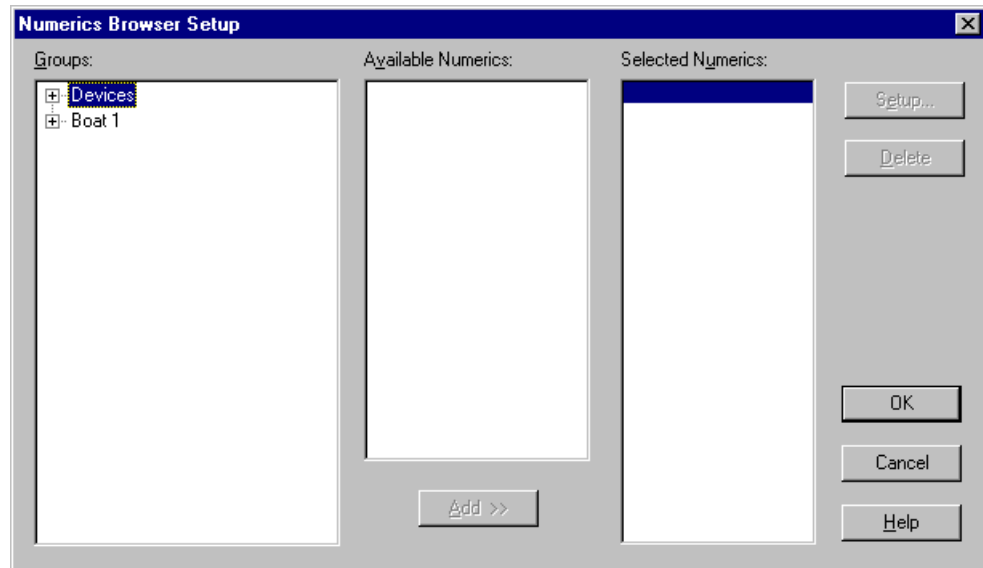
To Configure the Numerics Display

- 1 To configure this display, move the mouse pointer to within the limits of the Numerics display and click the right mouse button.

A small dialog box appears offering **Setup...** and **Font Size...** options. Select the appropriate option.

Setup

Select this option to display the **Numerics Browser Setup** window.



Groups

This section of the **Numerics Browser Setup** window divides the available data into two source groups: **Devices** and **Vehicles**.

Devices

This grouping contains all devices that have been added to WinFrog. Click on the “+” symbol beside the word “**Devices**” to see a list of these devices. Click on the “+” symbol beside a specific device name to see what data are available from this device. Select the data name to see what **numerics** are available from this data type, listed in the **Available Numerics** window.

Vehicles

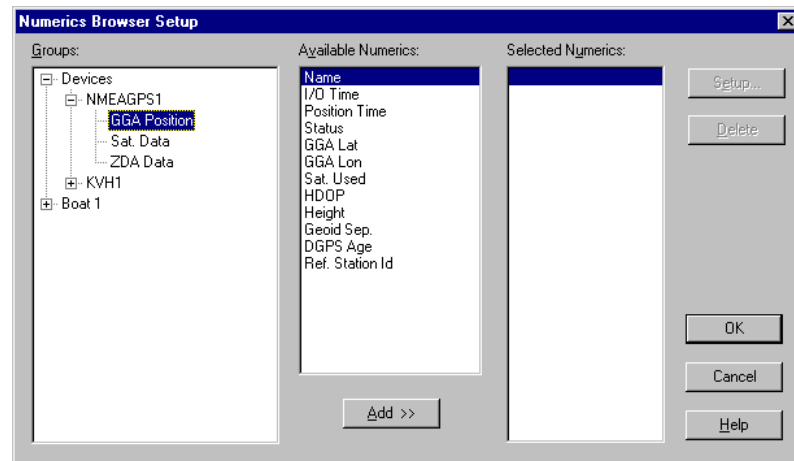
The name of each vehicle added to WinFrog will be listed in the **Groups** section. Click on the “+” beside a vehicle name to see what data categories are available for that vehicle. Click on a data category to see what data items are available for each vehicle data category, listed in the **Available Numerics** window.

Available Numerics

Available Numerics

This section of the **Numerics Browser Setup** window lists all individual **Numeric** items associated with the highlighted “group” data

item. The example below shows what **Available Numerics** are associated with a NMEA GPS device.



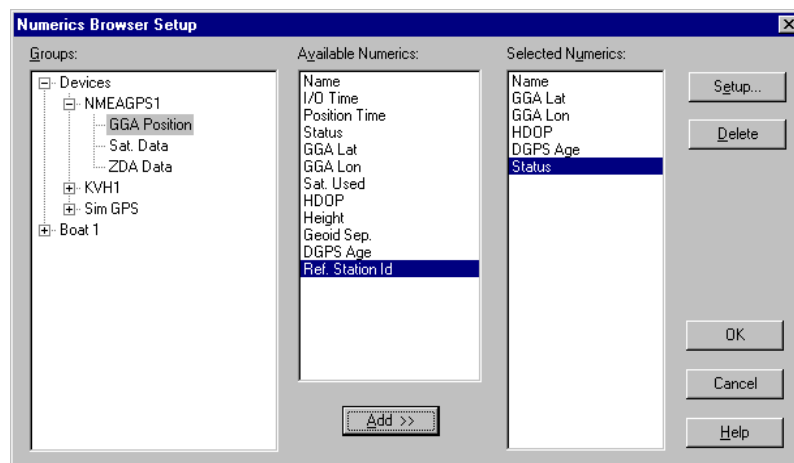
Selected Numerics

This portion of the **Numerics Browser Setup** dialog box lists the items that have been selected from the **Available Numerics** listing.

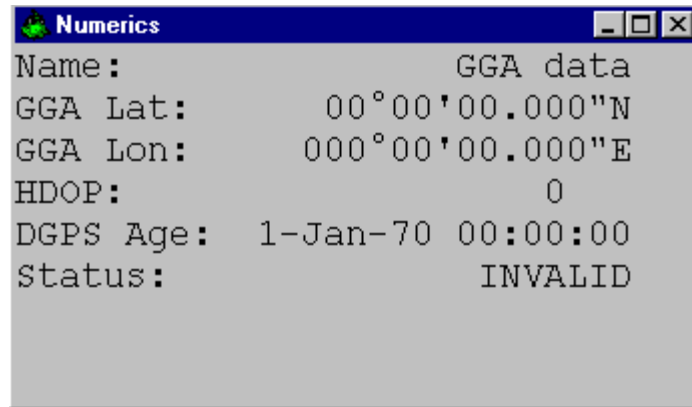
To Add an Item to the Numerics Display

- 1 Highlight the **Available Numeric** item
- 2 Click the **Add>>** button.

In the example below several items have been added from the **Available Numerics** for a GGA Position.

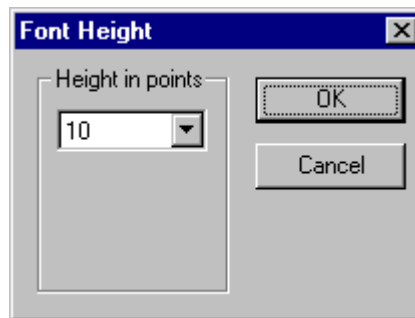


- 3 Once all desired items have been added, select the **OK** button to return you to the Numerics display, which now reflects the changes just made.



Font Size

Select this option to display the **Font Height** window as seen below. Use the dropdown to select the desired **Font Height**.



Smart Remote Control

WinFrog supports the operation of Smart Remotes. A WinFrog system that is not configured with real-time inputs and outputs may provide the means to view and monitor the positioning and navigation being performed by the primary WinFrog system. A Smart Remote does not require a license. A computer running WinFrog in demonstration mode can be operated as a Smart Remote.

To simplify the operation of the Smart Remotes, WinFrog provides the means for you to configure the Smart Remotes from the primary WinFrog system, referred to as a master in this section. The Smart Remotes will simply be referred to as remotes.

Network Communications

WinFrog uses UDP/IP to communicate between the master and remotes. This requires a suitably configured Ethernet card to be installed in the computer. When WinFrog is launched, whether it's to be used as a remote or a master, it retrieves the IP address of the computer's Ethernet card. This is used to read/write the required remote navigation information. If at launch, WinFrog

detects two or more Ethernet cards and none has been directly selected as the card to use, a dialog will appear allowing you to choose which card to use. If the computer does not have an Ethernet card when WinFrog is launched, or if the Ethernet cable is not connected, WinFrog will not be able to retrieve the IP address. In these cases, a message will appear to indicate this and instruct you to select, from the main menu, **Configure > Smart Remote Options > Select Ethernet Card** to select the card address when the Ethernet cable has been reconnected. In the case of an Ethernet card not being present, the PC will need to be powered down, a card installed and WinFrog re-launched.

As previously mentioned, WinFrog uses UDP/IP to send navigation data to the remote computers. It uses port 7050 for this. This data is broadcast and can be received by all the suitably configured computers on the network. This is determined by the subnet mask entered as part of the TCP/IP Properties for the particular card in use. The remote does not respond to this data.

The master uses port 7060 to send configuration data to the remotes. But first the master sends a command on port 7050 to inform the remotes to open and listen on port 7060 for the configuration data. This communications involves transmission of configuration data by the master and a confirmation of receipt by the selected computers. It should be noted that the output of the navigation data on port 7050 is suspended during configuration updates.

Remote Position Data Reception

If any vehicle on a given WinFrog system is configured to Network for the Data Source, that WinFrog listens for data from a master. The data is transmitted in packets. Each navigation packet contains the complete position information for all vehicles in a compressed format. The packet that informs a remote that it is to be configured only contains the computer's name. When a remote receives a packet it checks to see if it is a message informing it that a configuration update is going to be transmitted (see **Remote Configuration**) and if so, is it intended for this computer (see **Master Operation**). If a data packet is detected, the vehicle names in the packet are compared to those of the vehicles configured to Network for the Data Source at the remote. The comparison is case sensitive. If a match is found, the position data is assigned to that vehicle. If no match is found, the data is discarded.

After the receipt of position data from the master, the remote sets a time out clock. If new data is not received within 15 seconds, a message appears indicating a data time out. This message will not appear again until the reception of another position data packet restarts the timeout clock.

Note: It is critical that the names assigned to the vehicles configured at the remote is identical to that used at the master, including case. The use of the remote configuration ensures this.

Note: It is important to note that the remote will accept position data from any master. There should be only one master on the network at one time. If the overall system includes a primary and secondary WinFrog, the primary should be used to send the position data to the remotes. If it fails, you must turn the data transmission on at the secondary. The remotes do not require a configuration update in this case.

Remote Configuration

After launching WinFrog on the remote computer, the remote can be configured manually at the remote computer or remotely from the master. It is important to note that for the purpose of this section, configuration refers to the critical components of WinFrog that are required for the successful operation of a Smart Remote, specifically the geodetic and map projection parameters; vehicle name, shape and presentation; and though not so critical, the working survey lines and waypoint files and the BMM file used for the Graphics windows background display.

For manual configuration refer to Chapter 9, Network Data Source Configuration.

To execute the remote configuration, after launching WinFrog first check that the system is configured to accept remote configuration. This is done from the main menu item **Configure > Smart Remote Options > Enable Configuration by Master**. If the remote is configured to accept remote configurations, there will be a checkmark beside this item. Click this item to toggle between enabled and disabled. This setting is saved to and loaded from the *.ini and *.cfg files. The default setting is enabled for a WinFrog running in demonstration mode, disabled for a licensed WinFrog.

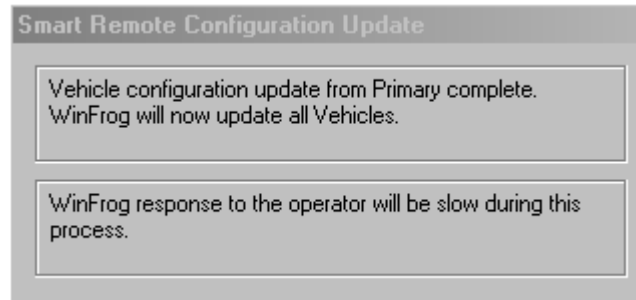
Second, open the desired Graphics, Vehicle Text and Dynamic Tracking windows. The master cannot open windows on the remote. Furthermore, if no Graphics windows are open on the remote when executing the remote configuration, the BMM map files assigned will not take affect.

The master sends data in three stages to match the configuration of a remote to itself:

- 1) Primary Configuration Components:
 - Geodetic and Map Projection parameters.
 - Display Units.
 - Vehicles including their names, colors, shape (at the remote each vehicle is set to Network for the Data Source and defaulted to Network for Waypoint, Line and Offset Source). Only vehicles that are configured at the master are setup at the remote. Any vehicles present at the remote that are not present at the master are removed.

- All dynamic tracking information.
- 2) Assigns the file name and path for the remote's Working Survey Line and Waypoints Files to those of the master.
 - 3) Creates copies of the BMM files displayed in the Graphics windows at the master and then links the remote Graphics windows to these files.

When a remote configuration is taking place, a window such as the one below is displayed at the remote stating the process being executed.



Note: The remote will accept a configuration update from any master. There should be only one master on the network at one time.

Note: The transmission of the primary configuration components starts with the Geodetics, then the units and then the transmission of the list of vehicles to be configured, followed by the configuration for each vehicle. The master then waits for the remote to inform it when the vehicle updating is completed before continuing. The above figure is the message displayed at this time. During this time, the remote will be very slow to respond to operator interaction (mouse clicks such as Zoom In). This is normal.

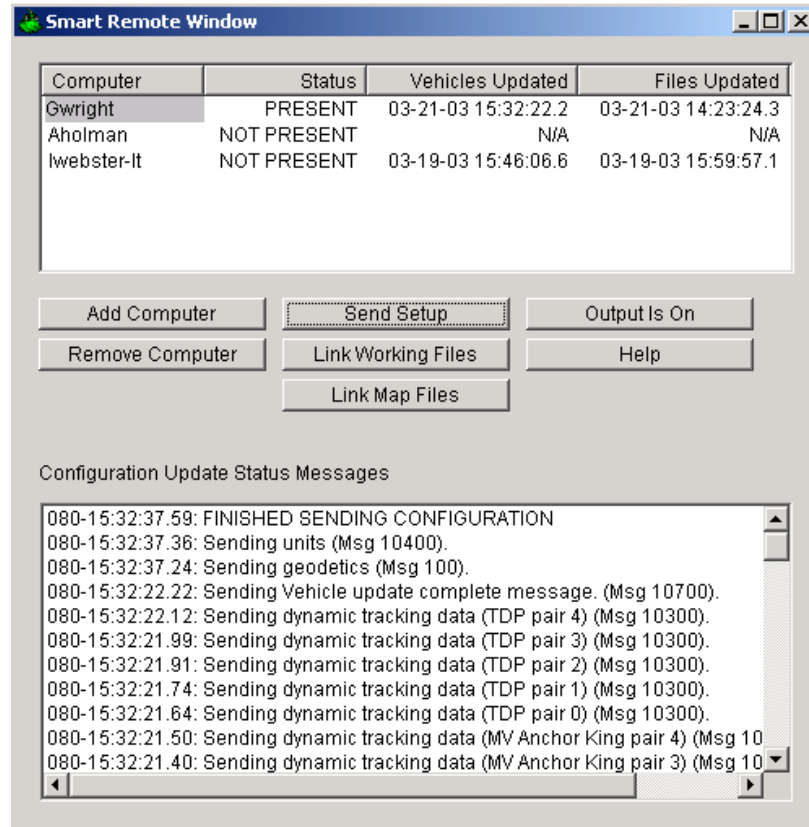
Note: The remote must have access to the Working Survey Line and Waypoint files and the *.BMM file and any files that are referenced in the BMM file if it is to use these. This requires that the immediate parent folders in which the files are located be shared and that permission be granted to the remote computer's user to access the files. This is most easily accomplished by ensuring that the **Master** computer has a **Guest** account. It is very strongly recommended that this access be limited to **Read Only** to ensure that the remote operator is not able to change them.

Note: When WinFrog is launched at the remote, if the Ethernet cable is not connected the Ethernet card will not be detected. After reconnection of the cable it is necessary to select the card from the main menu item **Configure > Smart Remote Options > Select Ethernet Card**.

Master WinFrog Operation

The WinFrog that is to operate as the master must be configured to do so. The configuration is performed from the **Smart Control Window**. This window is

opened from the main menu item **View**. The window appears as below, though initially, the computer list window and the status message list box are empty.



The following details the window components and button functions.

- Computer List Window** The computers that have been added are listed in this window. Note that these are the computers that can then be selected for remote configuration. The addition, selection or removal of computers does not affect the transmission of the position data packets. Computers can be selected by clicking on the name. Multiple computers can be selected by pressing the **Ctrl** key while clicking on the computer name.
- Status** Indicates whether or not the computer was detected when a configuration update was transmitted to it.
- Vehicles Updated** This is the date and time of the last successful update of this remote for the primary configuration components.
- Files Updated** This is the date and time of the last successful update or refresh of this remote for the Working or Map Files.

Add Computer	Click this button to browse the network and select a computer to add to the list of those that can then be selected to receive configuration updates.
Remove Computer	Click this button to remove any computers selected in the computer list window.
Send Setup	Click this button to instigate the transmission of the primary configuration components to those computers selected in the computer list window. While the transmission of the configuration is taking place, this button changes to an Abort button. Clicking this cause the configuration update to abort.
Link Working Files	Click this button to instigate the transmission of the Working Survey Line and Waypoint File names and paths to those computers selected in the computer list window.
Link Map Files	Click this button to instigate the transmission of the file names and paths for those BMM files that are configured as the backgrounds for those Graphics windows open at the master to those computers selected in the computer list window. If the respective Graphics windows are open at the remote, they will display the same layer files as their corresponding Graphics window at the master. This includes the setting of the Plot Map option in the Graphics window configuration Background tab.
Output is On/Off	This button toggles the broadcast of the position data on and off. The button text indicates the current status. This is not affected by those computers added or selected, as it controls the broadcast of the position data packets, which are then received by all computers on the network. When a configuration update is in progress, the output is suspended and this button displays Output Is Suspended and is disabled. When the configuration is completed, the button and the position output mode returns to normal. Note: This output must be turned on in order for remotes to operate regardless of whether or not they are configured remotely or locally.
Help	Access the help for Smart Remote configuration and operation.

Configuration Update Status Messages

The messages detailing what the Smart Remote Control is executing are listed in this box.

With the exception of the **Add Computer**, **Output is On/Off** and **Help** buttons, the buttons are only active when there are computers listed in the computer list window and at least one computer selected.

Note: When a configuration is initiated, all the selected computers are set to **NOT PRESENT** in the computer list. WinFrog looks for responses from all selected computers before sending the next packet. When a computer responds to confirm that it has received the configuration packet, it is set to **PRESENT**. If after five seconds not all computers have responded, the computers that have not responded are removed from the list of those that are expected to respond (they will still appear selected in the list) and the next packet is transmitted. If no computers respond, the configuration is aborted.

The **Smart Control Window** can be closed without affecting the transmission of the position data packets. Unlike most WinFrog windows, the next time it is opened, it will open in the same location at the same size it was when it was closed. The computer list is also maintained.

Note: The **Smart Control Window** cannot be opened if the computer is currently receiving a configuration or refresh command.

Note: When WinFrog is launched at the master, if the Ethernet cable is not connected, the Ethernet card will not be detected. After reconnection of the cable it is necessary to select the card from the main menu item **Configure > Smart Remote Options > Select Ethernet Card**. This selects the card for port 7050. Then close and open the Smart Remote window for a refresh so the configuration port (7060) can be used. Both ports are required for operations at the master.

Tracking Offsets Window

The **Tracking Offsets** window displays the real-time **Working Map Projection** coordinates of all **Tracking Offsets** configured on a vehicle, as well as survey Line tracking **Distance Down Line (DDL)** and **Distance Cross Course (DCC)** information, if a survey line is being tracked.

Only one **Tracking Offsets** window can be displayed in WinFrog, but the same window can be used to view **Tracking Offsets** for any WinFrog vehicle by simply toggling the **Vehicle** button located in the top of the **Tracking Offsets** window.

The **Tracking Offsets** window can only be configured for size. Only those **Tracking Offsets** that are configured with their **Plot** option enabled will be seen in the **Offsets** window.

Note: although the **Tracking Offsets** window displays the position of all **Plot** option enabled **Tracking Offsets**, only the coordinates displayed in the **Vehicle Text** window (i.e. the single **Tracking Offsets** point that is currently enabled) are recorded by WinFrog during **Automatic** or **Manual Eventing**.

Vehicle **Tracking Offsets** are configured by selecting the main menu item **Configure > Vehicles > Configure Offsets**. For more information, see **To Configure Offsets** in **Chapter 6: Vehicles**.

To Display the Tracking Offsets Window

- 1 From the **View** menu, choose **Tracking Offsets**.



The screenshot shows a window titled "Tracking Offsets" with a "Vehicle" button in the top left. The window contains a table with tracking data for a "Barge" vehicle. The table has four columns: Location, Elevation (EL), Easting (E), and Northing (N). Each location entry is followed by its Elevation, Easting, and Northing coordinates, as well as DDL and DCC values.

Barge			
Barge Stall	EL0.00m	E487802.29m	N3631933.94m
		DDL: 10192.02m	DCC: 51.15m
Stinger end	EL0.00m	E487802.24m	N3631893.96m
		DDL: 10152.02m	DCC: 51.37m
Port Bow	EL0.00m	E487792.34m	N3631973.94m
		DDL: 10231.96m	DCC: 40.92m
Stbd Bow	EL0.00m	E487812.33m	N3631973.91m
		DDL: 10232.08m	DCC: 60.92m
Stbd Stern	EL0.00m	E487812.26m	N3631913.93m
		DDL: 10172.08m	DCC: 61.26m
Port Stern	EL0.00m	E487702.30m	N3631914.07m
		DDL: 10171.46m	DCC: -48.74m

In the **Tracking Offsets** display above, the **Barge** vehicle is configured with 6 **Tracking Offsets** and is also tracking a survey line. As mentioned above, to see information for other vehicles, select the **Vehicle** button in the top right corner of the window.

Cable Model Windows

WinFrog’s **Cable Model** extension module provides real-time calculation and display of cable lay operational status. The real-time cable lay information calculated includes **Desired** and **Actual Slack** values, as well as cable installation “**Ahead and Behind**” information. This information, and various other data pertinent to the installation of a cable, is displayed in both the **Cable Model Large** window and the **Cable Model Small** window.

Details of the configuration and use of the **Cable Model** windows are found in the **Cable Management Extension Module User’s Guide**.

Chapter 9: Vehicle Data Source

WinFrog provides you with the ability to decide which **Data Source** will be used to provide data to a WinFrog vehicle. Typically, data required for real world, real-time operations come from interfaced **real-time** data sources. For that reason, WinFrog defaults every vehicle's **Data Source** to real-time devices. You are able to select which real-time devices to add to the appropriate WinFrog vehicle.

However, there are occasions when other sources of data are required, especially when you are using WinFrog on a networked computer. These networked computers are referred to as **Smart Remote** systems. Rather than receiving data directly from the interfaced devices, **Smart Remote** systems acquire navigation information from a **real-time** WinFrog system via a local area **network** data source.

Other **Data Sources** available include **Simulated**, **Controlled Remote**, **Pre Recorded WinFrog Files**, and **Pipe Track**.

Note: real-time systems require security approval before real-time data can be applied to a vehicle, whereas **Smart Remote** systems can be operated in **Demonstration** mode. Without the appropriate security approval, real-time devices can still be added to the WinFrog system, but not to a vehicle. This allows you to confirm that devices are working correctly and that the physical interfacing parameters are correct. Remember, a vehicle can utilize only one **Data Source** at a time.

The following sections detail all WinFrog **Data Sources**. For more information about adding **Peripheral Devices** to WinFrog, see the **Peripheral (I/O) Devices** chapter.

Definition of Data Source Options

Any WinFrog vehicle can be configured to use one of six different **Data Sources**:

Simulated	This option allows you to utilize all of WinFrog's navigation, tracking, and data collection utilities with simulated data that are generated internally by WinFrog.
Network	This option allows one WinFrog computer to access navigation information from another WinFrog computer via a network connection.
Controlled Remote	This option allows you to use one WinFrog computer to control the operation of another

Real-Time

WinFrog computer connected via a radio telemetry link or network connection.

File

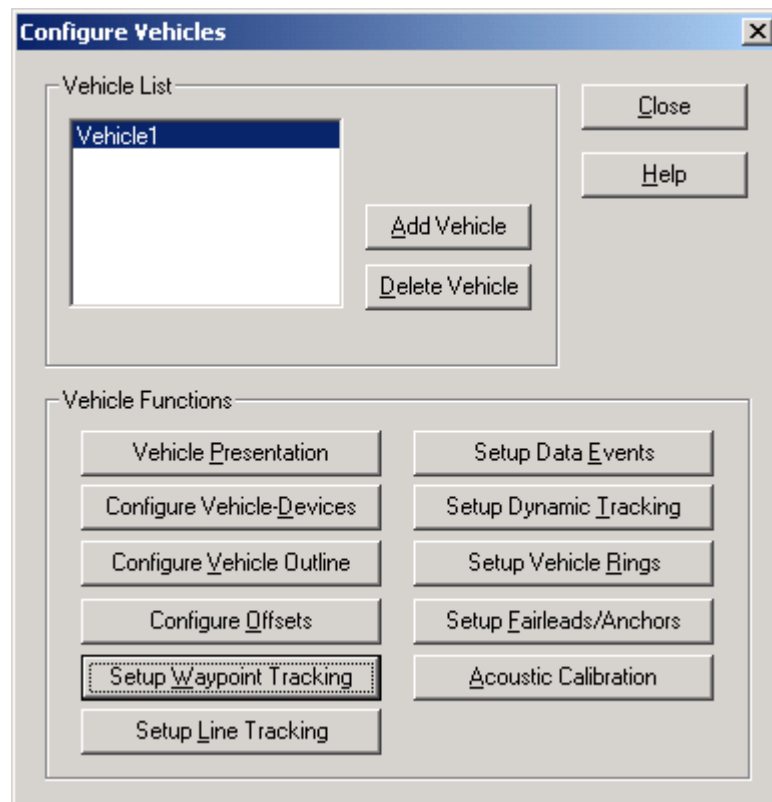
This option allows WinFrog to utilize data being received from real-time devices connected to WinFrog via the computer's serial ports and via data using the socket I/O devices "WriteToSocket" and "ReadSocket".

Pipe Track

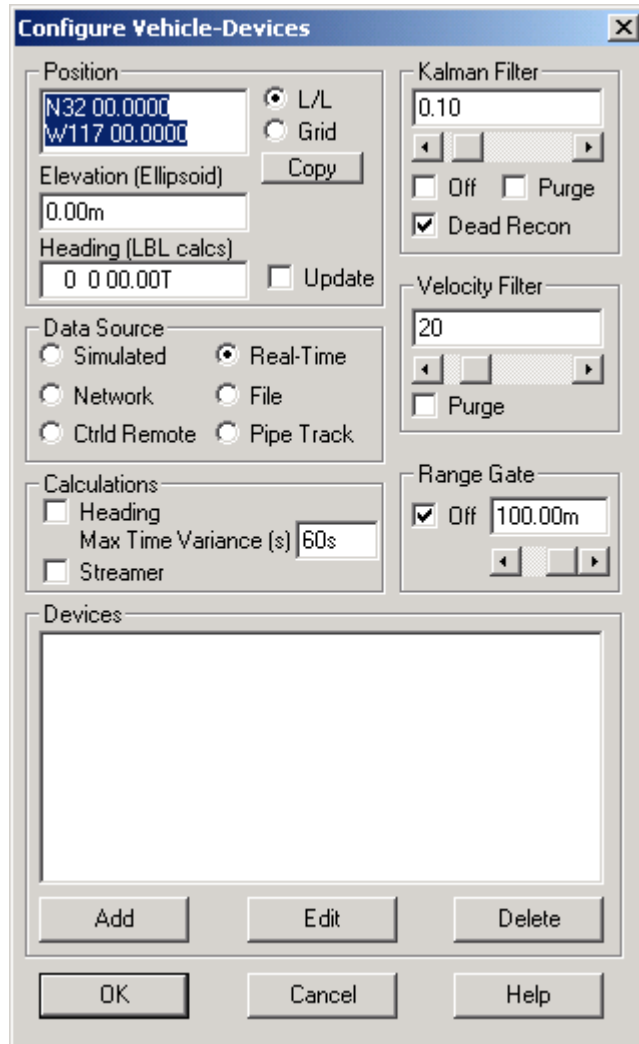
This option is used to provide a pipeline touchdown position based on a layback from a specified reference vehicle.

To Configure a Vehicle's Data Source

- 1 Choose **Configure > Vehicles**.



- 2 Select the **Vehicle** to be configured.
- 3 Click the **Configure Vehicle-Devices** button. The **Configure Vehicles-Devices** window appears, as seen in the next figure.



The **Configure Vehicle-Devices** dialog box configures the devices associated with a vehicle and how the information is used by that vehicle. One of the configuration parameters in this dialog box is the vehicle's **Data Source**.

- 4 In the **Data Source** area, click the desired **Data Source** radio button.

Simulated Data Source Configuration

WinFrog's **Simulated** data source configuration can be used for training, evaluation, and demonstration purposes. WinFrog allows you to simulate position, speed, heading, and ROV depth data for a vehicle. This feature allows you to use WinFrog without the trouble and expense of having working devices connected to the computer. The simulated devices are designed to mimic real devices, as closely as possible, and to allow you to experiment with WinFrog to learn about the software's behavior and options.

Note: if you choose the **Simulated** data source options, the software picks which simulated devices are used. If you would like to be able to choose the devices and have the ability to change some of the configuration settings, select the **Real-Time** data source option and add the **Simulated** devices of your choosing from the various categories. The **Real-Time** option is preferable to the **Simulated** option as it allows you to control which simulated devices are added to the vehicle.

For more information about simulated data in WinFrog, see the **Simulator** chapter.

Network Data Source Configuration

WinFrog allows you to configure a WinFrog system to utilize navigation data being generated by other WinFrog systems that are connected via a LAN network connection. This provides the ability for more than one WinFrog system to provide navigation/tracking/display functionality without each computer to actually be connected to the peripheral devices. The data transmission uses UDP/IP sockets.

Note: The use of the **ship.nps** file or TCP/IP sockets for the transmission of data is no longer supported by WinFrog version v3.3 and later.

The WinFrog computer that is connected to the peripheral devices is referred to as the **Master** or **Primary** system (a **Secondary** system is also connected to the peripheral devices and can fulfill the role of **Master**). These devices provide the required sensor information updates to WinFrog to support the derivation of multiple vessel's position information (e.g., latitude, longitude, elevation, water depth, heading course over ground and speed) and navigation information (range and bearing to waypoint and along line and offline line tracking data). The **Master** broadcasts the navigation and position information for each vehicle configured, along with the vehicle's name. The update depends on the number of vehicles; there is a minimum 75 milliseconds delay of between each vehicle's transmission.

Those WinFrog systems providing the navigation/tracking/display functionality through receiving the information from the **Master** are referred to as **Smart Remotes** or simply **Remotes**.

The **Remote** can be setup manually or remotely by the **Master**. The remote configuration is detailed in the Smart Remote Control section of Chapter 8. See that section for some diagnostic information. The manual configuration is detailed here.

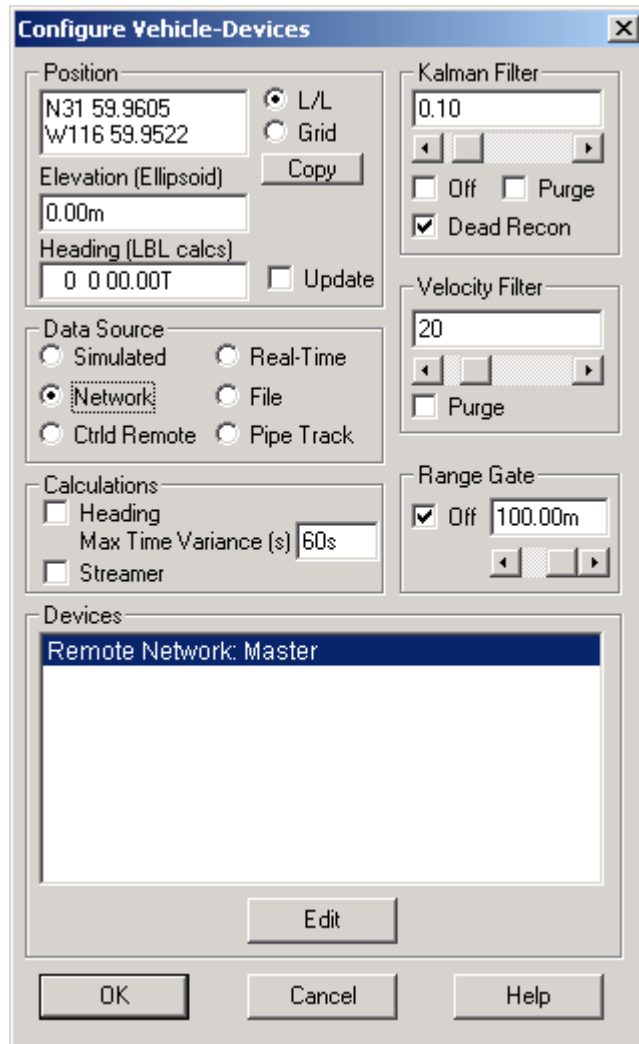
To Manually Configure a Smart Remote

- 1 On the **Smart Remote** WinFrog, create a new vehicle with its **Name** identical to that of the vehicle in the **Primary** WinFrog system. The **Name** must be **identical** (including upper and lower case characters and spaces in the name) or the **Smart Remote** system will not be able to match the vehicle information.

See the **Vehicles** chapter for details about adding a new vehicle, naming the vehicle, and configuring the vehicle position.

- 2 On the **Smart Remote** WinFrog, set this new vehicle's **Data Source** to **Network**.

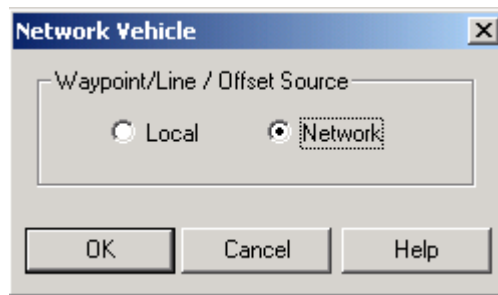
See the **To Configure a Vehicle's Data Source** section earlier in this chapter.



WinFrog displays a data item Remote Network: Master. The smart remote WinFrog will accept data from any WinFrog outputting data as long as the vehicle names match.

- 3 Click the **Edit** button.

The **Network Vehicle** dialog box appears as seen below.



The **Network Vehicle** dialog box defines how the **Smart Remote** WinFrog handles **Waypoint Tracking**, **Survey Line Tracking**, and **Vehicle Offsets**.

There are two possible configurations:

Local

The user at the **Smart Remote** WinFrog computer can select local (internally configured) **Offsets**, **Waypoints Tracking**, and **Line Tracking**.

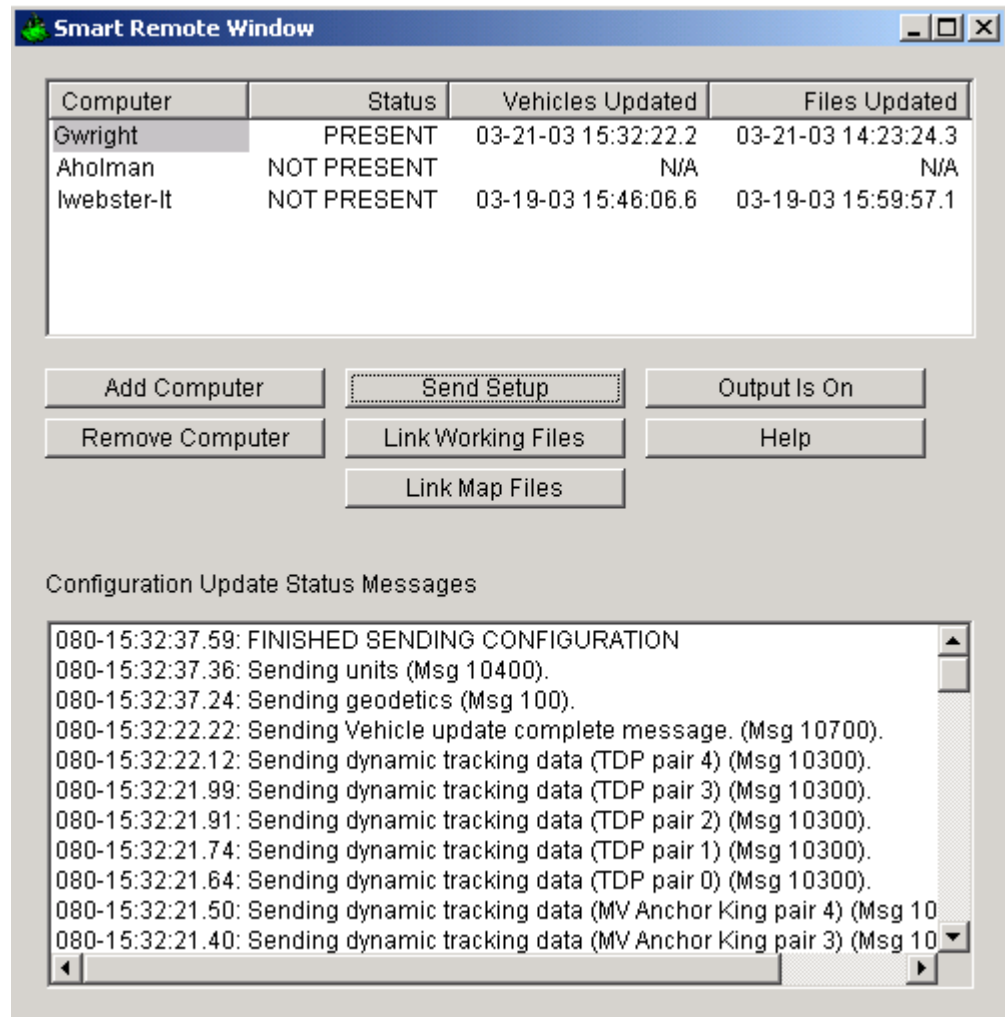
Network

The **Smart Remote** WinFrog uses/displays the same **Offsets**, **Waypoints**, and **Survey Lines** that the **Primary** WinFrog system is using. If you change the **Primary** WinFrog vehicle's **Offset**, or change which **Survey Line** or **Waypoint** is being tracked at the **Primary** WinFrog system, this change occurs at all **Smart Remotes** as well.

- 4 Once the appropriate radio button has been selected, click **OK** to close this dialog.

To Configure the Primary System for Network Data Output

- 1 On **Master WinFrog**, select **View > Smart Remote Control** from the main menu.



- 2 Click the (Position) **Output Is Off** button to toggle to (Position) **Output Is On** mode. Broadcast of the position and navigation information starts as soon as this mode is toggled. It is not necessary to select a computer for output of the vehicle navigation data. That and the other buttons are for remote configuration. Refer to the Smart Remote Control section in chapter 8 for remote configuration and socket information.

- 3 This window can be closed.

Note: Data is only transmitted for those vehicles at the **Master WinFrog** whose data source is set to other than **Network**.

Note: No vehicle data is transmitted if the data source for first vehicle at the **Master WinFrog** is set to **Network**.

Note: Only one WinFrog system should be set to output position data (**Master**). If more than one WinFrog were operated as **Master**, the **Network** vehicles at the **Remotes** would receive and use position and navigation data from all **Master** WinFrog systems.

Controlled Remote Data Configuration

This option tells WinFrog that the data source is a remote site connected via radio telemetry or a **TCP/IP** network. The **Control Site** can configure the **Remote Sites** to send position data, raw data, and event data at independent, specified intervals. This is intended for networks with more than one WinFrog system connected via token ring telemetry. The **Control Site** can also control many features of the **Remote Site** including vehicle, display, and data collection configurations.

See the **Remote Control** chapter for more information discussing controlled remote data configuration.

Real-Time Data Source Configuration

As mentioned in the introduction to this chapter, WinFrog's default **Data Source** for all vehicles is **Real-Time**. This option must be selected if WinFrog is to utilize data from interfaced **Real-Time Data Sources** such as GPS receivers, gyro compasses, or echo sounders.

The use of data from a peripheral device is a two step process: First, the devices must be added to WinFrog. Then individual devices must then be added to a vehicle's device listing. Only after both steps are completed will this information be used in the vehicle's real time navigation/data collection/display capabilities.

Note: security approval must be established by WinFrog before any real-time data can be attached to a vehicle.

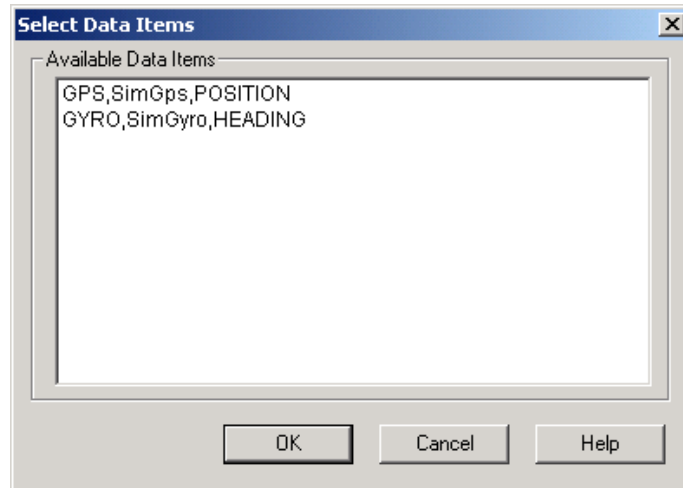
Adding a Peripheral Device to a WinFrog Vehicle

Before WinFrog can utilize data generated by a peripheral device, the device must be added to the vehicle's **Device list**. The **Configure Vehicle-Devices** dialog box is used for this purpose.

See the **Peripheral (I/O) Devices** chapter for information on adding a peripheral device to WinFrog.

To Add Data Generated by Peripheral Devices to a WinFrog Vehicle

- 1 Select **Configure > Vehicles**.
- 2 Select the **Configure Vehicle-Devices** button to display the **Configure Vehicle-Devices** dialog box.
- 3 Choose the **Real-Time** radio button in the **Data Source** area.
- 4 Click the **Add** button to display the **Select Data Items** dialog box.



The **Select Data Items** window shows a complete list of all devices that have been added to WinFrog. **Note:** devices are not removed from this window even after they have been added to a vehicle's position.

- 5 Select the desired **Data Item**.
- 6 Click **OK**.

The selected **Data Item** now appears in the **Devices** list at the bottom of the **Configure Vehicle-Devices** dialog box. This signifies that it is now added to the vehicle's list of devices. You must now **Edit** this device to ensure that it is correctly configured for this vehicle.

Editing a Vehicle's Peripheral Devices

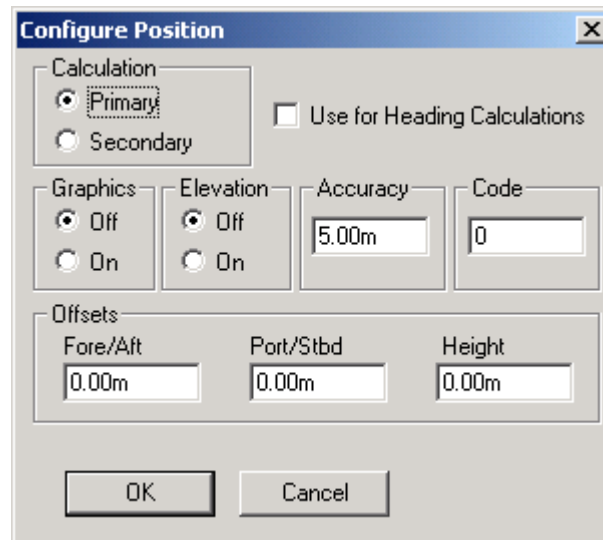
Most peripheral devices have specific parameters that must be edited to suit the vehicle and application for which they will be used. These parameters must be configured properly for WinFrog to correctly utilize the data generated by the device.

For example, when a GPS device is added to a vehicle, you must **Edit** that device to define its **Offsets** from the vessel's **CRP**. Failure to do so will result in incorrect positioning. Likewise, an echo sounder's transducer **depth offset** must be entered to correct for draft.

To Edit the Configuration of an I/O Device Once Added to a Vehicle

- 1 In the **Configure Vehicle-Devices** dialog box, select the specific peripheral device from the **Device** list.
- 2 Click the **Edit** button.

A unique **Configure** window will appear for this type of device. For example, highlighting a GPS device will bring up the **Configure Position** window, as seen below.



- 3 Enter the appropriate values/settings to suit the application.
For more details on the entry windows, see the **Peripheral Devices** chapter.
- 4 Click **OK** to confirm the changes and close this window.

Deleting a Vehicle's Peripheral Device

You can remove the data generated by a peripheral device from being included in a WinFrog vehicle's calculations.

To Remove a Device from a Vehicle's Calculations

- 1 In the **Configure Vehicle-Devices** dialog box, select the specific peripheral device which is to be removed from the **Device** list.
- 2 Click the **Delete** button.

The device will now be removed from the vehicle's calculations. **Note:** the device is not removed from WinFrog entirely, just from being included in this particular vehicle's calculations.

File Data Source Configuration

If you choose the **File** option from the **Data Source** list, you can use previously collected **.raw** format WinFrog data as a vehicle's position source. This allows you to review past data in a "playback" mode. In this playback mode, you can replay data observing the position, speed, heading, and course made good of the vehicle at the time of data collection.

See the **Eventing** chapter for information about **.raw** data files and collection.

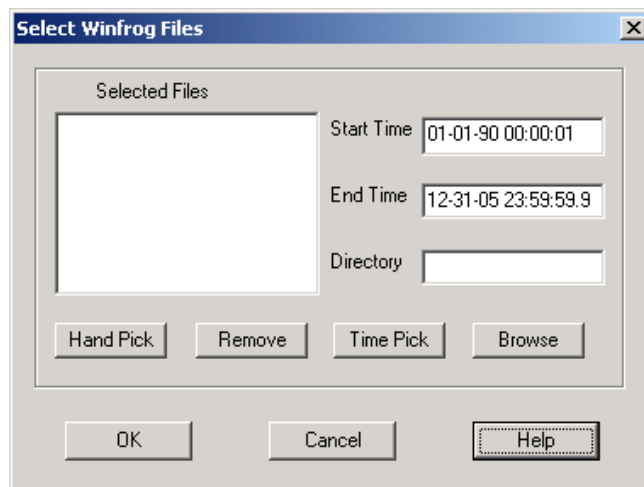
Using a **File** as a data source is a two step process.

First, positional data are collected and saved to a **.raw** file. This **.raw** file contains time, position, heading, and other available navigation information on the desired vehicle(s).

Second, after data are collected, the **.raw** data files are specified as the position source for a vehicle of the same name. WinFrog reads the time, position, and other available navigation information in the **.raw** file and applies it to the vehicle. You can **rewind** and **fast forward** the data to make it easy to find a specific point of interest. In addition, the data can be played back at **1, 2, 5, 10,** and **20** times the normal speed. This allows you to examine previously collected data in a more efficient manner.

To Use .raw File Data as a Position Source

- 1 Select **Configure > Vehicles**
- 2 Highlight the appropriate vehicle and select the **Configure Vehicles-Devices** button.
- 3 Set the vehicle's **Data Source** to **File**.
- 4 Click the **Add** button.



5 Select the **.raw** files to use.

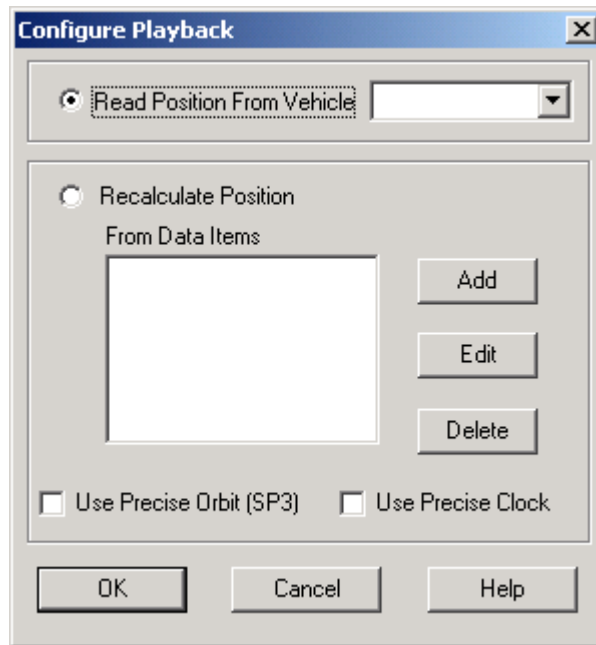
There are two methods to select **.raw** files using the **Select WinFrog Files** dialog box: **Hand Picked** or **Time Picked**.

Hand Pick button	Opens the Add Files dialog box. You need to navigate to the appropriate directory and select the desired .raw files.
Time Pick button	Selects all .raw files that fall within the Start Time and End Time found in the specified directory. You must first specify the appropriate Directory , Start Time , and End Time .
Start Time field	Use with Time Pick . The times must be entered in the following format: dd-mm-yy hh:mm:ss.sssss .
End Time field	Use with Time Pick . The times must be entered in the following format: dd-mm-yy hh:mm:ss.sssss .
Remove button	This button removes a .raw file selected from the available Selected Files list. Use this to further narrow the .raw files to be used for playback.
Browse button	Use with Hand Pick or Time Pick . Opens a dialog box to navigate to a directory containing the .raw files to be used.
Directory field	Displays the path to the directory selected via the Browse button.

6 Once the desired files are selected, click **OK**.

Next, you must instruct WinFrog as to which vehicle's data to use (from within the selected files).

7 Still in the **Configure Vehicle Calculations** dialog box, click the **Edit** button. The **Configure Playback** dialog box displays.

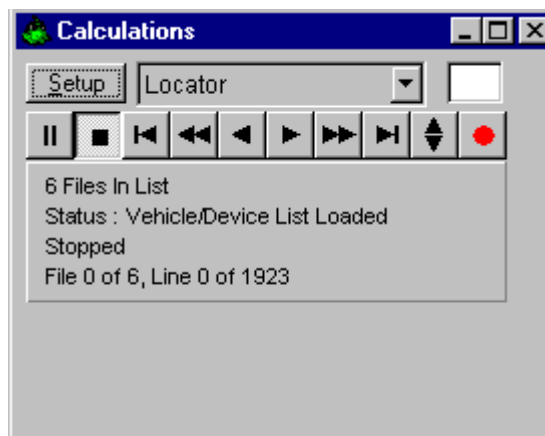


Currently, there is only one possible configuration from this dialog box: **Read Position From Vehicle**. The **Recalculate Position From Data Items** is reserved for future development.

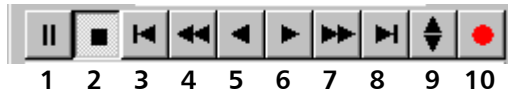
- 8 Select the **Read Position From Vehicle** radio button and then select the appropriate vehicle from the dropdown menu.

You do not have to repeat this step for every **.raw** file listed.

- 9 Click **OK** to close the **Configure Playback** dialog box.
- 10 Click **OK** to close the **Configure Vehicle-Devices** dialog box.
- 11 Choose **View > Calculations**. WinFrog's **Calculations** window now appears with 10 **Playback** buttons, as seen below.



- 12 Select the appropriate vehicle from the dropdown list.



The playback control buttons allow you to do the following:

- 1 pauses playback
- 2 stop playback
- 3 return to the beginning of the first **.raw** file
- 4 fast reverse playback
- 5 reverse playback at current speed
- 6 forward playback at current speed
- 7 fast forward playback
- 8 skip to the end of the last **.raw** file
- 9 change current playback speed to 1:1, 1:2, 1:5, 1:10, or 1:20
- 10 begin recording new raw data files from the playback results

- 13 Select the desired playback option(s).

Note: WinFrog's **Graphics** and **Vehicle Text** windows now display the playback data as configured above.

Pipe Track Data Source Configuration

WinFrog's **Pipe Track** positioning feature allows you to calculate the position of a **pipeline touchdown** point relative to another vehicle's (i.e., the pipelaying **barge's**) position and heading.

WinFrog treats the touchdown point as a separate vehicle (it is referred to as a **Layback** vehicle) and so requires that a new vehicle is added to and configured in WinFrog. This vehicle can be setup to track its own waypoints or survey lines, as required. The barge vehicle is referred to as the **Reference** (or **From**) vehicle. This vehicle typically utilizes **real-time** devices for its positioning.

The implementation of this feature requires the configuration of 3 specific parameters:

- 1 Select a reference (i.e. **From**) vehicle.
- 2 Specify the point on that vehicle from which the layback calculations will be initiated.

- 3 Select the method of bearing calculation to be used - either **Barge Heading** or **Barge Tracking**. The following sections detail each of these steps.

The configuration of layback distances and barge offsets affect not only the position of the **touchdown** point (i.e. layback vehicle), but also the line tracking features of the **barge** (i.e. reference vehicle). Typically, pipelaying route information is provided for the **touchdown** point as opposed to the barge. In order to keep the **touchdown** point on line, the **barge** may have to follow a different line from the line tracked by the **touchdown** point, particularly around curves. The **barge's** tracking line varies from that of the **touchdown** point as follows:

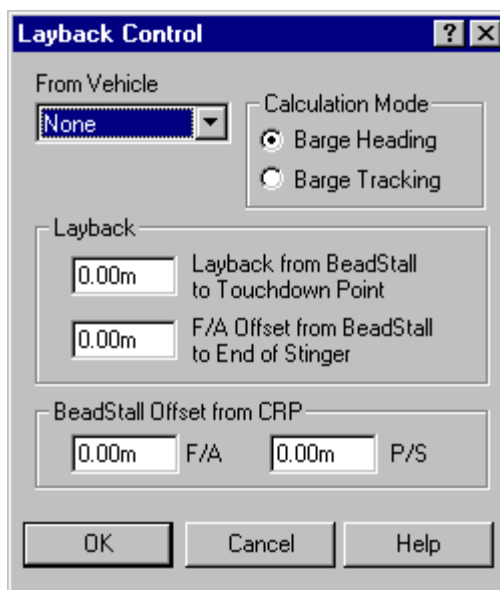
- Curves start for the reference vehicle (i.e. barge) a distance equivalent to the layback distance beyond the design start of curve.
- Similarly, curves end a distance equivalent to the layback distance beyond the design end of curve.
- Offline distances are relative to the modified line, including the modified curves.
- Downline distances, distance to go, and KPs are relative to the original design line. If this were not the case and they were relative to the modified line, there would be no correlation of reference vehicle and layback vehicle line tracking data. In addition, they would change whenever the layback was changed, resulting in a new modified line being created for the reference vehicle.
- A **Required Heading** is available for display in the **Vehicle Text** window. This is the heading that the barge (i.e. **From vehicle**) must maintain in order to keep the touchdown on the design line.

To Configure Touchdown Point Positioning Based on a Layback From a Reference Vehicle

- 1 Select **Configure > Vehicles**.
- 2 Highlight the touchdown point “vehicle.”
- 3 Select the **Configure Vehicle-Devices** button.
- 4 Set the data source of the touchdown point “vehicle” to **Pipe Track**.

This will add the **Layback** device to this vehicle’s **Devices** list. Ensure that there are no additional devices included in the vehicle’s **Devices** list.
- 5 Still in the **Configure Vehicle-Devices** dialog box, select the **Layback** data “device” in the **Devices** list.

- 6 Click the **Edit** button to display the **Layback Control** window as seen below.



The information entered in this dialog box enables WinFrog to compute the position of the touchdown point (i.e. **Layback** vehicle) relative to the barge (i.e. the **From Vehicle**).

From Vehicle

Select the **From Vehicle** (i.e. barge vehicle) from the dropdown menu.

Calculation Mode

Select the appropriate **Calculation Mode** from the two choices offered:

Barge Heading

The touchdown point (i.e. **Layback** vehicle) position is calculated by using the **From** vehicle's **heading** (as supplied by an interfaced heading device) and the layback distances entered below.

Barge Tracking

The touchdown point (i.e. **Layback** vehicle) position is calculated in a "vehicle following" mode using a computed azimuth from the latest **From Vehicle** position and the last **Layback Vehicle** position and the entered layback distances. Choose this option if gyro compass information is not available on the barge (i.e. **From**) vehicle.

Layback

Layback from BeadStall to TouchDown Point

Enter the measured horizontal distance from the **BeadStall** (or relevant reference point) to the **Touchdown Point**. This value is always a positive value.

F/A Offset from BeadStall

to End of Stinger

Enter the offset from the **BeadStall** to the point that the pipe/cable leaves the barge, usually the end of the stinger. Offsets in the aft direction from the CRP are entered as negative values.

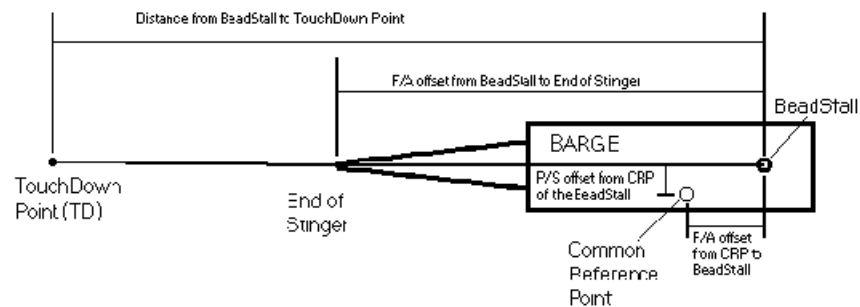
Beadstall Offset from CRP

F/A

Enter the fore/aft offset from the CRP to the **BeadStall**. Aft values are negative.

P/S

The port/starboard offset from the CRP to the **BeadStall**. Port values are entered as negative values.



- 7 After configuring the parameters in the **Layback Control** dialog box, click **OK**. The touchdown point “vehicle” now appears behind the barge at the distances specified by the offset entries.

All layback information is sent to each Smart Remote.

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Chapter 10: Eventing

The ability to record data is essential for all but the most basic offshore navigation/positioning projects. Data items required typically include the vehicle's position, speed, heading, course made good, etc. You may be required to record this information at a set **time** or **distance** interval or **on demand**, such as when the vehicle changes course or passes a point of interest.

WinFrog can accommodate all of these data logging requirements. In WinFrog, the recording of information is referred to as **Eventing**; each individual record is called an **"Event."**

Note: in hydrographic surveying, an **event** is often called a **"fix,"** while in seismic surveying operations the term **"shotpoint"** is often used.

WinFrog can be used to record events in two different ways: **automatically** and **manually**. The two methods of eventing can also be combined. For example, you can configure WinFrog to automatically record events at a set time or distance interval, while simultaneously recording **Manual Events** by clicking a button on the toolbar.

WinFrog is also capable of recording user-definable amounts of **raw** data from all interfaced I/O devices.

For more details, refer to the **Configuring Events** section later in this chapter.

Types of WinFrog Events

Automatic Events

WinFrog can record an event based on a specified time or distance interval or when activated by an interfaced external triggering device. The following information is recorded at each event:

- Event Number
- Vehicle Name
- Position
- Time and Date
- Height
- Depth (of water)
- Layback
- Speed
- Heading
- Course Made Good
- Offset

- QC
- Downline Distance
- Offline Distance
- KP - Kilometer Post (distance downline in kilometers)

Events generated automatically (or by an external trigger) are recorded as one of four different types:

Data Logging	identified with a .DAT file extension
Hydrographic	identified with a .DAT file extension
Source	identified with a .SRC file extension
Receiver	identified with a .RCV file extension

Note: although there are four different record types (3 actually as there are 2 **.dat** files), **the contents of the different record types are exactly the same.**

All files generated by **automatic eventing** are recorded in the directories specified under **File > Select Working Files.**

Manual Event

A “**manual Event**” is defined as the instantaneous recording of navigation and positioning data of all WinFrog vehicles. There are three ways that you can instruct WinFrog to record a **Manual Event**:

- 1 Click the “**EV**” button on the toolbar
- 2 Press the **F10** hotkey
- 3 Select **Configure > Manual Event**

The following information is recorded the instant that a manual event is initiated:

- User-Entered Comment
- All Vehicle Positions
- WinFrog Time and Date
- Height
- Depth (of water)
- Layback
- Speed
- Heading
- Course Made Good
- Offset
- QC
- Downline Distance
- Offline Distance
- KP - Kilometer Post (distance downline in kilometers)

All **Manual Events** are recorded in the **Working Logs (.log)** file, as specified under **File > Select Working Files > Logs**.

Cable Events

In addition to automatic and manual events, WinFrog can also be configured to record “**cable events**”. A **cable event** is a special type of a manual event that is related to cable laying projects. All **cable events** are stored in the **Working CET** file.

The following information is recorded with a **Cable Event**:

- User-Entered Comment
- WinFrog Time and Date
- All Vehicle Positions
- Water Depth
- Cable Tension
- Cable Data Source
- Cable Event Type (one of the following options):
 - KM (Kilometer Mark)
 - Transition
 - Splice Box
 - Repeater
 - Branch
 - Cable End
 - Square
 - Circle
 - Triangle
- Incremental Route Distance
- Cumulative Route Distance
- Incremental Cable Distance
- Cumulative Cable Distance
- Incremental Percent Slack
- Cumulative Percent Slack

Fugro Pelagos has written supporting software to automatically apply cable event information to real-time cable installation calculations. The WinFrog **Cable Management Extension Module** interacts with the **Cable Route Design Database** to model the cable and derive touchdown positions.

(For use of this model, refer to the **WinFrog Cable Management Extension Module (WCMEM) & Cable Route Design Database (CRDD)** User’s Guide.)

The following sections of this chapter explain how to configure a vehicle for **automatic**, **manual**, and **cable events**.

Configuring Vehicles for Automatic Events

In order to configure WinFrog to automatically record event data, you must define one vehicle as the **Primary Event Vehicle**. The information for any number of vehicles can be recorded using automatic eventing. However, only the **Primary Event Generation Vehicle** can trigger event recording. If you want to record information for any other WinFrog vehicle, the additional vehicles must be configured as **Secondary Event Vehicles**. When the **Primary Event Vehicle** triggers an **Automatic Event**, information for that vehicle (along with all secondary event vehicles) is written to disk.

The specification of which vehicle will be the **Primary Event Vehicle** is critical only when automatic events will be generated based on **distance**. Automatic events generated at distance intervals are triggered with respect to the **Downline** distance along a tracked **survey line**. Obviously, unless the various vehicles are at exactly the same location, the **automatic events** would occur at different times for the different vehicles. Thus, events are generated only as the **Primary Eventing Vehicle** crosses (at a right angle to) a multiple of the specified distance interval.

Note: the **downline** distance is not necessarily the same as the **distance traveled** by the vehicle, especially if the vehicle is "weaving" or traveling at an angle to the selected survey line.

The specification of a vehicle as the **Primary Event Vehicle** is not important when **automatic events** are generated based on **time**. In this case, **WinFrog Time** is used, which is the same for the all vehicles. Hence, the **automatic events** will be generated at the same time no matter which vehicle has been designated as the **Primary Event Vehicle**.

To Configure a Vehicle as Event Primary

- 1 Select **Configure > Vehicles**.
- 2 Highlight the vehicle that you wish to designate as the **Primary Eventing Vehicle**.
- 3 Select the **Vehicle Presentation** button to display the **Vehicle Presentation** window.
- 4 In the **Event Generation** area, click the **Event Primary** radio button.
- 5 Click **OK** to close the **Vehicle Presentation** dialog box.

Note: if another vehicle is already set as the **Primary Eventing Vehicle**, WinFrog displays a message stating that the other vehicle must be configured as a

Secondary Eventing Vehicle before this vehicle can be enabled as the **Primary Event Vehicle**.

To Configure a Vehicle as Event Secondary

In order to have data collected for vehicles other than the **Primary Eventing Vehicle**, they must be designated as **Secondary Event Vehicles**.

- 1 Select **Configure > Vehicles**.
- 2 Highlight the vehicle that you wish to designate as the **Secondary Eventing Vehicle**.
- 3 Select the **Vehicle Presentation** button to display the **Vehicle Presentation** window.
- 4 In the **Event Generation** area, click the **Event Secondary** radio button.
- 5 Click **OK** to close the **Vehicle Presentation** dialog box.

Enabling and Activating Automatic Events

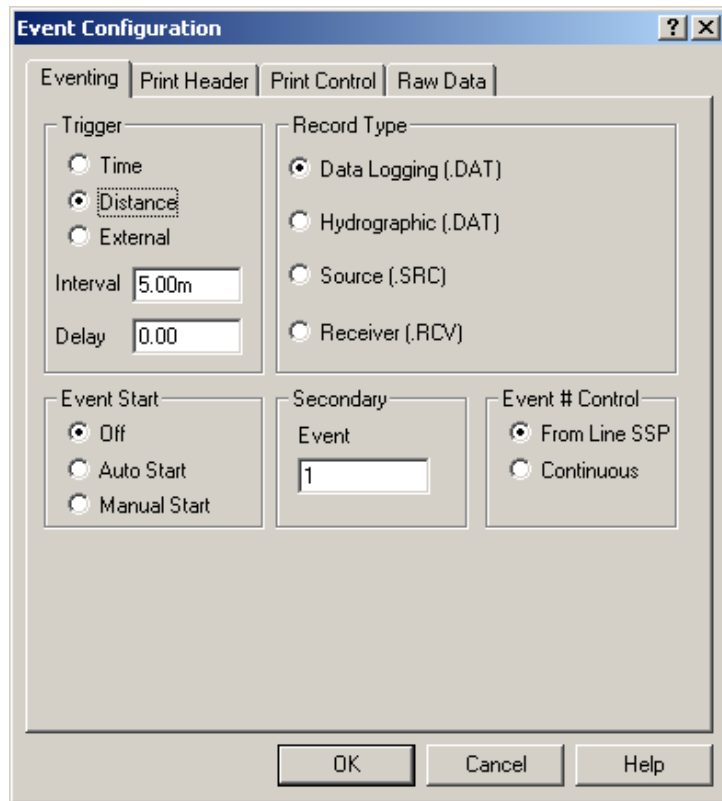
The following section details the steps required to **enable** and **activate automatic event** recording in WinFrog. These instructions require that a vehicle has been designated as the **Event Primary** vehicle. If this has not yet been completed, see the section above for details.

To Enable Automatic Event Recording

- 1 Ensure that the **Primary Eventing Vehicle** is visible in the **Vehicle Text** window.
- 2 Move the mouse pointer into the **Vehicle Text window** and click the right mouse button.
- 3 Move the mouse pointer to the **Setup Data Events** button and click the left mouse button to bring up the **Event Configuration** dialog box. (This dialog box can also be accessed by selecting **Configure > Data Events...Setup** or by **Configure > Vehicles > Setup Data Events**.)

The **Event Configuration** dialog box contains four tabs: **Eventing**, **Print Header**, **Print Control**, and **Raw Data**.

- 4 Select the **Eventing** tab first.



- 5 Select the appropriate **Trigger** radio button.

The **Trigger** selection defines the method by which **automatic events** are triggered.

Time radio button

Select this button to record events at a configurable **Time** interval and enter the time interval, in seconds, in the **Interval** field.

Distance radio button

Select this button to record events at a configurable **distance** interval. This mode requires that the **Primary Eventing Vehicle** be tracking a survey line. As the **Primary Eventing Vehicle** moves parallel to the selected survey line, WinFrog calculates the increasing or decreasing **Distance Downline** value relative to the vehicle's **Tracked Offset** point. WinFrog triggers events as the **Primary Eventing Vehicle's Tracked Offset Point** crosses whole number multiples of the specified **Distance Interval**. Remember, this is not necessarily the same as the distance traveled by the vessel. If this mode is selected, enter the distance interval in the

	Interval field, using the correct unit of measure. Note: if the Trigger mode is set to Distance and the Primary Eventing Vehicle is not tracking a survey line, WinFrog will not record any Automatic Events. If the Record Type is set to Hydrographic, Source, or Receiver, (as detailed below) WinFrog automatically prompts you to select a survey line to track. However, if the Data Logging record type is selected, WinFrog does not prompt for a survey line to be tracked. In this case, the survey line tracking must be enabled from the Survey Line dialog box (select Setup Line Tracking from the Vehicle Text window right click shortcut menu).
External radio button	Select this button to have an external triggering device generate Automatic Events. This requires the installation of a special cable between the triggering device and a WinFrog comm port. You must also add the appropriate Event device (typically the Trigger > Closure In device) to the Event Primary vehicle's Devices.
Interval field	Enter the time or distance interval as described above.
Delay field	This value only works with Eventing Based on Distance. As the vehicle travels down a survey line, WinFrog anticipates the next upcoming event and sends out a closure before the automatic event is to take place. The delay value defines the number of seconds before the event that this closure is sent. This calculation is based on WinFrog's calculated downline speed. This is intended for use with seismic systems that need some advance "warning" to prepare for an event.

6 In the **Record Type** area, click the appropriate radio button.

Remember, you can record automatic event data to a file using any of the four different record types. All four **Automatic Event Record Types** contain exactly the same data, in exactly the same format, but are easily distinguishable by their file extensions.

Any one of the four options can be used when triggering is based on time. In order to keep it simple, the **Data Logging** option is recommended.

Any one of the four options can also be used when triggering is based on distance. If you select the **Hydrographic**, **Seismic**, or **Cable Lay** record type, a window opens prompting you to select a survey line before automatic event recording is enabled. If the **Data Logging** type is selected with distance triggering, you must enable survey line tracking before you begin configuring automatic events.

(See the **Working Files** chapter and **Appendix A: WinFrog File Formats** for a detailed explanation of file use and file structure in WinFrog.)

- 7 In the **Event Start** area, click the desired radio button.

These buttons define how **Automatic Eventing** will be made **Active**.

Auto Start

This option instructs WinFrog to immediately enable **Event Active** status when **OK** is selected to close the **Event Configuration** window.

Manual Start

This option instructs WinFrog to initiate **Event Enabled** status when the **OK** is selected in the **Event Configuration** window. All of the **Event Configuration** window options that have just been set are retained and you are able to manually activate events.

WinFrog will not start automatic event recording until the **Event Status** is **Active**.

You must change the **Eventing Status** to **Active** by clicking on the **Event Start** button in the toolbar. Alternatively, you can select **Configure > Data Events... Start** from the main menu.

Regardless of which button is chosen, WinFrog actually completes two stages before it will start automatic event recording.

In the first stage, eventing is set to **Enabled** status. Data are not recorded while in **Event Enabled** status. There are 2 ways to determine if WinFrog is set to the **Event Enabled** status: the **Event Start** button in the toolbar will change in color from **gray** to **green** and the **Event Status** option in the **Vehicle Text** window will state **EVT Enabled** (as opposed to **Evt Active**).

The second stage is **Event Active**. WinFrog must be in **Event Active** status to record automatic event data. There are 2 ways to determine if WinFrog is in **Event Active** status: the **Event Stop** button in the toolbar will change in color

from **gray** to **red** and the **Event Status** option in the **Vehicle Text** window will state **EVT Active**.

8 Configure the **Secondary** option.

This option is for output to 2 specific devices: the **Odom DF3200** echosounder and the WinFrog **Closure Out** device. The value entered in this window defines how often an output will be sent. For example, entering a 5 in this window instructs WinFrog to output to these devices only every fifth automatic event.

9 In the **Event # Control** area, click the desired radio button.

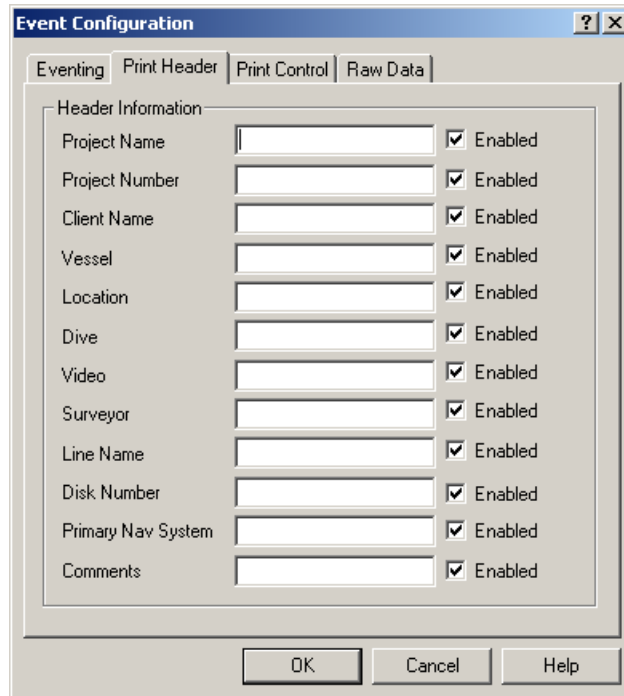
The selection made here will define the default starting **Event Number** that appears when you close the **Event Configuration** window (the window that you are in now) and the **Data Logging** window is displayed.

If you select the **Line** option, WinFrog will use the **Starting Event Number** entered when the survey line was created. This option obviously requires that a survey line be selected for tracking.

If you select the **Continuous** option, WinFrog will use the last **Event Number** that was generated when eventing was last used, incrementing or decrementing this value as required to match the defined counting order. (The number 1 will default here for the initial data collection session).

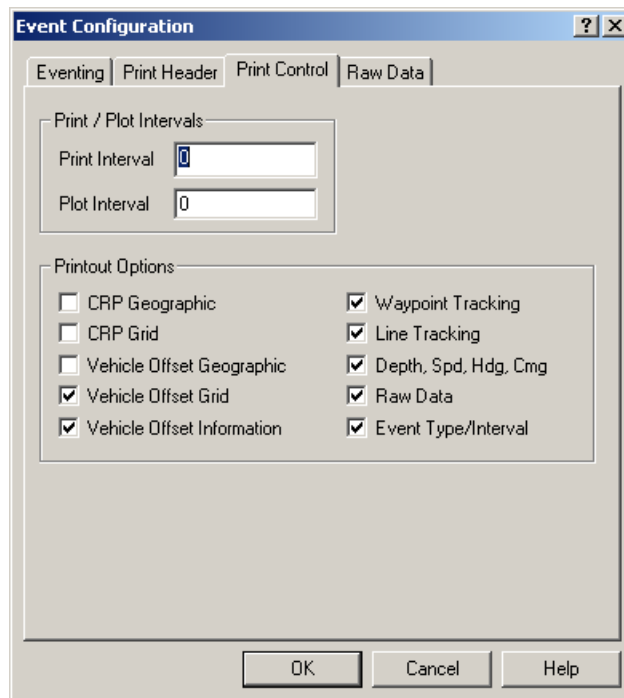
Note: this option only defines the **default** number that will appear in the **Starting Number** entry window. You can always change the number to another value later, if you wish. This option is provided only as a convenience in those situations where the same **Event Number** is used at the start of each survey line, as is typically the case with seismic surveys. This saves you from having to enter a **Starting Number** each time data collection is re-activated.

10 Click the **Print Header** tab.



This dialog box presents twelve fields for entering information that prints on the top of each page while WinFrog is generating automatic events. Click an entry field and enter text for that specific category. If a window is not pertinent and no data are entered, you can disable the printing of a blank space by de-selecting the **Enabled** option for that particular field.

11 Click the **Print Control** tab.



This dialog box allows you to define the interval at which information will be printed. (At present, the **Plot Interval** feature is not available).

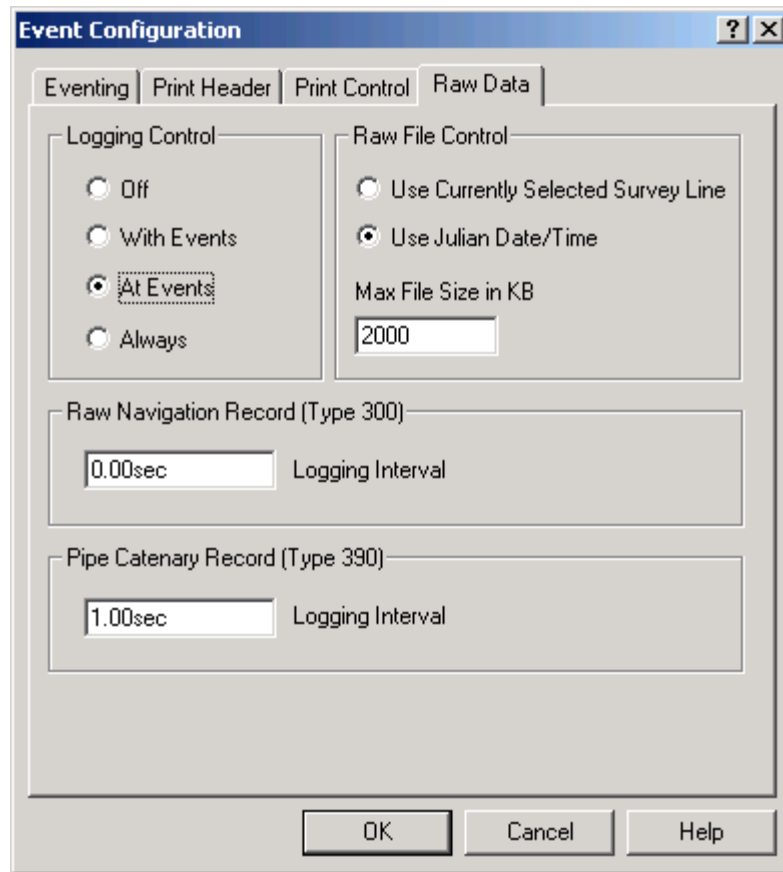
- 12 Click in the **Print Interval** field and enter the desired value. For example, entering a **5** here specifies that WinFrog will print at every **fifth** automatic event, while entering a **0** instructs WinFrog to **not** print any automatic events.

There are 10 **Printout Options** to choose what data (if any) are printed. The data are printed for the **Primary Eventing Vehicle** and all **Secondary Eventing Vehicles** as well.

The **Printout Options** include:

CRP Geographic	the geographic coordinates (latitude and longitude) of the vehicle's Common Reference Point (CRP)
CRP Grid	the grid coordinates (Northing and Easting) of the vehicle's Common Reference Point (CRP)
Vehicle Offset Geographic	the geographic coordinates (latitude and longitude) of the Vehicle Offset point being tracked
Vehicle Offset Grid	the grid coordinates (Northing and Easting) of the Vehicle Offset point being tracked
Vehicle Offset Info	offset details
Waypoint Tracking	the bearing and distance from the vehicle's currently tracked offset point to a selected waypoint
Line Tracking	survey line tracking information including the distance to the Start of Line (SOL), End of Line (EOL), and Offtrack distance and direction
Depth, Spd, Hdg, CMG	The water depth (as provided by an interfaced echosounder), the vessel's speed, heading, and Course Made Good
Raw Data	the raw, uncorrected data read directly from interfaced I/O devices at the instant of the printed event
Event Type/Interval	the type of event trigger (time or distance) and the event interval

13 Click the **RAW Data** tab.



This dialog box allows you to define the amount of raw data that is recorded and the naming convention used for the **.raw** files as they are recorded. Remember, except for the 300 and 390 records, raw data are the data recorded directly from an interfaced device; no offsets, corrections, or filtering is applied.

Logging Control

The **Logging Control** options are used to configure the amount of raw data that are recorded. There are four modes: **Off**, **With Events**, **At Events**, and **Always**.

Off

No raw data are recorded.

With Events

WinFrog begins recording raw data at the first automatic event, recording raw data continuously until automatic eventing is stopped.

For example, consider the case when automatic eventing is set to trigger based on **Distance** at an interval of 25 meters. Eventing on **Distance** is always based on the downline distance as calculated relative to a tracked survey line.

In this case, eventing will start as the vehicle's tracked offset point crosses perpendicular to the start of the survey line and will continue until stopped by the operator. If the raw data **Logging Control** is set to **With Events**, raw data are recorded continuously for the **same** time span.

If automatic eventing is set to trigger based on **Time** at an interval of 10 seconds, raw data are recorded continuously from the instant that the **Event Status** is made **Active** up to the instant that the **Event stop** button is pressed.

At Events

Raw data are recorded only when an automatic event occurs. For example, if automatic eventing is set to trigger every 10 seconds, raw data will be recorded only at those same 10 second intervals.

Always

Raw data are recorded as soon as the **OK** button is clicked to close the **Event Generation** dialog box. You do not have to enable automatic eventing recording to record **Raw Data Always**. As with **Raw With Events**, all data being received from interfaced I/O devices are recorded.

Raw File Control

Raw File Control establishes the **.raw file** name and the maximum **.raw** file size. All raw files are created with a **.raw** file extension. The raw file name can be one of two options:

Use Currently Selected

Survey Line

Using this option, the **.raw** file name will be the same as the currently selected survey line. For example, if **line1** is being tracked, the file name will be **line1.raw**. If no survey line is currently being tracked, the raw file name will default to **noline.raw**.

Use Julian Date/Time

Using this option, the **.raw** file name will be based on **WinFrog's** Julian date and time. The Julian day is the number of that day of the year, starting with January 1st as Julian day number 1. For example, September 27, 1999, is Julian day 270 for that year. If the raw data collection began at 8:00 am that day, the raw file name would be **270-0800.raw**. If another raw file is created in that same minute, the seconds would be added to the file name and the file name would display as **270-080032.raw**.

Note: WinFrog's time can be based on the computer's clock or synchronized to GPS time.

Max File Size in KB

This entry window only works in conjunction with the **Julian Date/time** naming option. It allows you to define the maximum size of any single **.raw** file. As the maximum file size is reached, a new **.raw** file will be created, again named according to WinFrog's date and time. The only limit to file size is the amount of space available on the computer's hard drive. You should limit the file size to a practical size so that the file can be easily transferred or edited. The default of 200 KB is recommended for most operations.

Note: during eventing, WinFrog constantly checks the amount of space left and issues a warning when the capacity gets down to 1 mb. **Note:** this warning will not occur if you have set raw data collection to **Always**. As mentioned above, recording raw data **Always** does not require **eventing** to be active.

Raw Navigation Record (Type 300)

Logging Interval

This entry window allows you to record the **type 300** raw record at an interval different to the other raw records. The type 300 record is a unique record type created for a specific client. **Note:** since most users do not require this data record type, enter 0.0 in this field. Once a logging control option has been selected, this record will be recorded to file at the rate selected regardless of the event status.

Pipe Catenary Record (Type 390)

Logging Interval

This entry window allows you to record the **type-390** raw record at an interval different to the other raw records. The type-390 record contains the dynamic tracking data (Chp 6) and calculated pipe catenary data. Once a logging control option has been selected, this record will be recorded to file at the rate selected regardless of the event status.

(For more information about raw data files, see the **RAW Files** section in the

Basic Ribbit chapter. The formats are given in appendix B.)

- 14 Once all of the **Event Configuration** options are set, click **OK**.

Depending upon the **Record Type** that was selected in the **eventing options**, one of two dialog boxes opens.

Event Secondary Configuration

If the **Data Logging (.DAT)** radio button is selected in the **Record Type** area of the **Event Configuration** dialog box, WinFrog opens the **Event Secondary Configuration** dialog box, as described immediately below. If either the Trigger is set to Distance or the Raw Data Raw File Control is set to Use Currently Selected Survey Line in the **Event Configuration** dialog box, the **Event Secondary Configuration** dialog box includes a Select Survey Line tab. This allows you to select a survey line to track directly from the eventing setup.

Distance Fixing

If **Hydrographic (.DAT)**, **Source (.SRC)**, or **Receiver (RCV)** is selected in the **Record Type** area of the **Event Generation** dialog box, WinFrog opens the **Distance Fixing** dialog box, as described further below.

To Configure the Event Secondary Configuration Dialog Box

The screenshot shows the 'Event Secondary Configuration' dialog box. It has a title bar with a question mark and close button. Inside, there are two tabs: 'Event File' and 'Select Survey Line'. The 'Event File' tab is selected. Under this tab, there is a 'File Name' text box containing the word 'EVENT'. Below that is an 'Event Number' section. It includes a 'Starting Number' text box with 'N/A' and two radio buttons: 'Increment' (which is selected) and 'Decrement'. Below the radio buttons is a 'by' text box containing the number '1'. At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Apply'.

- 1 Enter a name in the **File Name** field.

The name must be 24 characters or less. Any spaces in the file name will be removed when the file is written to disk. WinFrog adds the extension **.DAT** to the file name and records the file in the **Filing Directory** as specified in **File > Select Working Directories**.

- 2 Enter a value in the **Starting Number** field in the **Event Number** area.

Each individual automatic event has a numerical value assigned to it. The **Starting Event Number** is the value assigned to the first event. WinFrog will enter a default number in this window, based upon the last event taken in the previous event file or the event number specified for a tracked survey line.

- 3 Select the **Increment** or **Decrement** radio button.

Configure this option as required. For eventing based on time, this is typically set to **Increment**. For eventing based on distance, this may be determined by the direction the line is run. Often, when conducting a site survey with numerous parallel lines, you will want to have matching event numbers located at the same distance downline locations. In this case, you would increment the count as you go in one direction, then decrement it as you go back.

- 4 Enter a value in the **by** field. Typically, this is left at the default value of 1.

This sets the amount that the event number will increment or decrement. For example, if **by** is set to **2** and the **Starting Number** is set to **0**, WinFrog numbers the events **0, 2, 4, 6...** when the **Increment** radio button is selected.

- 5 Click **OK** to close this window and proceed to eventing.

Event File Dialog Box

The **Event File** dialog box opens if an **Event file** of the same name already exists in the **Filing Directory**.

- 1 If the existing file is not to be used, click **No**. WinFrog returns to the **File Name Entry** dialog box.
- 2 If the existing file is to be used, click **Yes**. WinFrog opens the **Append File** warning box.
- 3 To overwrite the existing file, click **No**.
- 4 To append new data to the existing file, click **Yes**.

WinFrog now returns you to the previously configured real-time display. Depending on the **Event Start** selection made (see above), the **Event Status** is now either **Enabled** or **Active**. (See below for further information on Event Status.)

Distance Fixing Dialog Box

If the **Hydrographic**, **Seismic**, or **Cable Lay** radio button is selected in the **Record Type** area of the **Event Generation** dialog box, WinFrog opens the **Distance Fixing** dialog box. This dialog box is used to configure the distance fixing for event generation.

To Configure the Distance Fixing Dialog Box

The **Distance Fixing** dialog box is used to configure event generation settings. It includes the following fields and controls:

- Survey Line:** Radio buttons for **Forward** and **Reverse**, and a dropdown menu.
- Event File Name:** Text box.
- File Name Prefix:** Text box.
- Event Number Interval:** Text box (value: 1) and radio buttons for **Increment** and **Decrement**.
- Start Of Eventing:** Fields for **Event # at SOL** (0), **EOL** (0), **Distance Downline of SOL** (0.00m), and **Start of Data Logging Event #** (0).
- Run-In/Out Events:** Fields for **Number Of Run-In** (0) and **Number Of Run-Out** (0), each with an **Event #** field (0).
- Graphics Extension:** Radio buttons for **Off** (selected) and **On**, and a **Length** field (0.00m).

Buttons: **OK**, **Cancel**, **Help**.

Survey Line

dropdown menu

lists all of the survey lines in the **Working Survey Line (.pts)** file . Select the desired choice.

Forward radio button

informs WinFrog that the survey line will be tracked in the “forward” direction (the direction that the coordinates were entered).

Reverse radio button

informs WinFrog that the survey line will be tracked in the “reverse” direction (the opposite direction from the way that the coordinates were entered).

Event File Name

entry field

Enter the name of the file in this field. WinFrog will enter the survey line name as a default, but you can enter your own file name. WinFrog adds a three letter file extension to the file name based on the user's selection in the **Record Type** area of the **Event Generation** dialog box: **.DAT**, **.SRC**, or **.RCV**.

File Name Prefix

entry field

If you want to add a prefix to the name of the **Event File Name**, enter it in this field. This is primarily used for “re-shoots” of the same survey line.

Note: the prefix must not contain quotes, back slashes, forward slashes, square angle braces, curly braces, colon, semicolon, equal sign, dots, spaces or commas as these characters will not be appended to the EVENT FILE NAME.

Event Number Interval

entry field

WinFrog labels consecutive events by the value entered in this field.

Increment radio button

Increases the event number for the next event by the value entered in the **Event Number Interval** window.

Decrement radio button

Decreases the event number for the next event by the value entered in the **Event Number Interval** window.

Start Of Eventing

Event # at SOL field

WinFrog labels the first automatic event with the number entered in this field.

Distance Downline of SOL
field

This is the distance from the **Start of Line** where eventing will commence. This option is used when it is necessary to begin the data collection somewhere other than at the start of the survey line. If eventing is to start at the SOL, leave this as the default value of 0.

First Shot Downline field

Enter the number of the event where you want to start the eventing. Again, this is for

re-shoots. The default value here (0.0) configures eventing to start at the SOL, but you can enter a different value to start eventing somewhere down the line. WinFrog takes this event number and multiplies it by the event interval to determine where this event will take place.

Run-In/Out Events

Number of Run-In field

This is the number of events to take before the start of the currently tracked survey line.

Number of Run-Out field

This is the number of events to take after the end of the currently tracked survey line.

Graphics Extension

Off/On radio button

Select the **On** button to have WinFrog create a dotted line in the **Graphics** window, extending the currently tracked survey line. This assists the helmsman in lining up the vessel with the survey line before actually reaching the start of it.

Length

Enter the length of the dotted **Graphics Extension** line.

When all values are configured as desired, click **OK**. The **Event File** dialog box opens if an **Event** file already exists. (See above for details.) Otherwise, WinFrog returns you to the previously configured real-time display. Depending on the **Event Start** selection made (see above), the **Event Status** is now either **Enabled** or **Active**.

Eventing is Enabled/Active

Collection of automatic events commences when **Event Status** is made **Active**. If the **Auto Start** radio button was selected in the **Event Generation** dialog box, WinFrog proceeds directly to **Event Active** status and begins recording data.



If the **Manual Start** radio button was selected in the **Event Generation** dialog box, WinFrog is only in **Event Enabled** status.

To Activate Data Recording

- 1 Click the green **Start** button in the toolbar or choose the main menu item **Configure > Data Events...Start**.

Several things will happen when the **Automatic Event** data collection **Status** is **Active**.

- In the **Vehicle Text** window, the **Event Status** section indicates **EVT ACTIVE** and the **Event Number** section displays the current event number.
- The **Graphics** display (in its default configuration) will display the event locations and event numbers (scale dependent).
- If a survey line is being tracked, its color in the Graphics window will change to the color of the **Primary** eventing vehicle. The Vehicle Text window will display the **Line Name**, **Distance to SOL**, **Distance to EOL**, and the **Port/Starboard** information (the distance perpendicular from the current survey line segment to the vehicle.)
- The red **Event Stop** button is enabled. This button is used to stop eventing, as described in the following section.

Stopping Automatic Event Data Recording

To Stop Recording Data

- 1 Click the red **Event Stop** button on the toolbar (as seen below), or choose **Configure > Data Events... Stop**.



WinFrog will present the same window that was used to configure the **Event File Name** for the data recording session that just ended.

If the **Data Logging** radio button was selected in the **Record Type** area of the **Event Generation** dialog box, WinFrog opens the **Data Logging** dialog box.

If the **Hydrographic**, **Seismic**, or **Cable Lay** radio button was selected in the **Record Type** area of the **Event Generation** dialog box, WinFrog opens the **Distance Fixing** dialog box.

This allows you to quickly restart automatic event recording using the same event configuration options previously selected. If these event configuration parameters are still suitable, you only have to change the **Event File Name**.

If you want to change the recording parameters or stop data recording completely, click the **Cancel** button. This causes WinFrog to exit **Event Configuration** altogether.

Manual Events

In addition to recording automatic events, WinFrog also allows you to record **Manual Events** and **Cable Events** at the press of a button.

To Record a Manual Event

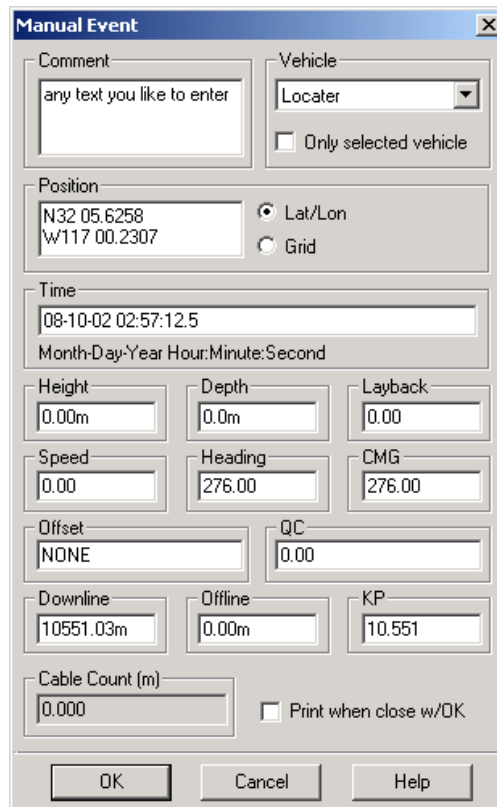
There are three ways to record a **Manual Event**:

- 1 Click the **Manual Fix** button in the toolbar, as seen below



- 2 Choose the main menu item **Configure > Manual Event**.
- 3 Press the **F10** key along the top row of the keyboard.

Regardless of which of the above methods is used, the **Manual Event** dialog window appears, as seen in the next figure.

A screenshot of the 'Manual Event' dialog box. It contains several input fields and checkboxes. The 'Comment' field has the text 'any text you like to enter'. The 'Vehicle' dropdown menu is set to 'Locator'. There is a checkbox for 'Only selected vehicle'. The 'Position' section shows 'N32 05.6258' and 'W117 00.2307' with radio buttons for 'Lat/Lon' (selected) and 'Grid'. The 'Time' section shows '08-10-02 02:57:12.5' with a label 'Month-Day-Year Hour:Minute:Second'. There are three rows of input fields: 'Height' (0.00m), 'Depth' (0.0m), 'Layback' (0.00); 'Speed' (0.00), 'Heading' (276.00), 'CMG' (276.00); and 'Offset' (NONE), 'QC' (0.00). Below these are 'Downline' (10551.03m), 'Offline' (0.00m), and 'KP' (10.551). At the bottom is a 'Cable Count (m)' field (0.000) and a checkbox for 'Print when close w/OK'. The dialog has 'OK', 'Cancel', and 'Help' buttons at the bottom.

To see the information for another vehicle, click the **Vehicle** dropdown field. All of the other fields will update to show the selected vehicle's data.

By default, WinFrog will record information for all vehicles. If you want to record data for only one specific vehicle, select that vehicle from the dropdown field and select the **Only selected vehicle** checkbox. If this checkbox is not selected, you can see the information for any other vehicle by using the **Vehicle** dropdown field.

To print the event, select the **Print when close w/OK** checkbox. This sends this event to the printer when the OK button is clicked.

To Edit a Manual Event After it has been Recorded

- 1 Select **File > Edit Working Files.... > Logs**
- 2 Highlight the appropriate **Manual Event**
- 3 Select **Edit**.

The same **Manual Event** dialog window will appear as when the manual event was initially recorded.

WinFrog's **Graphics** and **Bird's Eye** windows can be configured to display the location of manual events. See the **Operator Display Windows** chapter for more information on WinFrog displays.

Cable Events

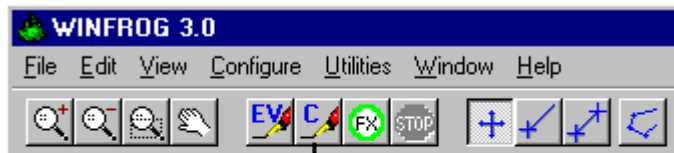
Much like manual events, **Cable Events** allow you to record information at the touch of a button. However, **Cable Events** differ from manual events in that they record additional data specific to cable installation projects. Specifically, cable events record the observed **Incremental and Cumulative Route and Cable Distances**, and the observed **Incremental and Cumulative Slack Percentages**.

Note: a **Working .cet** file or **.mdb Cable Engineering Database** file must be opened before a cable event can be recorded. (See the **Working Files** chapter for more information on these file types.)

To Record a Cable Event

There are three ways to record a **Cable Event**:

- 1 Click the **Cable Event** button on the toolbar, as seen below.



Cable Event

- 2 From the main menu item **Configure**, select **Cable Event**.
- 3 Press the **F11** hotkey along the top row of the keyboard.

Regardless of which method is used, the same **Cable Event** dialog box will appear, as seen in the next figure.

Cable Event

Comment: SB 1

Vehicle: Locator

Time: 08-10-02 02:54:21.0

Position: N32 52.9689
W116 46.2520

Water Depth: 138.8m

Tension: 1200t

Cable Data

Count Source: SimCounter

Tension Source: SimCounter

Type: KM Mark

Route Distance

Incremental: 363.07m

Cummulative: 363.07m

Cable Distance

Incremental: 0.00m

Cummulative: 0.00m

Percent Slack

Incremental: -100.00

Cummulative: -100.00

☐ Print When Exit w/OK

OK Cancel Help

The **Cable Event** dialog box displays a variety of information pertinent to cable laying operations.

- User-Entered Comment
- Vehicle Name
- WinFrog Date and Time
- All Vehicle Positions
- Water Depth
- Cable Tension

Cable Data

Source	Select a cable counter peripheral device previously added to WinFrog.
Type	Select one of the provided options.

The options presented are specific to cable laying projects:

KM Mark	Splice Box	Circle	Repeater	Cable End
Transition	Square	Triangle	Branch	

Route Distance

Incremental	The distance traveled along the route since the previous cable event.
Cumulative	The distance traveled along the route since the first cable event.

Cable Distance

Incremental	The amount of cable let out since the previous cable event.
Cumulative	The amount of cable let out since the first cable event.

Percent Slack

Incremental	The amount of slack in the cable since the previous cable event.
Cumulative	The amount of slack in the cable since the first cable event.

To see the information for another vehicle, select from the **Vehicle** dropdown field. All of the other fields will update to show the selected vehicle's data.

To print the event, select the **Print When Exit w/OK** checkbox. This sends this event to the printer when the OK button is clicked.

To Edit a Cable Event After it has been Recorded

- 1 Select **File> Edit Working Files.... > Cable Events**
- 2 Highlight the appropriate cable event
- 3 Select **Edit**.

The same **Cable Event** dialog box displays as when the event was initially recorded.

The **Graphics** and **Bird's Eye** windows can be configured to display **Cable Events**. For more details, see the **Operator Display Windows** chapter.

Chapter 11: Utilities

WinFrog's main menu includes a **Utilities** category that provides several tools that can be used to perform various frequently required survey operations. Included in the **Utilities** category are the following options:

Geo/Grid Coordinate Conversion

Use this utility to convert geographical (latitude/longitude) coordinates to grid (Northing/Easting) coordinates and vice versa.

KP/Coordinate Conversion

Use this utility to convert KP (Kilometer Post) values to geographical (latitude/longitude) or grid (Northing/Easting) coordinates and vice versa.

WGS84/Working Datum Transformation

Use this utility to convert WGS84 geographical (latitude/longitude) coordinates to the working datum geographical (latitude/longitude) coordinates and vice versa.

Forward/Inverse Calculation

Use this utility to calculate coordinates of a new point from a fixed point (latitude/longitude or Northing/Easting) by entering range and bearing values. This utility can also be used to calculate true and grid bearing and distance between two coordinates.

LOP/Position Calculation

Use this utility to calculate a position from either geographic slope ranges or acoustic two-way-travel-times (TWTT) from fixed transponder stations currently in the Working Xponder file. If TWTT data is used, you can select between using the Working Velocity file or entering velocity values for each TWTT entered. The calculation can also be performed in reverse, that is, calculate geographic slope ranges and TWTTs from an entered position to fixed transponder stations currently in the Working Xponder file.

Acoustics

Three utilities are available here:

1) Sound Velocity

Enter two depths; velocity is calculated

using the current working velocity file.

2) Digiquartz Depth

Enter depth and temperature count and observation time. Select parameters from a Digiquartz equipped COMPATT or enter manually. Depth is calculated using UNESCO formula or given density.

3) Pressure Depth and Sound Velocity

Enter pressure or depth and latitude to calculate the other using the UNESCO formula. Specific ocean corrections can also be applied. As well, enter temperature and salinity and sound velocity is calculated using several different formulae. The pressure entered is to be the absolute pressure minus atmospheric pressure. If the depth is entered, the calculated pressure does not include atmospheric pressure.

Map Wizard

Use this utility to create a Blue Marble Map (*.BMM) file for use as a background image in a Graphics window.

Plotter Base Map Wizard

Use this utility for base map configuration when using the Roland DPX-4600 plotter device.

Generate DXF Map

Use this utility to generate a map in the **.DXF** file format.

Generate MGD77 File

Use this utility to generate a file in the **MGD77** format.

Time Conversion

Use this utility to convert PC Time (the number of seconds since 00:00:00.0, Jan. 1, 1970) to ASCII Time (MM:DD:YY HH:MM:SS.S)

Position Averaging

Use this utility to record position information and generate average position and standard deviation values.

Import Bathymetry

Use this utility to convert ASCII x,y,z bathymetry data into a WinFrog formatted soundings database file that can be displayed in the WinFrog Profile window.

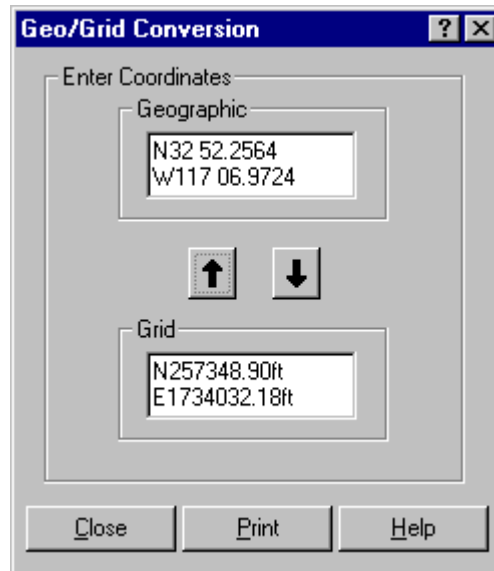
The following sections explain each of these utilities in detail, in the order that they are listed above.

Geo/Grid Conversion

Use this WinFrog utility to convert geographical (latitude/longitude) coordinates to grid (Northing/Easting) coordinates and vice versa.

To Convert Geographic Coordinates to Grid Coordinates

- 1 From the **Utilities** menu, choose **Geo/Grid Conversion**. The **Geo/Grid Conversion** dialog window displays, as seen below.



- 2 Highlight the latitude value displayed in the **Geographic** field.
- 3 Press the **Delete** key on the keyboard.
- 4 Enter the desired latitude by typing the appropriate letter (**N** for North or **S** for South) followed by the value in the format specified in the main menu item **Configure >Units** (i.e. **dd mm.mmmm** or **ddd mm ss.ss**).
- 5 Highlight the longitude value displayed in the **Geographic** field.
- 6 Press the **Delete** key on the keyboard.
- 7 Enter the desired longitude by typing the appropriate letter (**E** for East or **W** for West) followed by the value in the format specified in the main menu item **Configure >Units** (i.e. **dd mm.mmmm** or **ddd mm ss.ss**).
- 8 Click the “**down**” arrow button to perform the conversion to grid coordinates. The grid coordinates (as configured in **Working Geodetics**) are displayed in the **Grid** field.

Note: if the format of the geographical coordinates entered is not correct, the conversion will produce incorrect grid values. To confirm that the

coordinates are entered in the correct format, click the “**up**” arrow to recalculate the geographical coordinates from the grid values. The geographical coordinates will not change if the values were entered correctly.

To Convert from Grid Coordinates to Geographic Coordinates

- 1 From the **Utilities** menu, choose **Geo/Grid Conversion**.
- 2 Highlight the Northing value displayed in the **Grid** entry window.
- 3 Press the **Delete** key on the keyboard.
- 4 Enter the desired Northing by typing **N** followed by the numerical value (as specified in **Configure > Geodetics**).
- 5 Highlight the displayed Easting value displayed in the **Grid** entry window.
- 6 Enter the desired Easting by typing **E** followed by the numerical value (as specified in **Configure > Geodetics**).
- 7 Click the “**up**” arrow button to perform the conversion to geographic coordinates. The geographic coordinates are displayed in the **Geographic** field.

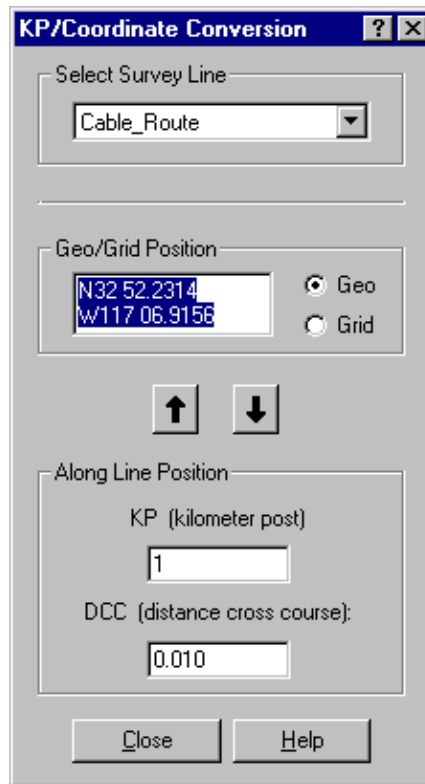
Note: if the format of the grid coordinates entered is not correct, the conversion will produce incorrect geographical values. To confirm that the coordinates are entered in the correct format, click the “**down**” arrow to recalculate the grid coordinates from the geographical values. The grid coordinates will not change if the values were entered correctly.

KP/Coordinate Conversion

Use this WinFrog utility to convert KP (kilometer post) values to geographical (latitude/longitude) or grid (Northing/Easting) coordinates and vice versa. This utility is used primarily in cable laying operations, where cable positions are referenced using both of these systems.

To Convert KP Values to Geographical/Grid Coordinates

- 1 From the **Utilities** menu, choose **KP/Coordinate Conversion**. The **KP/Coordinate Conversion** dialog window displays, as seen in the next figure.



- 2 Select the appropriate survey line from the **Select Survey Line** dropdown menu.
- 3 Highlight the **KP** (kilometer post) value from the **Along Line Position** window.
- 4 Press the **Delete** key on the keyboard.
- 5 Enter the desired **KP** value (in units of Kilometers).
- 6 Highlight the displayed **DCC** (distance cross course) value.
- 7 Enter the desired **DCC** value.

Note: this entry is required in units of kilometers, with the appropriate mathematical sign. Positions that are to the port side of the survey line are entered as negative values, while starboard positions are entered as positive.

- 8 Click the “**up**” arrow button to perform the conversion to geographic/grid coordinates.

Note: if the format of the KP and DCC values entered is not correct, the conversion will produce incorrect geographic/grid coordinate values. To confirm that the coordinates are entered in the correct format, click the “**down**” arrow to re-calculate the KP values from the geographical/grid values. The KP and DCC values will not change if the entries were made correctly.

To Convert Geographical/Grid Coordinates to KP Values

- 1 From the **Utilities** menu, choose **KP/Coordinate Conversion**. The **KP/Coordinate Conversion** dialog window displays, as seen in the figure above.
- 2 Select the appropriate survey line from the **Select Survey Line** dropdown menu.
- 3 Select the appropriate **Geo** or **Grid** button to define how the coordinates will be entered.
- 4 Highlight the latitude (or Northing) value from the **Geo/Grid Position** window.
- 5 Press the **Delete** key on the keyboard.
- 6 Type the desired latitude (or Northing) value.
- 7 Highlight the longitude (or Easting) value from the **Geo/Grid Position** window.
- 8 Press the **Delete** key on the keyboard.
- 9 Type the desired longitude (or Easting) value.
- 10 Click the “**down**” arrow button to perform the conversion from geographic/grid coordinates to KP/DCC values.

Note: if the format of the geographic/grid coordinate values entered is not correct, the KP and DCC values produced will be incorrect. To confirm that the coordinates are entered in the correct format, click the “**up**” arrow to recalculate the geographical/grid values from the KP values. The coordinates will not change if the values were entered correctly.

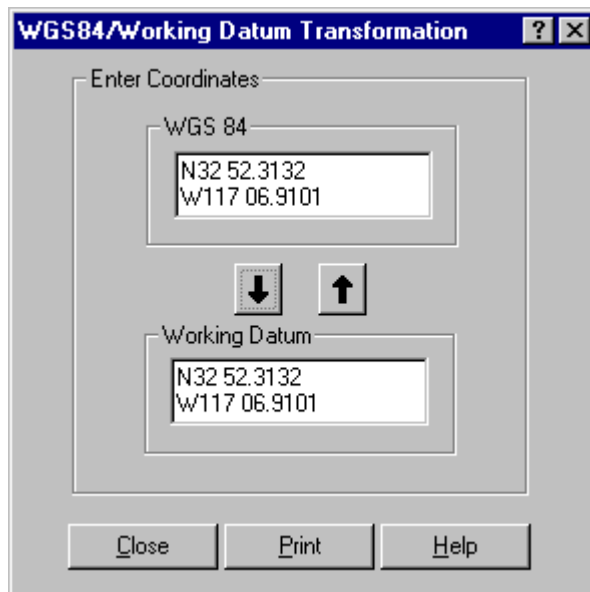
Datum Transformations

Use this utility to convert geographic coordinates between WGS84 and the currently configured working datum. This utility is used most often to convert the WGS84 position displayed on a GPS receiver to coordinates in the working datum and vice versa.

Select the main menu item **Configure > Geodetics** to confirm the working geodetics settings. See the **Configuring Geodetics and Units** chapter for more information on **Geodetics**.

To Convert Coordinates from WGS84 to the Working Datum

- 1 From the **Utilities** menu, choose **WGS84 Working Datum Transformation**.



- 2 Highlight the latitude value displayed in the **WGS 84** field.
- 3 Press the **Delete** key on the keyboard.
- 4 Enter the desired **WGS 84 Latitude** by typing **N** or **S** followed by the coordinates in the format specified under the main menu item **Configure > Units > Coordinates**.
- 5 Highlight the longitude value displayed in the **WGS 84** field.
- 6 Enter the desired **WGS 84 longitude** by typing **W** or **E** followed by the coordinates in the format specified under the main menu item **Configure > Units > Coordinates**.
- 7 Click the “down” arrow button to perform the conversion. WinFrog displays the results in the **Working Datum** field.

Note: if the format of the geographic/grid coordinate values entered is not correct, the calculated coordinate values produced will be incorrect. To confirm that the coordinates are entered in the correct format, click the “**up**” arrow to re-calculate the **WGS84** values. The coordinates will not change if the values were entered correctly.

To Convert Working Geodetic Datum Coordinates to WGS84

- 1 From the **Utilities** menu, choose **WGS84 / Working Datum Transformation**.
- 2 Highlight the latitude value displayed in the **Working Datum** field.
- 3 Press the **Delete** key on the keyboard.
- 4 Enter the desired **Working Datum** latitude by typing **N** or **S** followed by the coordinates in the format specified under the main menu item **Configure > Units > Coordinates**.
- 5 Highlight the longitude value displayed in the **WGS 84** field.
- 6 Enter the desired **Working Datum** longitude by typing **W** or **E** followed by the coordinates in the format specified under the main menu item **Configure > Units > Coordinates**.
- 7 Click the “**up**” arrow button to perform the conversion. WinFrog displays the results in the **WGS 84** field.

Note: if the format of the geographic/grid coordinate values entered is not correct, the calculated coordinate values produced will be incorrect. To confirm that the coordinates are entered in the correct format, click the “**down**” arrow to re-calculate the **Working Datum** values. The coordinates will not change if the values were entered correctly.

Forward/Inverse Calculations

Use this utility to calculate coordinates of a new point from a known point (latitude/longitude or Northing/Easting) by entering **Range** and **Bearing** values. This is known as a **Forward** calculation. This utility can also calculate the **True** and **Grid Bearing** and **Distance** between two known coordinates. This is known as an **Inverse** calculation.

In both cases, the calculation is performed either on the Map Projection Grid or Working Ellipsoid depending upon which coordinate type is selected, **Grid** or **Geo** respectively. The exception to this is if the **Perform Rhumb Line Calculations** option is selected, in which case the Inverse or Forward calculation is performed using geographic coordinates and Rhumb Line algorithms. Note that these Rhumb Line calculations are independent of the current Working Map

Projection but are performed based on the current Working Ellipsoid.

To Calculate the Range and Bearing from One Known Point to Another Known Point

- 1 From the Utilities menu, choose Forward/Inverse Calculation.

The screenshot shows a dialog box titled "Forward/Inverse Calculation". It contains two main sections: "From" and "To". Each section has two text boxes for coordinates (North and East) and two radio buttons labeled "Geo" and "Grid". In the "From" section, the coordinates are N33 43.3491 and E139 57.9441, with "Geo" selected. In the "To" section, the coordinates are N33 44.3033 and E139 59.0911, with "Geo" selected. Below these sections are two buttons with up and down arrows. Further down are two text boxes labeled "Range" (containing 2500) and "Bearing" (containing 45.12). Below these is a checkbox labeled "Perform Rhumb Line Calculations" which is unchecked. At the bottom is a box labeled "Map Projection Values" containing "Convergence: - 0 34 27.2552" and "Map Scale Factor: 0.999711". At the very bottom are three buttons: "Close", "Print", and "Help".

- 2 In the **From** area of the **Forward/Inverse Calculation** dialog box, select either the **Geo** or **Grid** radio button, depending on which calculation method is to be used.

Note: there can be a significant difference in the calculated **Bearing** and **Distance** depending on which option (**Grid** or **Geo**) is chosen. When you select the **Grid** button, instructs WinFrog to generate **Grid** bearings and distances, which differ from **True** bearings and distances by varying amounts, depending on the location of the points (see below). Alternatively, select the **Perform Rhumb Line Calculations** checkbox to use Rhumb Line inverse algorithms.

Ensure that the correct coordinate option is selected.

- 3 Enter the coordinates of the first point into the blank fields of the **From** area.

See Steps 2 through 6 in either of the two procedures described in the **Coordinate Conversions** sections earlier in this chapter.

- 4 In the **To** dialog box, enter the coordinates of the second point.
- 5 Click the “**down**” arrow button.

The results of the calculation are displayed in the **Range** and **Bearing** fields at the bottom of the **Forward/Inverse** dialog box. The **Range** will be in the same units configured in the Working Datum Projection. The **Bearing** is in decimal degrees format (i.e. **ddd.dddd**).

Also displayed are the calculated **Convergence** and the **Map Scale Factor**.

Note: **Convergence** = Geo or True Bearing - Grid Bearing

Map Scale Factor = Map Projection Distance/True Distance.

To Calculate the Coordinates of a Point by Entering a Range and Bearing from a Known Coordinate

- 1 From the **Utilities** menu, choose **Forward/Inverse Calculation**.
- 2 In the **From** area of the **Forward/Inverse Calculation** dialog box, select either the **Geo** or **Grid** radio button.

Note: there can be a significant difference in the calculated point position depending on which option (**Grid** or **Geo**) is chosen. Select the **Grid** button to instruct WinFrog to use **Grid Bearings** and **Distances**, which differ from **True Bearings** and **Distances** by varying amounts, depending on the location of the points. Ensure that the correct coordinate option is selected. Alternatively, select the **Perform Rhumb Line Calculations** checkbox to use Rhumb Line direct algorithms.

- 3 Enter the coordinates of the first point into the blank fields of the **From** area.

See Steps 2 through 6 in either of the two procedures described in the **Coordinate Conversions** sections earlier in this chapter.

- 4 Type the **Range** value into the **Range** entry window. Ensure that the correct distance units are entered.
- 5 Type the **Bearing** value into the **Bearing** entry window. The **Bearing** must be in decimal degrees (i.e. **ddd.dddd** format).
- 6 Click the “**up**” arrow button.

The results of the calculation are displayed in the **To** area as either geo or grid coordinates, depending on the radio button setting.

LOP/Position Calculation

Use this utility to calculate a position from either geographic slope ranges or acoustic two-way-travel-times (TWT'T) from fixed transponder stations currently in the Working Xponder file. If TWT'T data is used, you can select between using the Working Velocity file or entering velocity values for each TWT'T entered. The calculation can also be performed in reverse, that is, calculate geographic slope ranges and TWT'Ts from an entered position to fixed transponder stations currently in the Working Xponder file.

To Access LOP/Position Calculation

- 1 From the **Utilities** menu, select **LOP/Position Calculation**. The **LOP/Position Calculation** dialog box displays.

LOP/Position Calculation

Configuration

Calculation Mode

☒ LOP to Position
☐ 2D ☒ 3D
Data Entry Type
☐ Raw Data ☒ Ranges
☐ Position to LOP

Station Selection

Xponders File Control Station File Manual Entry

Velocity

☐ Off ☒ Working Velocity File ☐ Manual

Data

LOPs

Stn	Address	Transmit	Receive	Raw LOP	Geo LOP

Position Data

N00 00.0000
E000 00.0000
0.00m
☒ Geo ☐ Grid
+Ht/-Depth

Statistics

Error Ellipse
a = N/A
b = N/A
Az = N/A
RMS = N/A

Standard Deviations
Lat = N/A
Lon = N/A
Ht = N/A

Calculate Print Exit Help

You are able to select what calculation to perform and how to perform it. The options are as follows:

Calculation Mode

LOP to Position

Enter the LOP data and the position is calculated using least squares.

2D or 3D	If you select 2D , you must enter a height/depth. This value is held fixed and the position is solved for. If you select 3D , the height/depth and position is solved for.
Raw Data or Ranges	Enter either raw data or geographical slope ranges. In the case of LBL acoustics, the raw data is the TWT'T in milliseconds (ms) for a given transponder, including any turn-around-time (TAT) value that has been entered in the Working Xponder file for that transponder. If you select Ranges , enter the true slope range for each transponder. If you enter ranges, no velocity information is required to obtain a solution. However, if none is provided, the respective TWT'Ts are not computed and displayed or printed.
Position to LOP	Enter a position and height/depth, and the geographic slope ranges between this position and each of the selected LOP stations are calculated. If velocity information is available, the respective LOPs are also presented in their associated raw data format.
Station Selection	
Xponder File	This provides access to a dialog box (see Selecting Stations) where you can select which stations in the Working Xponder file to use for the calculation.
Velocity	
This controls the use of velocity data for the calculations. If Raw Data is used for an LOP to Position calculation, this must be set to either Working Velocity File or Manual or the calculation will fail. If Ranges are used for an LOP to Position calculation, this setting is not critical. For a Position to LOP calculation, this setting is not critical.	
Off	No velocity information is to be used. As a result, no TWT'T data can be used for a calculation or calculated from entered or calculated range data.
Working Velocity File	Velocities for each LOP are calculated using the current Working Velocity file.

Manual	Velocity data is entered for each LOP (see Entering LOPs)
Data	
LOPs	This list view provides two functions. For LOP to Position calculations, it provides you access to each LOP for data entry. For Position to LOP calculations, it presents the results.
Stn	This lists the name of the station selected for the LOP. This column includes a status indicator in the form of a red or green LED. If the LED is red, the associated LOP has had a problem in the solution, for example, an invalid velocity. The cause of the problem should be investigated. A green LED indicates that the LOP is OK in the calculation.
Address	This lists the address of the transponder associated with the LOP station.
Transmit	This lists the transmit code of the transponder associated with the LOP Station.
Receive	This lists the receive code of the transponder associated with the LOP Station.
Raw LOP	This lists the raw data for the LOP (TWTT in the case of LBL acoustics). If the TWTT is not available, for example, if range data is used for a Position to LOP calculation and there is no velocity information, the term N/A is given.
Geo LOP	This lists the true (geographic) slope range.
Grid LOP	This lists the reduced grid slope range. Note that though this value is listed, it is not available for entry as a range. Only true (geographic) ranges are entered.
Residual	This lists the residual for the associated LOP for an LOP to Position calculation. In the case of a Position to LOP calculation, the term N/A is given since the solution provides the exact range/TWTT between the entered position and the LOP stations.

Accuracy	This lists the entered accuracy (standard deviation) for the LOP. This is only valid for an LOP to Position calculation, and therefore the term N/A is given for Position to LOP calculation.
Velocity	This lists the velocity used (whether calculated or entered) for the associated LOP plus a status. If the LOP has a red LED, this column should be investigated for the probable cause.

Position Data

Position	The position to use for a Position to LOP calculation is entered here. For an LOP to Position calculation, the resulting position is presented here. Note that the data entry and display can be toggled between geographic (Geo option) and map grid (Grid option). Note that this affects only the position data entry and display. The entry of range data is geographic regardless of the setting here.
Height/Depth	The height/depth to use for a Position to LOP calculation is entered here. For an LOP to Position calculation, the resulting height/depth is presented here. Note that depths are negative and heights are positive.

Statistics

Statistics is a presentation of the accuracy indicators for an **LOP to Position** calculation only. If a **Position to LOP** calculation is performed, these values will all show **N/A**.

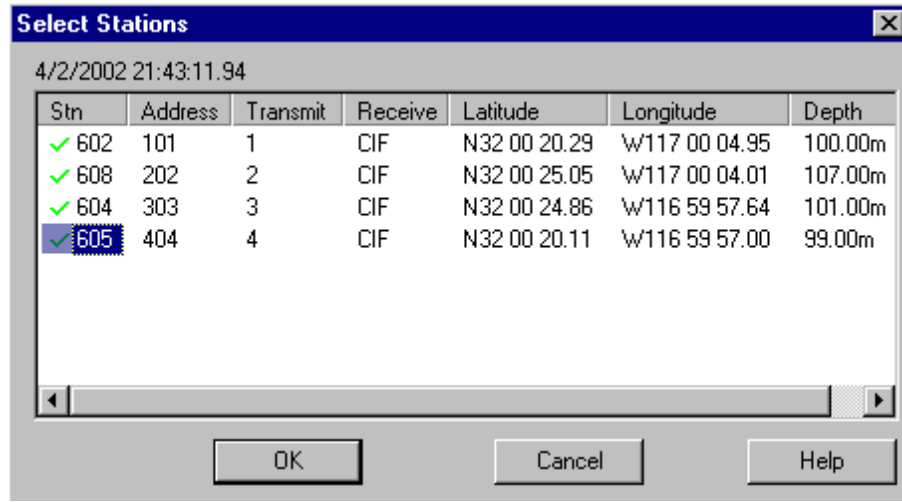
Buttons

Calculate	Performs the selected calculation as configured.
Print	Prints the results to the printer in a report format. (See Printing).
Exit	Leaves the utility.
Help	Future development. Will provide online help for this utility.

Selecting Stations

Click the **Xponder File** button to present the following dialog box. In it, all the transponders set to LBL Fixed are listed along with the address of the associated

transponder and their position data. The name of the Working Xponder file displayed is given on top of the list view.



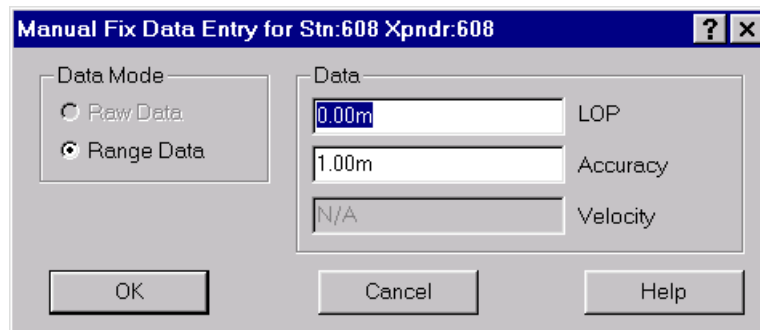
The stations are selected and deselected by double clicking on the name. If the station is selected, a green checkmark is shown next to the name. If the station is not selected, a red X is shown next to the name.

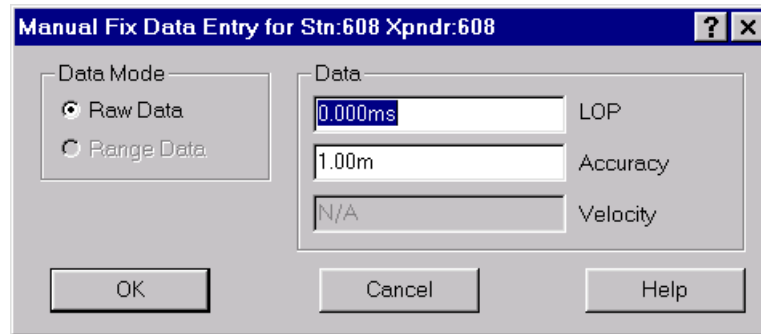
Note: No editing of the station transponder address or position data is possible from this dialog.

Selected stations are listed in the LOP list view in the main dialog.

Entering LOPs

To enter LOP data for an **LOP to Position** calculation, double-click the station name of the associated LOP in the LOP list view in the main dialog. One of the two dialog boxes shown below is then presented, depending upon the data type selected. Note that if **Position to LOP** is selected, nothing happens when you double-click the station name.



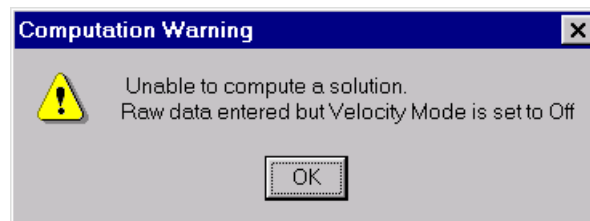


You enter the respective data, either TWTT or a geographic slope range and the accuracy to be associated with the LOP. The data entry type is controlled by the **Data Entry Type: Raw Data or Ranges** setting in the main dialog. This setting is indicated in the **Data Mode** panel. Note that the accuracy entered is a distance unit regardless of data type setting.

If the velocity option is set to **Manual**, the velocity to be used for the calculation can also be entered, otherwise this entry box displays **N/A** and is disabled.

Performing the Calculation

Once the calculation is configured, click the **Calculation** button to execute the calculation. If a problem is encountered that prevents a solution, a warning is presented as shown below.



If the solution is successful, the results are presented in the main dialog. An example of a successful **LOP to Position** calculation is shown below.

LOP/Position Calculation

Configuration

Calculation Mode
☒ LOP to Position
 Mode
☐ 2D ☒ 3D
 Data Entry Type
☐ Raw Data ☒ Ranges
☐ Position to LOP

Station Selection

Velocity
☐ Off ☐ Working Velocity File ☒ Manual

Data

LOPs

Stn	Address	Transmit	Receive	Raw LOP	Geo LOP	Grid LOP	Residual
 602	101	1	CIF	195.854 ms	146.29m	146.25m	0.00m
 608	202	2	CIF	207.746 ms	155.14m	155.10m	0.00m
 604	303	3	CIF	191.922 ms	143.35m	143.31m	0.00m
 605	404	4	CIF	0.000 ms	135.56m	135.52m	0.00m

Position Data
 N32 00.3659
 W117 00.0110
 -22.00m +Ht/-Depth

Statistics
 Error Ellipse
 a = 3.60m
 b = 2.45m
 Az = 123.54
 RMS = 0.0
 Standard Deviations
 Lat = 3.20m
 Lon = 2.49m
 Ht = 3.39m

The results shown above also illustrate the warning given by the red LED for station 605 due to an invalid velocity entered with the velocity mode set to **Manual**.

Saving of the Configuration

The configuration for the LOP to/from Position utility is read from the **winfrog.ini** file when the utility is accessed. Upon exiting the utility, the current configuration is saved to the **winfrog.ini** file. This facilitates repeated calculations with similar setups.

Acoustic Utilities

Use this utility to compute sound velocity from the working velocity profile or given depth or pressure, temperature and salinity. Also convert between depth and pressure.

Velocity Tab

Enter the depths between which you want to calculate the velocity. The calculation uses the data in the working velocity file. If a working velocity file is not selected, a message indicating this will be displayed. The formula used to compute the velocity is the same as used to compute the velocity for all LBL work. This is the harmonic mean as described by Christian de Moustier, Lecture Notes 16, Sound Refraction in the Water Column in Clarke, de Moustier, Mayer, and Wells, Lecture Notes for Multibeam Training Course, No 26, 2001. Scripps Institute of Oceanography, pp. 2 - 4.

Depth tab

Enter the pressure and temperature count and the observation time in seconds, usually 1 or 9 seconds. The Digiquartz coefficients may be manually entered or obtained from a Digiquartz equipped COMPAT'T found in the working transponder file. Manually entered coefficients are retained after the utility is closed, but not if WinFrog is shut down. You cannot change a COMPAT'T's coefficients or any other values assigned to a COMPAT'T from this dialog. The atmospheric pressure entered is subtracted from the calculated pressure before the depth is calculated. If the Average Density method is selected for depth calculation the following formula is used:

$$D = (\text{pressure} - \text{atmospheric pressure}) / \text{water density}.$$

The UNESCO selection uses the international equation of state for seawater (EOS-80). This is described by Fofonoff, N.P. and Millard, R.C., Algorithms for computation of fundamental properties of seawater, UNESCO technical papers in marine science No. 44 (1983)

Sound Velocity, Pressure, and Density tab

This dialog will convert depth to pressure or pressure to depth depending on

which one you enter. The formula used to convert pressure to depth is the UNESCO formula as described above. The formula used to convert depth to pressure is from Leroy, C.C. and Parthiot, F., Depth-pressure relationships in oceans and seas, Journal of Acoustical Society of America 103(3), (March 1998). The corrections to either of the calculated values are also from the Leroy and Parthiot paper. The pressure entered is to be the absolute pressure minus atmospheric pressure, i.e., pressure just due to the water. If the depth is entered, the calculated pressure does not include atmospheric pressure.

Two sound velocity formulae (Del Grosso and Chen-Millero) have been included with recalculated coefficients by Wong and Zhu 1995 following the adoption of the International Temperature Scale 1990. Technical Guides – Speed of Sound in Seawater, National Physics laboratory. For those formulae requiring pressure in kg/m^3 (Wilson and both Del Grosso), this value is obtained by applying the calculated gravity at the given latitude regardless if the pressure is entered or calculated.

Density is calculated using the formula found in the UNESCO paper mentioned above.

Map Wizard

Use this utility to create a Blue Marble Map (*.BMM) file for use as a background image in a graphics window.

The BMM map can be composed of many different layers each of a different map type. Currently, the BMM file supports the following vector and raster file types. The supported vector file types are DXF, DWG, SHP, MIF, DGN, and BML. The supported raster file types are JPG, BMP, TIF and GEOTIFF. Note that all layers added to a BMM file must have been created in the same coordinate system and using the same units. When importing a BMM file into WinFrog, the geodetic and unit settings of WinFrog must agree with the system the layer files were created in.

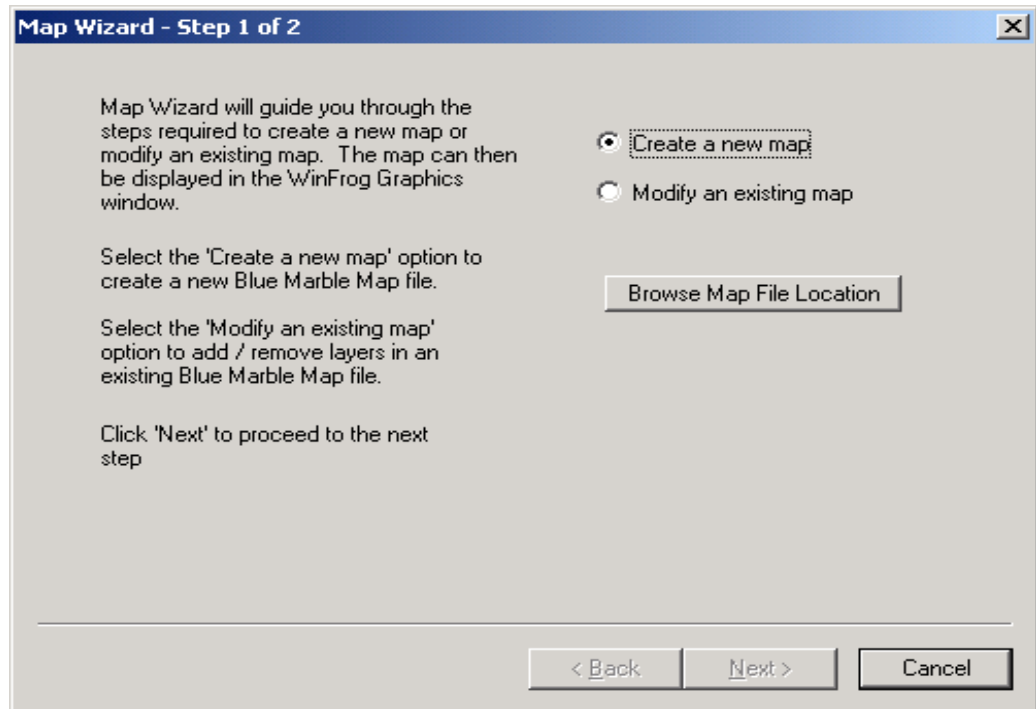
Depending on the file format used, some layers and feature types may not be fully supported by the Blue Marble library. It is important to verify the integrity and completeness of the imported file when displayed in the Graphics window. If features are the same color as the background color, they will be masked and will not be visible.

To Create a BMM map file

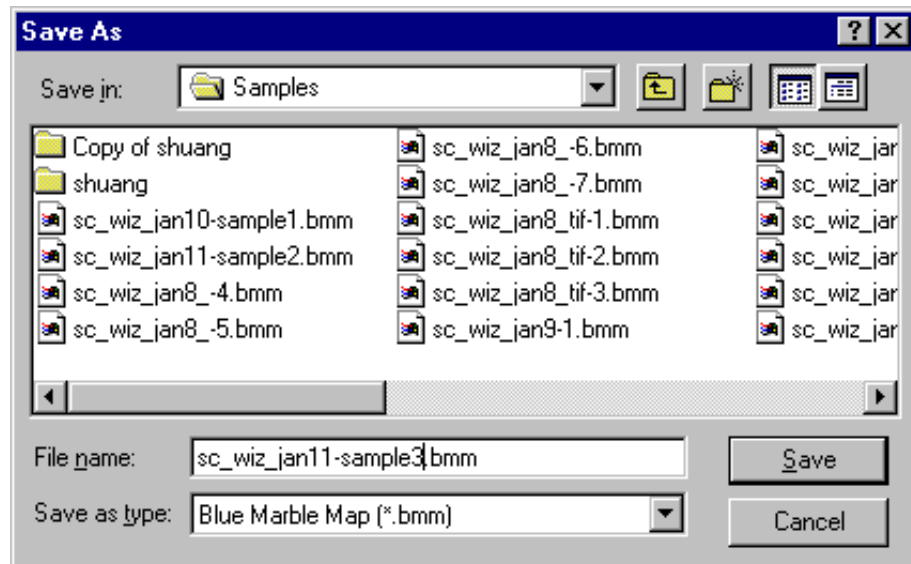
From the **Utilities** menu, choose Map Wizard. A map wizard will be launched that will take you through the process of creating a new map or adding to an existing map.

Create a new map:

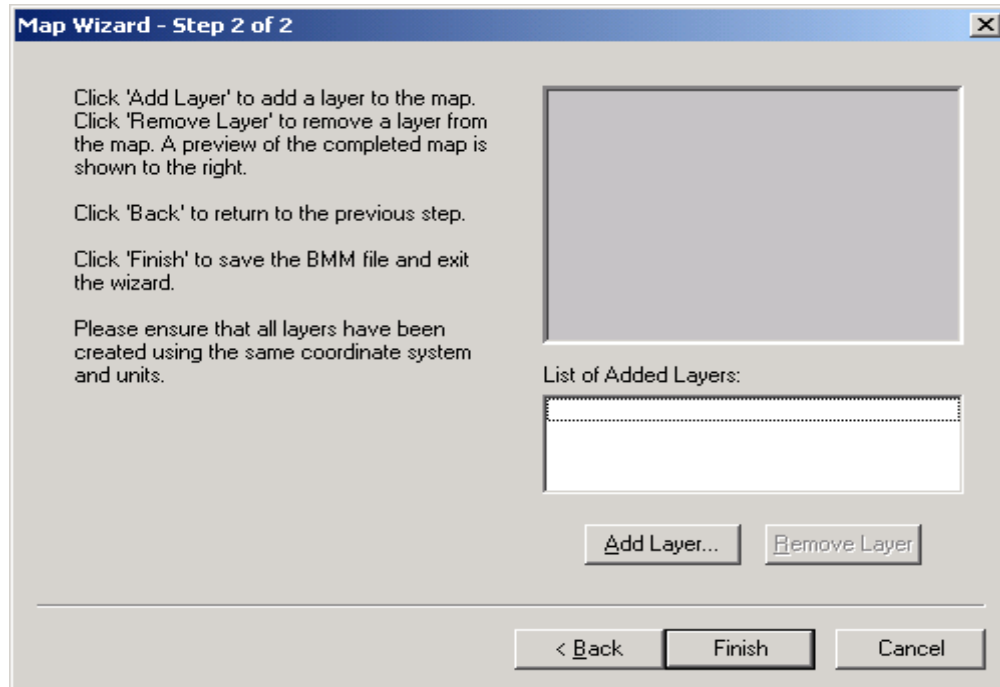
- 1 Select the **Create a new map** radio button.



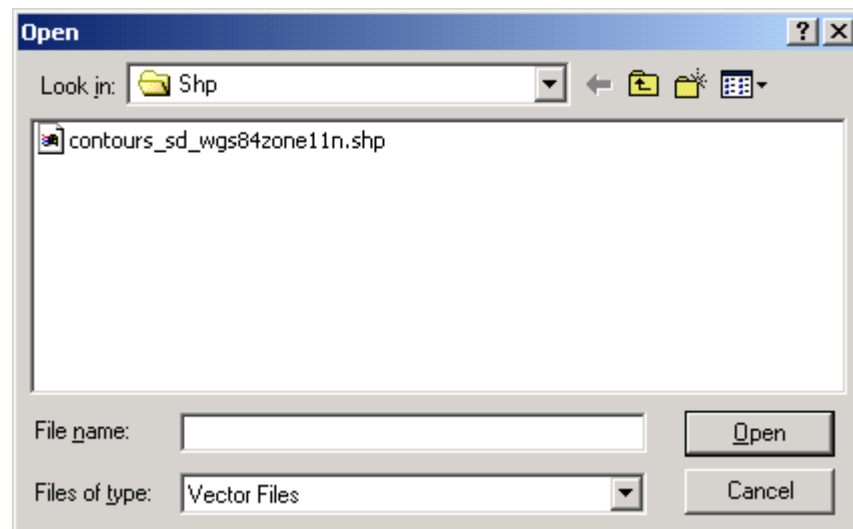
- 2 Click the **Browse Map File Location** button to launch a file create dialog.



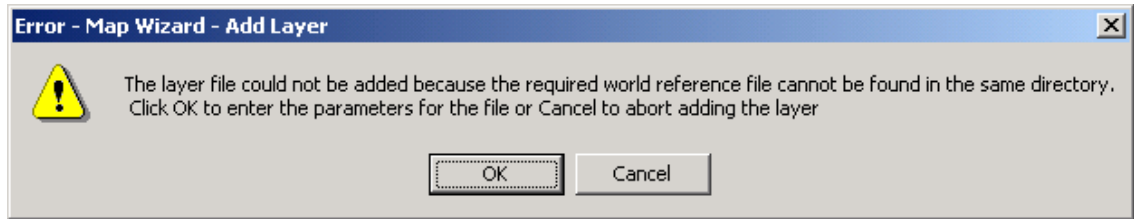
- 3 Once your file has been created, the name and path of the file is displayed below the button in the wizard.
- 4 Click **Next** on **Map Wizard - Step 1 of 2** to proceed to step 2 of the wizard where the layers of the BMM file are added and removed.



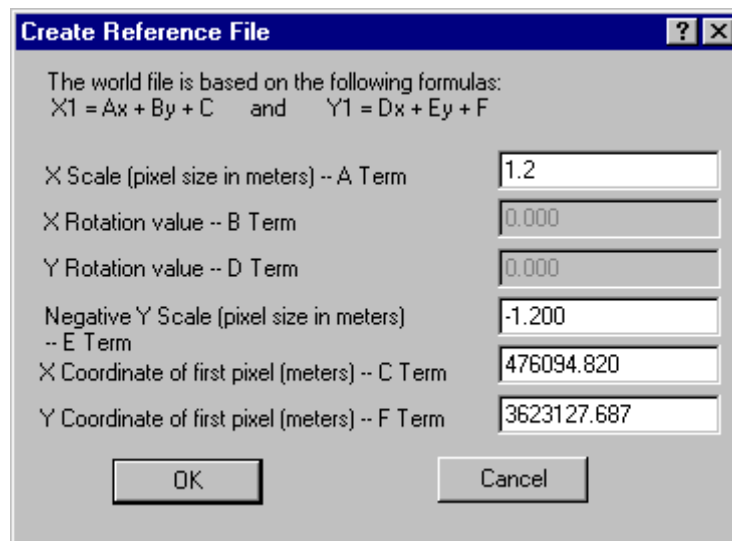
- 5 To add a layer, click **Add Layer**. This will open a standard **File Open** dialog in which to select the layer to add to the BMM map file. Click OK when the file has been chosen.



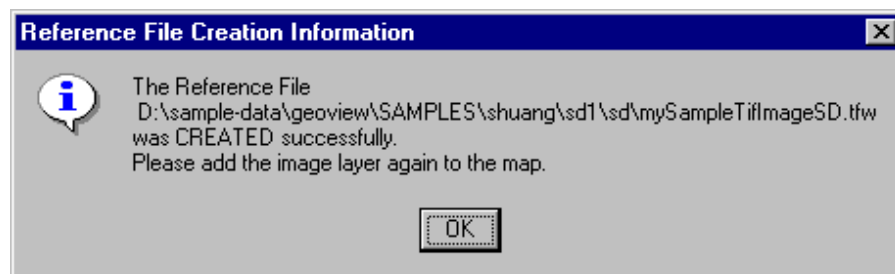
If the layer that is being added is an image such as a .TIF file and there is no .TIF reference file, then an error message, as shown below, is displayed to inform you of the corrective action to take. Otherwise, skip to step 6.



- a) Clicking **OK** will launch the **Create Reference File** dialog in which you can enter the reference parameters for the image file. Enter the pixel size in meters for the X (Easting) and Y (Northing) dimensions of the image as well as the X and Y coordinates of the first pixel (topmost left) of the image. Click **OK** to complete the operation. Click **Cancel** to cancel adding the layer.



You will be informed of the result of the Reference File creation process as displayed below.

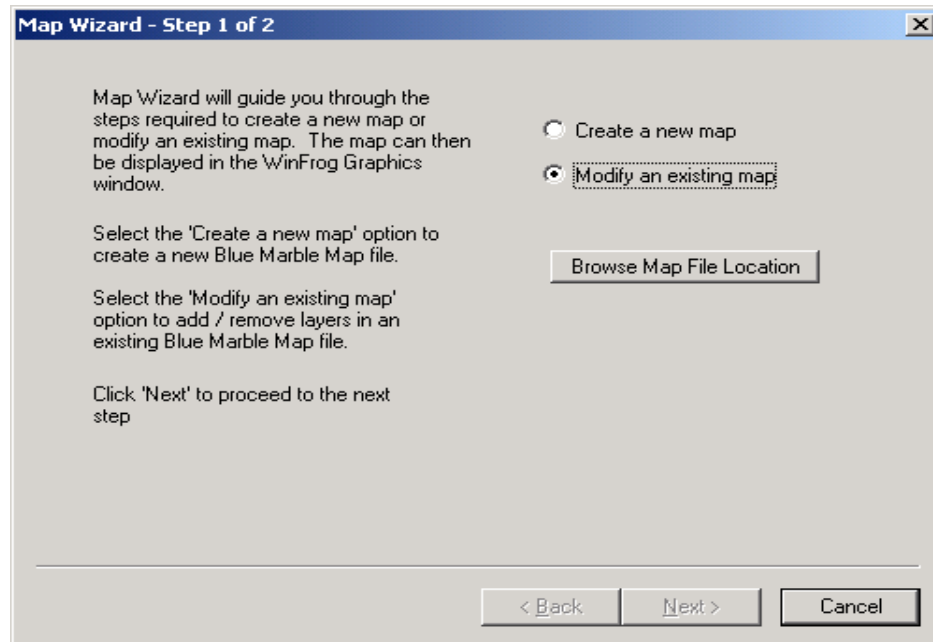


- b) Click **OK** to return to the **Map Wizard** dialog box where you must select the layer again – return to the start of step 5.
- 6 You will be presented with a preview of the composite map showing all added layers in the top right of the dialog. To add another layer repeat step 5.
 - 7 To remove a layer, select any layer in the list on the right of the dialog and click **Remove Layer**. The preview window will be updated accordingly.

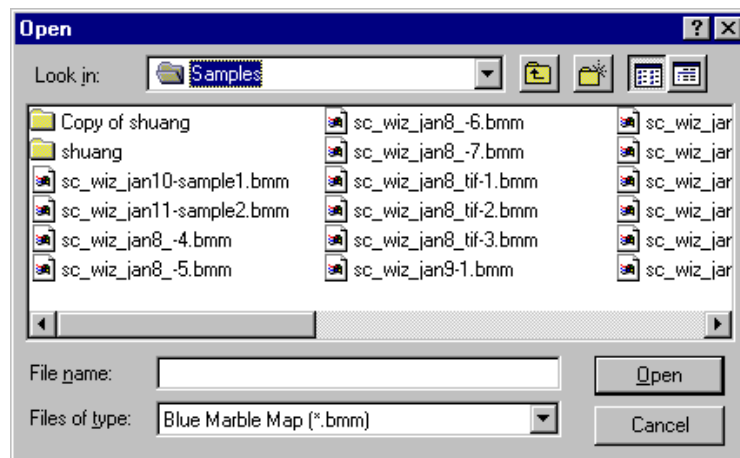
- 8 Once all the layers have been added and removed, click **Finish** to save the BMM file and exit the wizard.

Modify an existing map:

- 1 Select the **Modify an existing map** radio button.



- 2 Select the **Browse Map File Location** button to launch a file open dialog and select the file.



- 3 Click **Next** on **Map Wizard - Step 1 of 2** to proceed to step 2 of the wizard.
- 4 At **Map Wizard - Step 2 of 2**, the layers of the BMM file are added and removed. See steps 5 – 7 in the Create a new map section above to complete these procedures.
- 5 Click **Finish** to save and update the BMM file and complete the map wizard.

Plotter Base Map Wizard

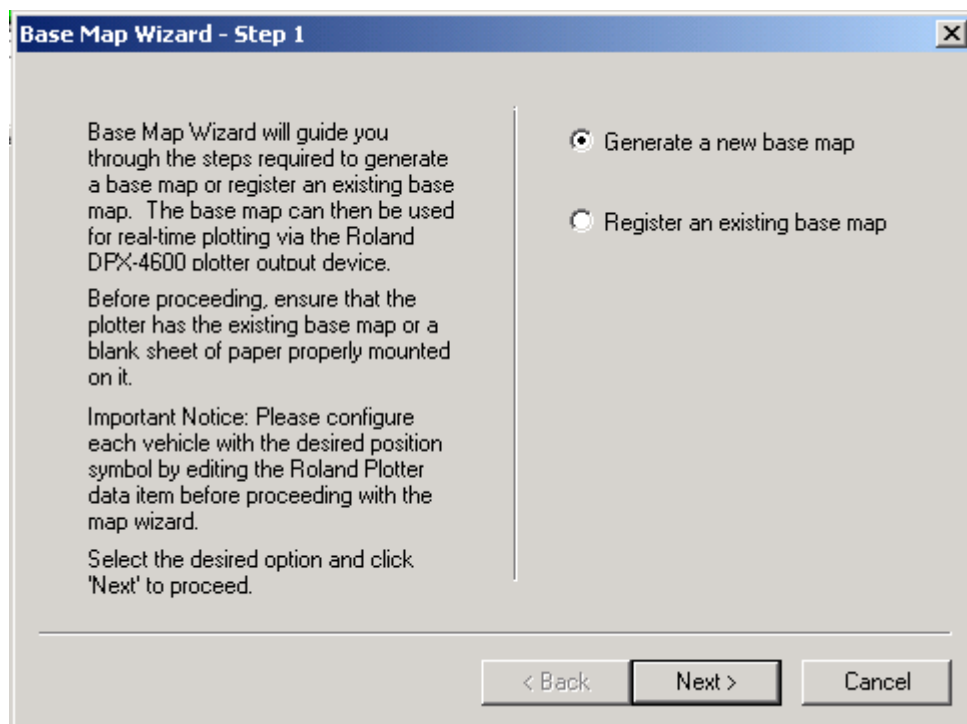
Use this utility for base map configuration when using the Roland DPX-4600 plotter device. Once the device has been connected to the computer and has been configured as described below, you can either register an existing map for real time data plotting or define scale, orientation and offsets for plotting on a blank sheet of paper. Both of these activities are supported through the use of this setup wizard tool.

To Add The Plotter to WinFrog

The plotter device is added in the same way as any other device – through the I/O Devices window. Right-click in the upper pane and select Add Device. The Roland DPX-4600 plotter can be found in the OUTPUT category. Select the device and click OK. Refer to the Roland DPX-4600 device document for details on installation and configuration.

To Generate a New Base Map

- 1 From the **Utilities** menu, choose **Plotter Base Map Wizard**.



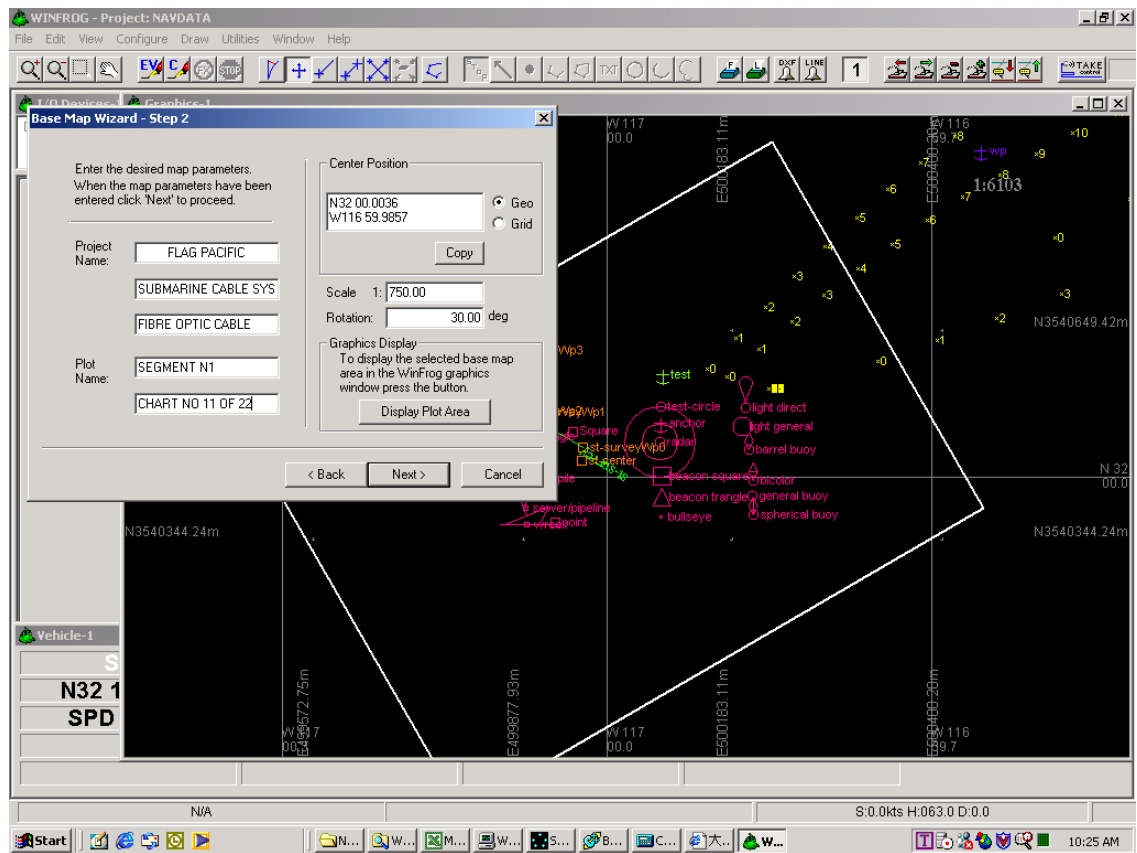
Note the advisory notice stating that the base map or blank sheet should already be properly mounted on the plotter. It is also important to note that, when generating a new map with a standard legend, the desired position symbols for each vehicle have to be configured before proceeding with the

map wizard. This is because the position symbols will be plotted on the standard legend as the vehicle track symbol. The position symbol is configured by editing the ROLAND PLOTTER data item for each vehicle. Refer to the Roland DPX-4600 device document for details.

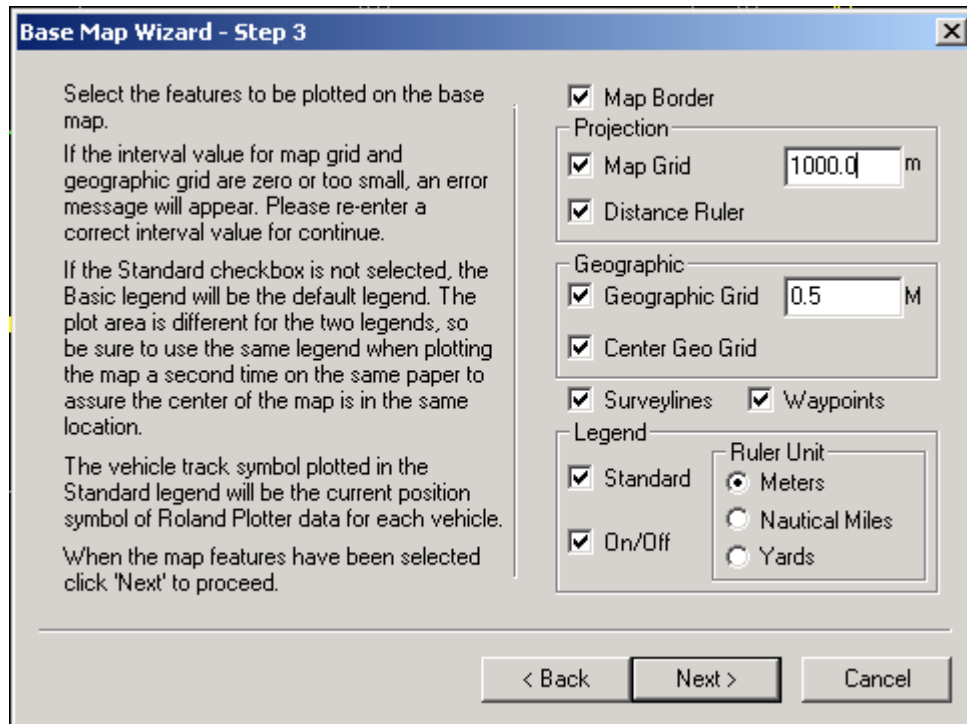
- 2 Select the **Generate a new base map** radio button and click **Next**.

- 3 Enter the desired map/chart parameters in Step 2.

Project Name	This will be plotted as the title of the map/chart in the legend.
Plot Name	This will be plotted as the name of the map/chart in the legend.
Center Position	the world coordinates of the center of the plot
Scale	the scale of the plot
Rotation	any rotation angle between the world coordinate system and the plotter coordinate system
Display Plot Area	The selected base map/chart area can be displayed in the Graphics window to check the plot area. Click this button to display the outline of the plot area in the Graphics window. The outline is a frame of white lines. Adjust the entered map parameters for plotting the desired map/chart. The following screen shot is a sample.



- 4 Once the map parameters have been entered, click **Next** to proceed to Step 3 of the wizard.



5 Select various additional items to be plotted along with the vessel position.

Map Border	Plots a map/chart border with a thin frame.
Map Grid	Plots projection grid at the given interval with the unit of meters.
Distance Ruler	Plots a scale drawn on the chart in the plot area along the left side of the map/chart reading distances in meters.
Geographic Grid	Plots graticule grid at the given interval with the unit of minutes.
Center Geo Grid	Plots a graticule drawn at the centermost Latitude line and Longitude line. Plots 9 tics between each Latitude/Longitude line for 10 spaces.
Survey Lines	Plots survey lines that are in the chosen working file.
Waypoints	Plots waypoints that are in the chosen working file.
Legend Group	
Standard	Plots a standard legend on the right side of map/chart. If the Standard checkbox is not selected, the Basic legend will be the default legend. The Standard Legend contains the Project Name, Plot Name, Vehicle Name, Geodetic

System, Scale, Rotation, Vehicle Track and Corner Data for register.

The Basic Legend contains the Custom Input Lines, Geodetic System, Scale, Rotation, Created time stamp and Corner Data for registration.

Note: The plot area is different for the two legends, so be sure to use the same legend when plotting the map a second time on the same paper to ensure the center of the map is in the same location.

Note: When you click the Standard checkbox to select this legend, or deselect it for the Basic legend, the display of the base map area in the Graphics window (white frame) will resize to show the different plot areas.

On/Off

Plots the legend if the checkbox is checked, otherwise does not plot a legend.

Ruler Units

The scale in the standard legend of the map/chart can be selected in meters, nautical miles and yards.

- 6 Once the features to be plotted have been chosen, click **Next** to proceed to Step 4 of the wizard.

The Base Map Wizard - Step 4 dialog box is shown. It contains instructions on the left, a list of entered parameters in the middle, and a preview of the map on the right.

Instructions:

- The base map will be created according to the displayed specifications.
- Click 'Back' to modify the entered parameters.
- Click 'Finish' to confirm the base map parameters and send the base map to the plotter to be plotted.

Entered Parameters:

Project Name:	FLAG PACIFIC SUBMARINE CABLE SYS
Plot Name:	SEGMENT N1 CHART NO. XXX OF XXX
Map center:	N32 00.0000 W117 00.0000

Display of the entered map parameters and selected features:

Paper size:	A0
Scale:	1: 10000.00
Rotation:	0.00
Plot border:	Yes
Plot projection grid:	Yes
Project grid interval:	1000.00
Plot geographics grid:	Yes
Geo grid interval:	0.5000
Plot Center Geo grid:	Yes
Plot Distance Ruler:	Yes
Plot survey lines:	Yes
Plot waypoints:	Yes
Plot legend:	Standard
Ruler Unit:	Meters

Buttons: < Back, Finish, Cancel

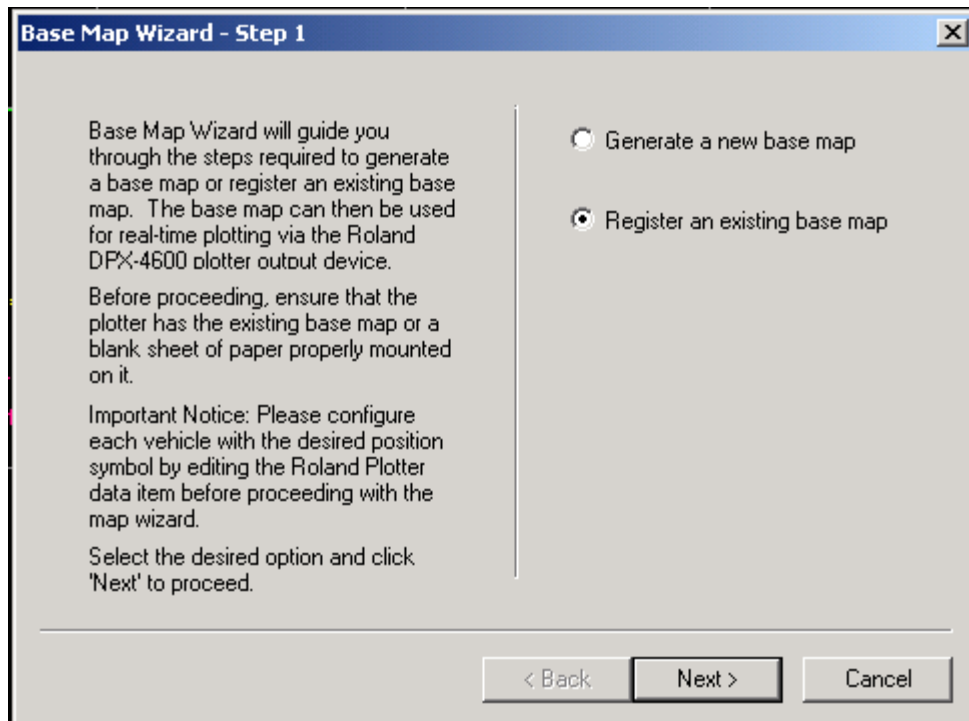
- 7 Review the summary of the entered transformation parameters. If any changes are needed at this point, click the **Back** button to access the appropriate page and edit the values. When satisfactory, click **Finish** and the new data will be sent to the plotter.

Once the plotter has been set up in this manner, a base map/chart will be plotted out. The options for the background will be plotted on the blank sheet of paper as the new map. For example, if the Border, Map Grid, Survey Lines and Waypoints are selected, those items will be plotted on the paper after the Finish button is clicked.

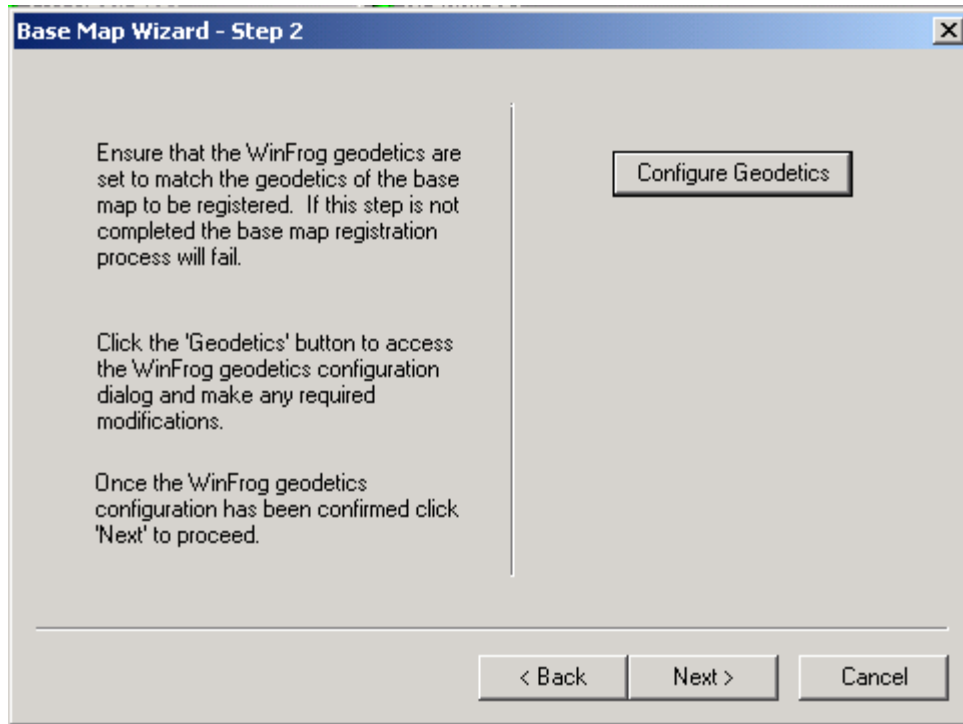
After the map/chart is plotted, and the Real Time plotting mode is enabled, the positions for selected vehicles will be sent to the plotter at the interval defined by the trigger event and other real time plotting options. Refer to the Roland DPX-4600 device document for details.

To Register an Existing Map and Plot to it in Real Time

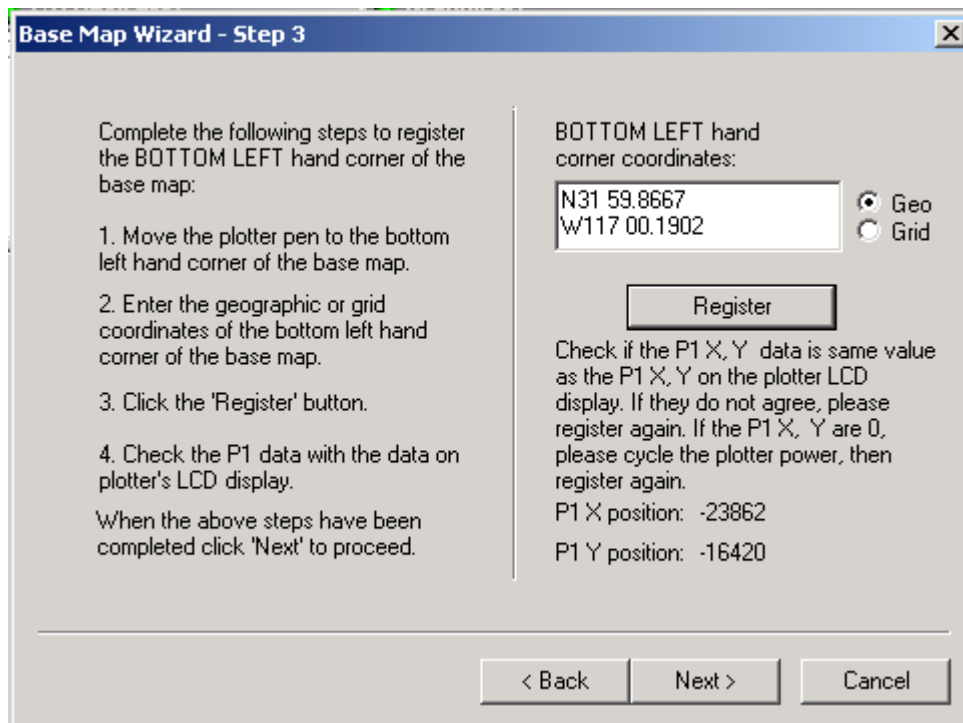
If it is desired to plot the multiple vessel positions and other data on an existing base map or chart, then the map must be registered first in order to define the transformation parameters between the plotter coordinate system and the world coordinate system.



- 1 Select the **Register an existing base map** radio button at Step 1 of the wizard. Click **Next** to proceed.



- 2 Choose the geodetic system that the base map is in. It is vital that the base map geodetics match those in WinFrog – this dialog allows you to change the WinFrog settings if required. Click **Next** to proceed.



- 3 At Step 3 you need to define two known positions in order to perform the registration. For a drawn base map/chart, the left bottom and right top

corner data is on the legend. By following the instructions on the left of the wizard page, the real world and plotter coordinates of the bottom left corner of the plot are recorded.

Follow the following steps to operate the plotter for registration:

- a) Press the FAST button on the plotter LCD display. The plotter will grab the pen No. 1.
 - b) Press FAST and $=>$ or $=<$ keys to move the plotter pen to the Left Bottom hand corner.
 - c) Press the Pen Down menu on the LCD display to check that the pen is on the top of the point, and then press Pen Up.
 - d) Click the Register button on the Base Map Wizard.
 - e) Check that the P1X and P1Y position agrees with the data on the plotter LCD display.
- 4 Click Next to proceed to Step 4 where you need to follow the same steps for the upper right corner of the map/chart – the only difference is to check that the P2X and P2Y positions agree with the data on the plotter LCD display. In this way, a two-dimensional similarity transformation is computed between the plotter and real world coordinates.

Base Map Wizard - Step 4

Complete the following steps to register the TOP RIGHT hand corner of the base map:

1. Move the plotter pen to the top right hand corner of the base map.
2. Enter the geographic or grid coordinates of the top right hand corner of the base map.
3. Click the 'Register' button.
4. Check the P1 data with the data on plotter's LCD display.

When the above steps have been completed click 'Next' to proceed.

TOP RIGHT hand corner coordinates:

N32 00.1333
W116 59.8189

☒ Geo
☐ Grid

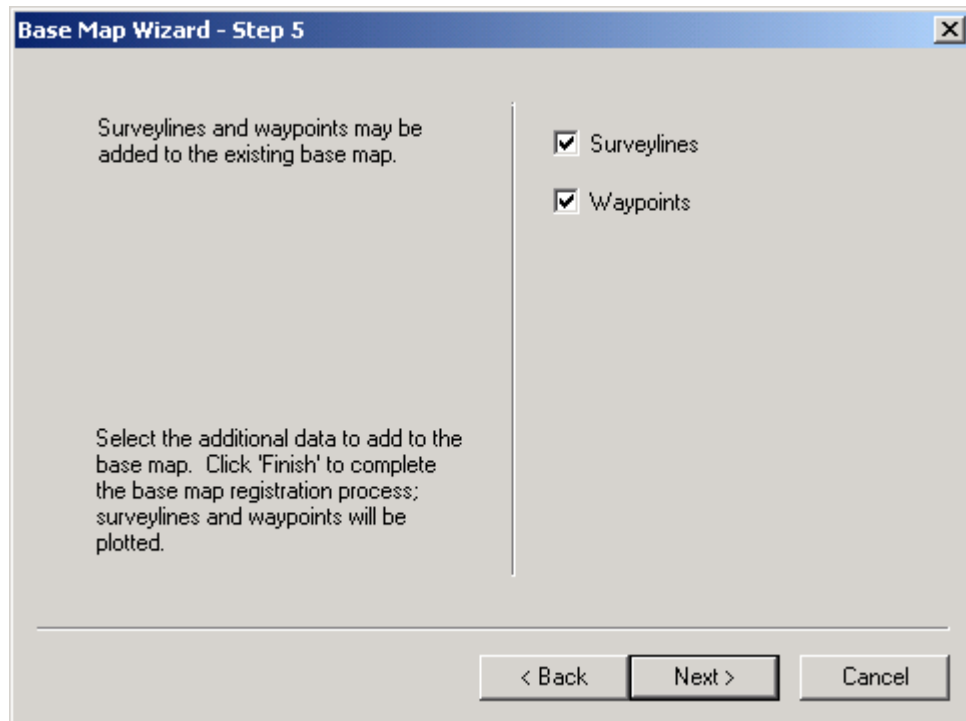
Register

Check if the P2X, Y data is same value as the P2 X, Y on the plotter LCD display. If they do not agree, please register again. If the P2 X, Y are 0, please cycle plotter power, then register again.

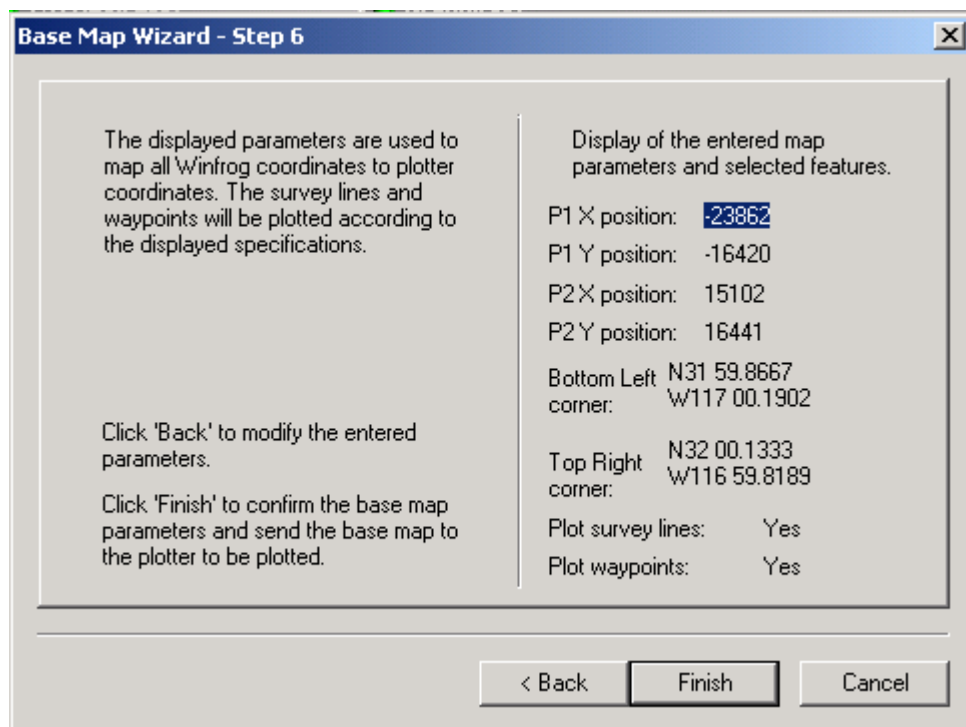
P2 X position: 15102
P2 Y position: 16441

< Back Next > Cancel

- 5 Click **Next** to continue to Step 5.



- 6 In addition to the vessel position, it is possible to plot survey lines and waypoints at Step 5. If these are desired, select the appropriate checkboxes and click **Next** to continue.



- 7 Review the summary of the entered data. Corrections can be made by using the **Back** button. If the P1 and P2 data is zero, an error message will appear

and you will need to go back and register again before continuing. When satisfactory, click **Finish** and survey lines and/or waypoints will be sent to the plotter, if you made those selections.

After the map/chart is registered, enable the Real Time plotting mode and the positions for selected vehicles will be sent to the plotter at the interval defined by the trigger event and other real time plotting options. Refer to the Roland DPX-4600 device document for details.

Generate DXF Map

Use this utility to generate a map in the form of a **.DXF (Drawing Exchange Format)** file.

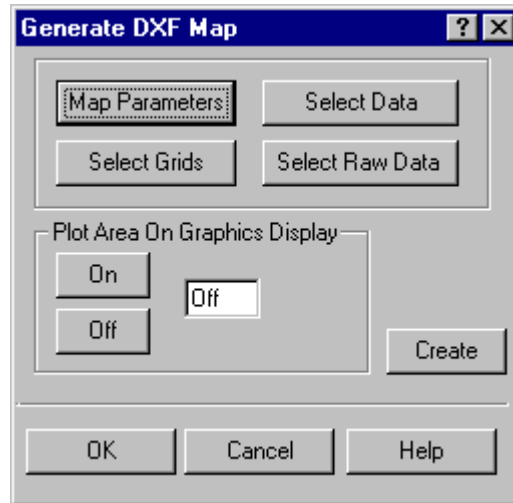
This map can include the contents of the **Working Picture**, **Survey Line**, **Waypoint**, and **Data** files, all of which are referenced using the current WinFrog geodetic configuration. Other options include **Borders**, a **Bar Scale**, and **Grid Lines**. You can also control the **Size**, **Scale**, and **Rotation** of the final product.

The **.DXF** file can then be imported into programs, such as AutoCAD, MicroStation, or other CAD or mapping packages.

This section discusses all steps required to create a **.DXF** file using WinFrog, starting with a brief overview of the procedures required.

To Create a .DXF Format Map

- 1 Open a **Graphics** window if one is not already open.
- 2 Center and zoom the **Graphics** window so that it displays the area to be exported.
- 3 From the **Utilities** menu, choose **Generate DXF Map**. The **Generate DXF Map** dialog box is the main dialog box for configuring and creating a **.DXF** map in WinFrog. This dialog box provides access to four other dialog boxes that provide the actual configuration tools.



- 4 In the **Plot Area On Graphics Display** area of the **DXF Output** dialog box, click the **On** button.
- 5 Click the **Map Parameters** button to open the **Map Parameters** dialog box.
- 6 Configure the parameters in the **Map Parameters** dialog box.
See the **Map Parameters Dialog Box** section later in this chapter for details concerning configuring these parameters.
- 7 Click the **Select Grids** button to open the **Select Grids** dialog box.
- 8 Configure the parameters in the **Select Grids** dialog box.
See the **Select Grids Dialog Box** section later in this chapter for details concerning configuring these parameters.
- 9 Click the **Select Data** button to open the **Select Data** dialog box.
- 10 Configure the parameters in the **Select Data** dialog box.
See the **Select Data Dialog Box** section later in this chapter for details concerning configuring these parameters.
- 11 Click the **Select Raw Data** button to open the **Select Raw Data** dialog box.
- 12 Configure the parameters in the **Select Raw Data** dialog box.
See the **Select Raw Data** section below for details concerning configuring these parameters.
- 13 Click the **Create** button to build the **.DXF** file.

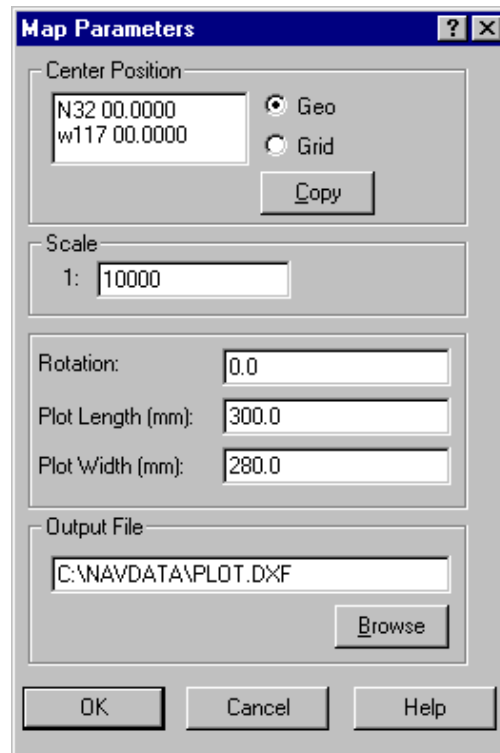
If the file already exists, WinFrog asks if the file is to be overwritten.

OK	overwrites the existing file
Cancel	returns to the Generate DXF Map dialog box

The following sections detail each of the above mentioned dialog boxes.

Map Parameters Dialog Box

Click the **Map Parameters** button in the **Generate DXF Map** dialog box to open the **Map Parameters** dialog box.



The following parameters are set within the **Map Parameters** dialog box:

Center Position

entry field	the Center Position coordinates of the map display in this field
Geo radio button	indicates that values in entry field are in latitude and longitude
Grid radio button	indicates that values in entry field are in Northing and Easting
Copy button	copies the coordinates displayed in the WinFrog Position Display toolbar into the entry field.

Scale

entry field

Enter the **Scale Factor** for the map (representing the scale of **Drawing Units** to **Ground Units**).

Rotation

Rotation field

Enter the rotation angle of the plot in degrees (**dd.dddd**), as measured clockwise from North.

Plot Length (mm)

Enter the length of the plot in millimeters.

Plot Width (mm)

Enter the width of the plot in millimeters.

Output File

entry field

Enter a name for the new .DXF file along with a directory path.

Browse button

use this typical WindowsTM navigation dialog box to select a file name and directory.

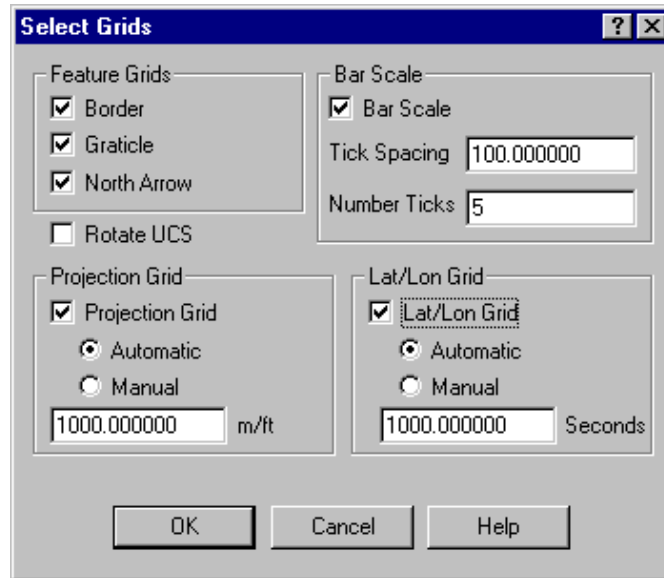
Click **OK** to return to the **Generate DXF Map** dialog box.

A blue box outlining the area to be exported appears in the **Graphics** window.

Select Grids Dialog Box

WinFrog can be configured to generate three types of grid lines in a **.DXF** map. These parameters (as well as some other line options) are configured using the **Select Grids** dialog box.

Click the **Select Grids** button in the **Generate DXF Map** dialog box to open the **Select Grids** dialog box.



The following parameters are set using the **Select Grids** dialog box:

Feature Grids

Border checkbox

Check this to enable the plotting of a border outlining the plot area.

Graticle checkbox

Check this to enable the plotting of a grid “cross” in the center of the map.

North Arrow checkbox

Check this to enable the plotting of a North arrow.

Bar Scale

Bar Scale box

Check this to enable the plotting of a bar scale.

Tick Spacing field

Enter the distance between adjacent ticks. Units used are as per the **Working Geodetic** units.

Number Ticks field

Enter the number of ticks to be displayed.

Rotate UCS box

Enable this option to create a map with a rotated UCS (User Coordinate System) so that the **X** direction corresponds to North and the **Y** direction corresponds to East. This option is used to compensate for those CAD systems that utilize this mathematical coordinate system as opposed to the survey convention.

Projection Grid

Projection Grid box	Check this option to generate small “crosses” on the map that mark the intersection of projection grid lines.
Automatic radio button	Select this option to have WinFrog define the projection grid line spacing.
Manual radio button	Select this option to have WinFrog use the value entered in the m/ft field immediately below to define the projection grid spacing.
m/ft field	Enter a value to define the ground distance in meters or feet between projection grid ticks.

Lat/Lon Grid

Lat/Lon Grid check box	Check this option to generate a set of lines on the map with marked latitude and longitude values.
Automatic radio button	Select this option to have WinFrog define the spacing of the lines of latitude and longitude.
Manual radio button	Select this option to have WinFrog use the latitude and longitude spacing value immediately below.
Seconds field	Enter a value (in seconds) to define the number of seconds of latitude or longitude between lat/long grid lines.

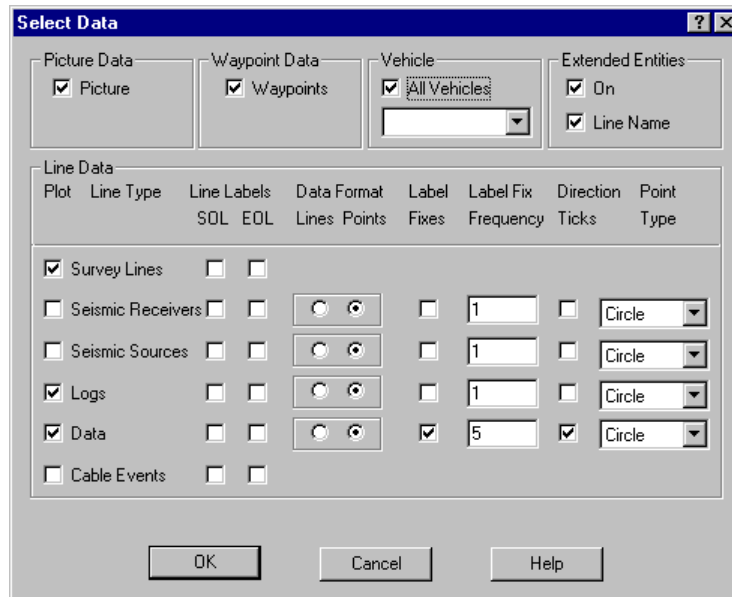
Click **OK** to save the changes and return to the **Generate DXF Map** dialog box.

Select Data Dialog Box

WinFrog can be configured to include the contents of several different types of WinFrog working files in the DXF map. These parameters are configured using the **Select Data** dialog box.

You can choose from the following list of **Working File** types: **Picture**, **Waypoint**, **Survey Lines**, **Seismic Receivers**, **Seismic Sources**, **Logs**, **Data**, and **Cable Events**. You also have various options that determine how the information is displayed in the DXF map.

Click the **Select Data** button in the **Generate DXF Map** dialog box to open the **Select Data** dialog box.



The following parameters are set in the **Select Data** dialog box:

Picture Data

Picture box

Check this option include the contents of the **Working Picture** (.pic) file on the .DXF map.

Waypoint Data

Waypoints box

Check this option include the contents of the **Working Waypoints** (.wpt) file on the .DXF map.

Vehicle

All Vehicles box

Check this option to have all vehicles included.

dropdown menu

Use this option to enable the plotting of one, individual vehicle.

Extended Entities

On box

Check this option to have the DXF map include “**Extended Entities**.” Currently, **Line Name** is the only extended entity available.

Line Name box

Check this option to include the line name on the DXF map.

Line Data

Check the box to the left of the appropriate option to plot data from the following list of **Working Files: Survey Lines (.PTS), Seismic Receivers (.ALL), Seismic Sources (.ASC), Logs (.LOG), Data (.ALG), and Cable Events(.CET).**

The following options can be included for any of the mentioned **Working Files:**

Line Labels - SOL box	If checked, WinFrog creates a label with the survey line name at the start of each data set.
Line Labels -EOL box	If selected, WinFrog creates a label with the survey line name at the end of each data set.

The following options can be included for **Working Seismic Receivers, Seismic Sources, Logs, and Data** files:

Data Format - Lines	Select this radio button to connect adjacent data points to create a line.
Data Format - Points	Select this radio button to not connect adjacent data points into a line, instead plotting each point individually.
Label Fixes box	Check this box to enable the plotting of labels for each of the fixes (events) within the data files. The value of the label is equal to the event number as shown within WinFrog.
Label Fix Frequency field	This parameter sets how often event labels are plotted. If the Label Fix Frequency is set to 1, every event is labeled. If it is greater than one, WinFrog only labels every nth fix, where n is the value entered.
Direction Ticks box	This option is dependent upon the Data Format radio buttons. If you select the Data Format Points radio button, check this option to plot “ticks” that point in the direction of travel along a line. The ticks are not created if the Data Format - Lines radio button is selected.
Point Type menu	If the Data Format - Points radio button is selected, there are four different types of point markers that can be chosen from this dropdown menu: Circle, Square, Triangle, or Point.

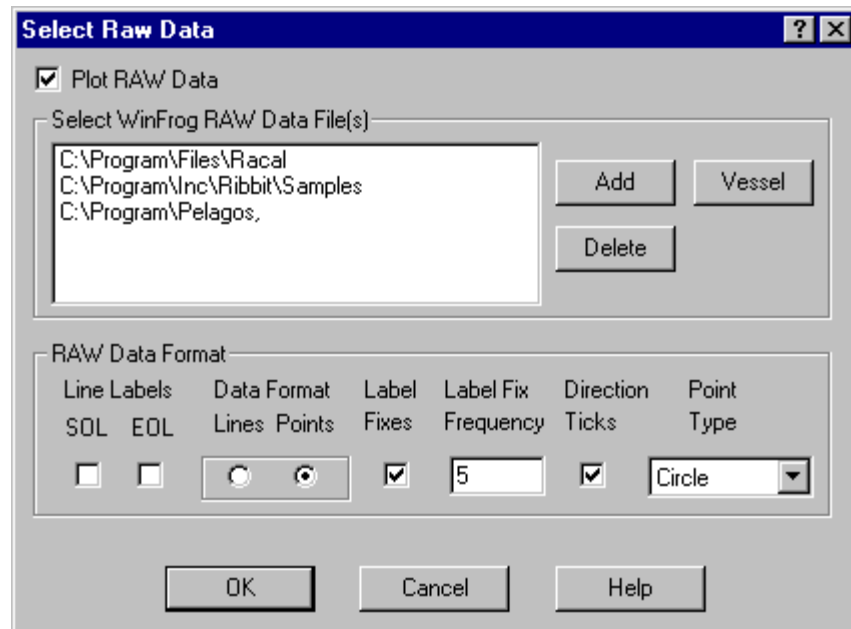
Click **OK** to return to the **Generate DXF Map** dialog box.

Select RAW Data Dialog Box

WinFrog can also be configured to include positional data from WinFrog **Raw** (.raw) files in the .DXF map. These parameters are configured in the **Select RAW Data** dialog box.

To Plot Raw Positional Data in the DXF Map

- 1 In the **Generate DXF Map** dialog box, click the **Select Raw Data** button.



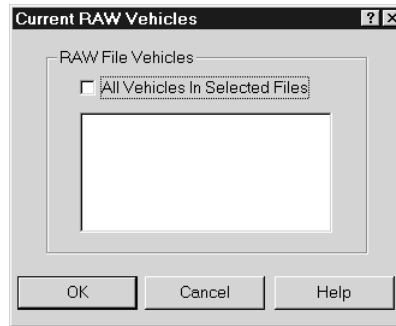
- 2 Select the **Plot RAW Data** option at the top of the **Select RAW Data** dialog box.
- 3 Click the **Add** button.
- 4 Navigate to the desired directory.
- 5 Select the desired file(s) from the list of **.RAW** files.
- 6 Click **Open**.
- 7 Click **OK**.

The file is displayed in the **Select WinFrog RAW Data File(s)** list in the **Select RAW Files to Plot** dialog box.

- 8 Repeat steps 3 through 7 to add more raw files.

Note: to remove a raw file from this list, select it and click the **Delete** button.

- 9 When all desired files are listed in the **Select WinFrog RAW Data File(s)** list, click the **Vessel** button.



From the **Current RAW Vehicles** dialog box, WinFrog can be configured to export raw data from all vehicles or individual vehicles:

- 10 To select all vehicles, check the **All Vehicles In Selected Files** box.
- 11 To select individual vehicles, select the desired vehicles from the list in the white field.

Note: make sure that the **All Vehicles In Selected Files** box is not checked or all vehicles will be used.

- 12 Click **OK** to return to the **Select RAW Data** dialog box.
- 13 Configure the parameters in the **RAW Data Format** area:

Line Labels SOL box	Check this option to have WinFrog plot the line name at the start of each line.
Line Labels EOL box	Check this option to have WinFrog plot the line name at the end of each line.
Data Format - Lines	Select this radio button to connect adjacent points into a line.
Data Format - Points	Select this radio button to not connect adjacent points into a line, instead plotting them individually.
Label Fixes box	Check this option to label the fixes (events) within the raw file. The value of the label is equal to the event number as saved in the raw file.
Label Fix Frequency field	Sets this to determine how often event labels are plotted. If the Label Fix Frequency is set to 1, every event is labeled. If it is greater than one, WinFrog only labels every nth fix, where n is the value entered.
Direction Ticks box	If you select the Data Format - Points radio button, WinFrog can create ticks that point in the direction of travel along a line. If you select the Data Format Lines radio button,

Point Type menu

the direction ticks are overwritten by the line.

If the **Data Format - Points** radio button is selected, there are four different types of point markers that can be chosen from this dropdown menu: **Circle**, **Square**, **Triangle**, or **Point**.

Click **OK** to return to the **Generate DXF Map** dialog box.

Generate MGD77 File

The **Generate MGD77 File** utility allows you to combine client created and supplied magnetometer and bathymetry data files with raw format WinFrog data into a single ASCII file. This utility can then convert that merged file into a file in **MGD77** format.

The three types of data that can be merged are magnetics (**.CSV**), bathymetry (**.DEP**), and raw WinFrog (**.RAW**) files. These three files are merged into a **.ROD** file that is then converted to an **.MGD** file. WinFrog generates the **MGD77** format as defined by **The Marine Geophysical Data Exchange Format - MGD77**. This document can be found on the internet at the following site:
<ftp://ftp.ngdc.noaa.gov/MGG/geodas/docs/mgd77.txt>

File Formats

The **Magnetics** file contains **Julian Day**, **Time (hhmmss)**, **Magnetic Value**, and **Event Number** data in a single, comma-separated string (i.e. **343,100834,32,12**).

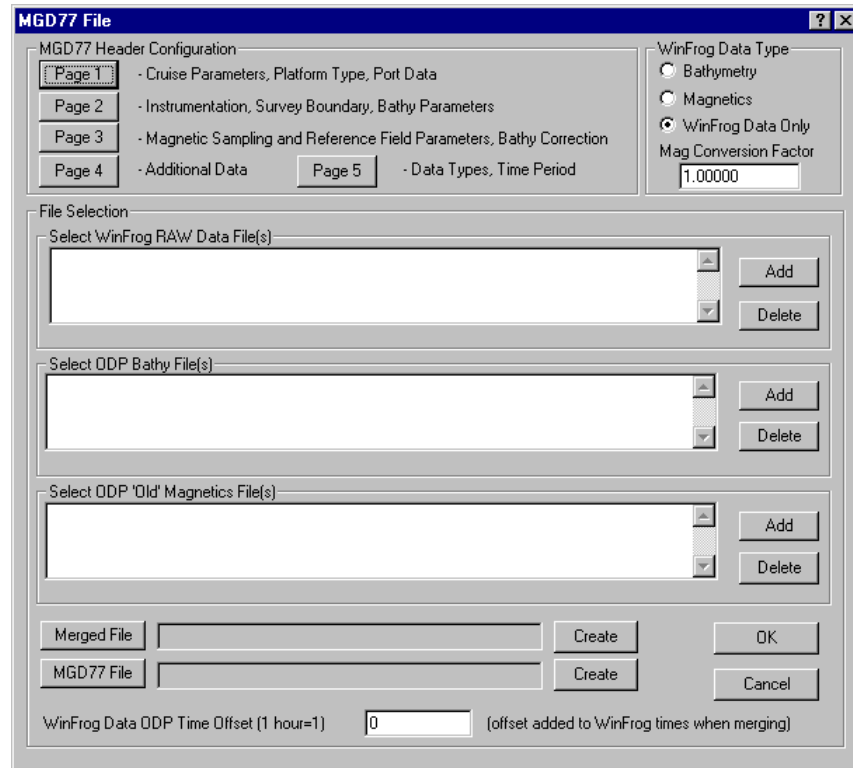
The **Bathymetry** file contains **Year**, **Julian Day**, **Hours (hh)**, **minutes (mm)**, **seconds (ss)**, and **Depth** (i.e. **1994,343,10,08,34,10.1**).

The WinFrog **.raw** file must contain **Type 351** records. See the **WinFrog File Formats** appendix of this manual for details.

The MGD77 format consists of two parts: a header section and a data section. The header section contains information about the content and structure of the geophysical data as well as other general information. WinFrog allows you to enter the header information using five dialog boxes.

To Create an MGD77 Format File

- 1 From the **Utilities** menu, choose **Generate MGD77 File**.



- 2 Configure the **Header Information** using the **Page 1** through **Page 5** buttons at the top of the **MGD77 File** dialog box.

See the **Header Page Buttons** section below.

- 3 In the **WinFrog Data Type** area of the **MGD77 File Utility** dialog box, select one of the three radio buttons to define the type of data recorded in a WinFrog **.raw** file:

Bathymetry	these are files created offline by user
Magnetics	these are files created offline by user
WinFrog Data Only	no data other than WinFrog data

If navigation data is the only data type in the WinFrog **.raw** data file, you can include bathymetry data files (*.dep) and magnetics data files (*.csv) from other sources.

- 4 Enter the **Mag Conversion Factor**.

This is a scale factor that is multiplied by bathymetry and depths during the file creation.

- 5 In the **File Selection** area of the **MGD77 File Utility** dialog box, click the **Add** button next to the type of file you wish to add.
- 6 Navigate to the desired directory.

7 Select the desired files from the available **Raw WinFrog Data Files**, **ODP Bathy Files**, or **ODP Magnetics Files**.

8 Click **Open**.

9 Click **OK**.

Note: if WinFrog does not show the file in the respective list, this indicates that the file has no usable data.

10 Repeat steps 5 through 9 to add more files.

Note: to remove files from any of the three lists, select them and click the relevant **Delete** button.

11 Enter a value in the **WinFrog ODP Time Offset (1 hour=1)** field.

This is a time bias that is added to WinFrog times so that they correspond with **ODP** times. More information about this parameter can be found in the **WinFrog Data ODP Time Offset** section below.

12 Either enter the path and file name in the **Merged File** field. Or,

12a Click the **Merged File** button.

12b Navigate to the desired directory.

12c Select the desired file.

12d Click **Open**.

12e Click **OK**.

13 Click the **Create** button (immediately to the right of the **Merged File** field) to perform the merge and create a new file.

14 Either enter the path and file name in the **MGD77 File** field. Or,

14a Click the **MGD77 File** button.

14b Navigate to the desired directory.

14c Select the merged file.

14d Click **Open**.

14e Click **OK**.

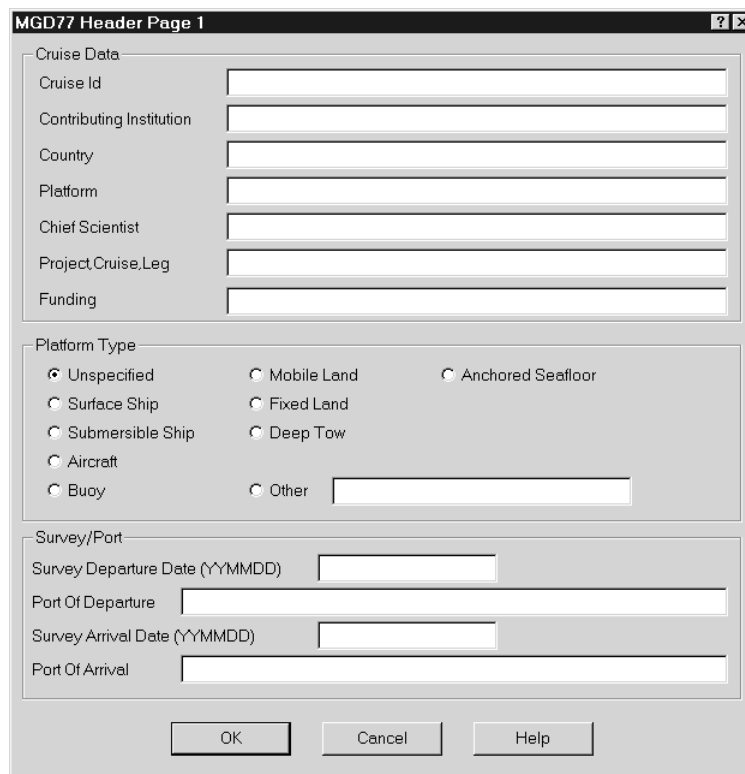
15 Click the **Create** button (immediately to the right of the **MGD77 File** field) to perform the export.

Header Page Buttons

Each of the **Page 1** through **5** buttons at the top of the **MGD77 File Utility** dialog box leads to a unique dialog box. The information in each of these dialog boxes needs to be entered in order to configure the header in the proper **MGD77** format.

Page 1

The **Header Page 1** dialog box includes **Cruise Parameters**, **Platform Type**, and **Survey/Port Data**. Highlight the appropriate fields and enter the necessary data.



The image shows the 'MGD77 Header Page 1' dialog box. It is divided into three main sections: 'Cruise Data', 'Platform Type', and 'Survey/Port'. The 'Cruise Data' section contains text input fields for 'Cruise Id', 'Contributing Institution', 'Country', 'Platform', 'Chief Scientist', 'Project Cruise, Leg', and 'Funding'. The 'Platform Type' section contains a group of radio buttons for 'Unspecified', 'Surface Ship', 'Submersible Ship', 'Aircraft', 'Buoy', 'Mobile Land', 'Fixed Land', 'Deep Tow', and 'Anchored Seafloor', along with an 'Other' option and a corresponding text field. The 'Survey/Port' section contains text input fields for 'Survey Departure Date (YYMMDD)', 'Port Of Departure', 'Survey Arrival Date (YYMMDD)', and 'Port Of Arrival'. At the bottom of the dialog box are three buttons: 'OK', 'Cancel', and 'Help'.

Page 2

The **Header Page 2** dialog box includes with **Instrumentation**, **Survey Boundary**, and **Bathy Parameters**.

Highlight the appropriate field and enter the necessary data.

MGD77 Header Page 2

Instrumentation Data

Navigation Instrumentation

Position Determination Method

Bathymetry Instrumentation

Additional Bathy Data

Magnetics Instrumentation

Additional Magnetics Data

Interpolation Scheme

Survey Boundaries (degrees)

Top Latitude (eg +33) +33 Bottom Latitude (eg +32) +32

Left Longitude (eg -118) -118 Right Longitude (eg -117) -117

Bathy Datum

☒ No Correction Applied (Sea Level) ☐ Mean Low Water Spring ☐ Other

☐ Lowest Normal Low Water ☐ Mean Sea Level

☐ Mean Lower Low Water ☐ Mean Low Water

☐ Lowest Low Water ☐ Equatorial Spring Low Water

☐ Mean Lower Low Water Spring ☐ Tropic Lower Low Water

☐ Indian Spring Low Water ☐ Lowest Astronomical Tide

Bathy Data

Digitizing Rate (eg 5min=050) 050 Sampling Rate 1/SECOND

Assumed SV (eg 1463.5=14635) 00000

OK Cancel Help

Page 3

The **Header Page 3** dialog box is concerned with **Magnetic Sampling and Reference Field Parameters**, and **Bathy Correction**.

Highlight the appropriate field and enter the necessary data.

MGD77 Header Page 3

Magnetic Sampling Data

Digitizing Rate (eg 5min=050) 050 Tow Distance (eg 4m=0004) 0000

Sampling Rate (eg 2sec=02) 01 Sensor Depth (eg 0.1m=00001) 00000

Bathy Correction Code

☐ Matthews Zone Matthews Zone Value

☐ Skuwahara Formula ☐ Carters Tables

☐ Wilson Formula ☒ Unspecified

☐ Del Grosso Formula ☐ Other

Reference Field Code

☐ Unused ☐ UK75

☐ AWC70 ☐ POGO0368

☐ AWC75 ☐ POGO1068

☐ IGRF65 ☐ POGO0869

☐ IGRF75 ☐ IGRF80

☐ GSFC1266 ☐ IGRF85

☐ GSFCPOGO0674

☒ Other - Name

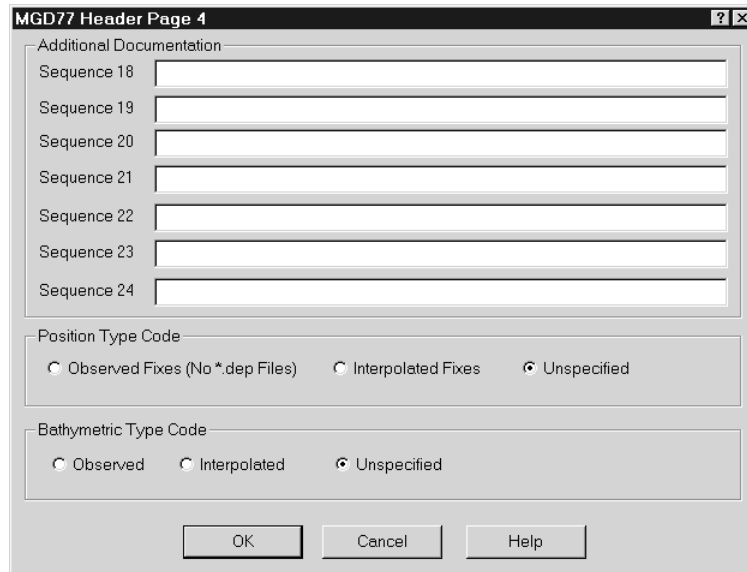
Method Of Applying Field

Time Zone Correction ((Hours) eg 1) 0.00 (Corrects survey time to GMT when added)

OK Cancel Help

Page 4

The **Header Page 4** dialog box is concerned with any additional data. Highlight the appropriate field and enter the necessary data.

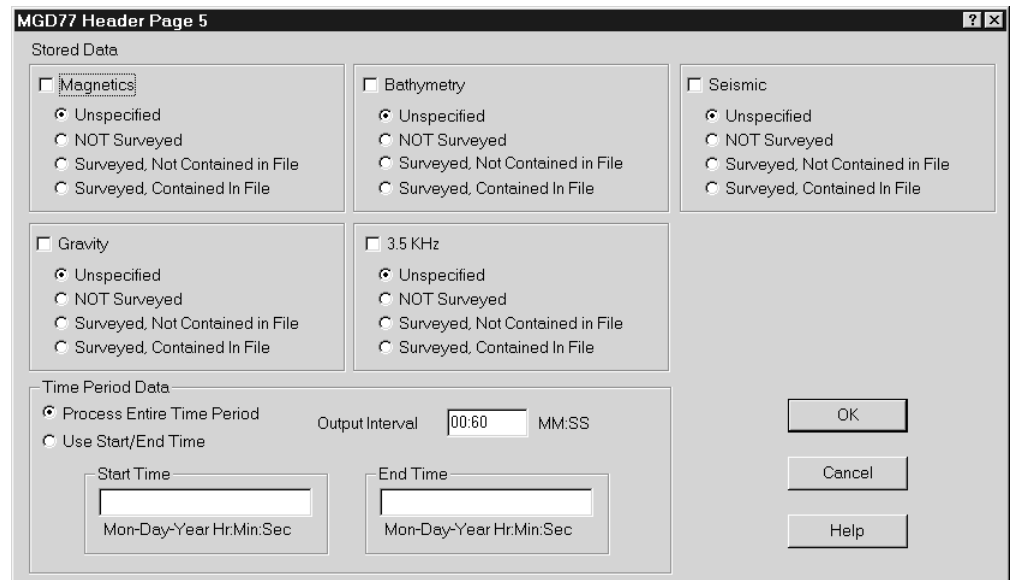


The MGD77 Header Page 4 dialog box contains the following sections:

- Additional Documentation:** Seven text input fields labeled Sequence 18 through Sequence 24.
- Position Type Code:** Three radio buttons: Observed Fixes (No *.dep Files), Interpolated Fixes, and Unspecified (selected).
- Bathymetric Type Code:** Three radio buttons: Observed, Interpolated, and Unspecified (selected).
- Buttons:** OK, Cancel, and Help.

Page 5

The **Header Page 5** dialog box is concerned with **Data Types** and **Time Period**. Highlight the appropriate field and enter the necessary data. For more information refer to the **Time Period Data** section below.



The MGD77 Header Page 5 dialog box contains the following sections:

- Stored Data:**
 - Magnetics:** Unchecked checkbox. Radio buttons: Unspecified (selected), NOT Surveyed, Surveyed, Not Contained in File, Surveyed, Contained In File.
 - Bathymetry:** Unchecked checkbox. Radio buttons: Unspecified (selected), NOT Surveyed, Surveyed, Not Contained in File, Surveyed, Contained In File.
 - Seismic:** Unchecked checkbox. Radio buttons: Unspecified (selected), NOT Surveyed, Surveyed, Not Contained in File, Surveyed, Contained In File.
 - Gravity:** Unchecked checkbox. Radio buttons: Unspecified (selected), NOT Surveyed, Surveyed, Not Contained in File, Surveyed, Contained In File.
 - 3.5 KHz:** Unchecked checkbox. Radio buttons: Unspecified (selected), NOT Surveyed, Surveyed, Not Contained in File, Surveyed, Contained In File.
- Time Period Data:**
 - Radio buttons: Process Entire Time Period (selected), Use Start/End Time.
 - Output Interval: 00:60 MM:SS.
 - Start Time: Mon-Day-Year Hr.Min:Sec.
 - End Time: Mon-Day-Year Hr.Min:Sec.
- Buttons:** OK, Cancel, and Help.

To finish preparing WinFrog for data merging and file export in the MGD77 format, continue with step 3 of the **To Create a Merged Export File in MGD77 Format** section earlier in this chapter.

Time Period Data

The time period data are configured in the **MGD77 Header Page 5** dialog box. This parameter allows you to select an interval within which the data records will be merged and the MGD77 file created. If the **Process Entire Time Period** radio button is selected in the **Time Period Data** area, data are output for the entire time period covered by the WinFrog files. If a time period is entered in the **Output Interval** field in the **Time Period Data** area and the **Use Start Time/End Time** radio button is selected in the **Time Period Data** area, only data within this time period are output.

WinFrog Data ODP Time Offset

The **Data ODP Time Offset** is the time (in hours) that is added during the file merge to the WinFrog time to match the time to the ODP file time. For example, if the ODP files were recorded in GMT and the WinFrog files were recorded in PST (which is 8 hours behind), the value **8** would be entered here. The value entered in the **Time Zone Correction ((Hours) eg 1)** field at the bottom of the **MGD77 Header Page 3** dialog box is therefore the offset from the ODP file time to GMT.

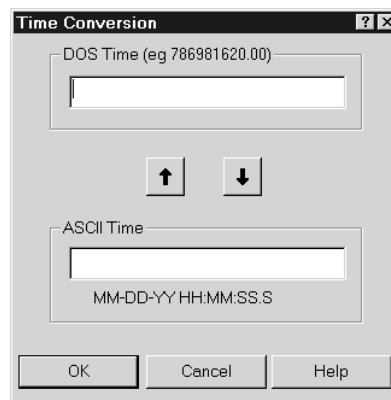
Time Conversion

Use this utility to convert between **DOS** time and **ASCII** time. **DOS** time is defined as the number of seconds since midnight, January 1, 1970. **ASCII** time is in the form **mm-dd-yy hh:mm:ss.s**.

WinFrog **.raw** files contain **DOS** time in each record, whereas **Automatic** and **Manual Event** data files contain **ASCII** time. This utility is often used to relate **.raw** data records to **Automatic Events** for data processing efforts.

To Convert DOS Time to ASCII Time

- 1 From the **Utilities** menu, choose **Time Conversion**.



- 2 Enter the **DOS** time into the **DOS Time** field. This must be entered in seconds.
- 3 Click the “**down**” arrow button.

The result of the conversion is displayed in the **ASCII Time** field.

To Convert ASCII Time to DOS Time:

- 1 From the **Utilities** menu, choose **Time Conversion**.
- 2 Enter the **ASCII** time into the **ASCII Time** field. It must be in the form **mm-dd-yy hh:mm:ss.s**.
- 3 Click the “**up**” arrow button.

The result of the conversion is displayed in the **DOS Time** field.

Note: if an invalid ASCII time is entered, WinFrog displays **0.0** in the **DOS Time** field. To confirm that the correct ASCII time format was entered, click the “**down**” arrow button. The ASCII time value will not change if the conversion is correct.

Position Averaging

This WinFrog utility provides the ability to configure time-based recording of a vehicle’s **Tracked Offset** position into an **.aep** file. The contents of this file are then used and displayed in a **Position Averaging and Editing** dialog box. This dialog box provides you with the following information:

- Mean Position
- Mean Height
- Mean Depth
- Mean Heading (True and Grid)
- Standard Deviations of the above Means
- Mean Line Tracking data (KP, EOL, Offline)
- Mean Waypoint Tracking data (Range, Bearing)

Also displayed is a graphical plot of the scatter of the collected data, a spreadsheet of all recorded **Observations**, along with the calculated **Residuals** of each observation and a **Used/Not Used** status. Using the spreadsheet, you can manually look through all recorded data and residuals, then specify to include/remove observations from the final **Mean Position** calculations as you wish. The final **Mean Position** can then be saved to the **Working Log (.log)** file. The **.aep** file can also be saved with all edits in tact.

The following sections detail all features and functions of the **Position Averaging and Editing Utility**.

To Record Vehicle Positions into an .aep File

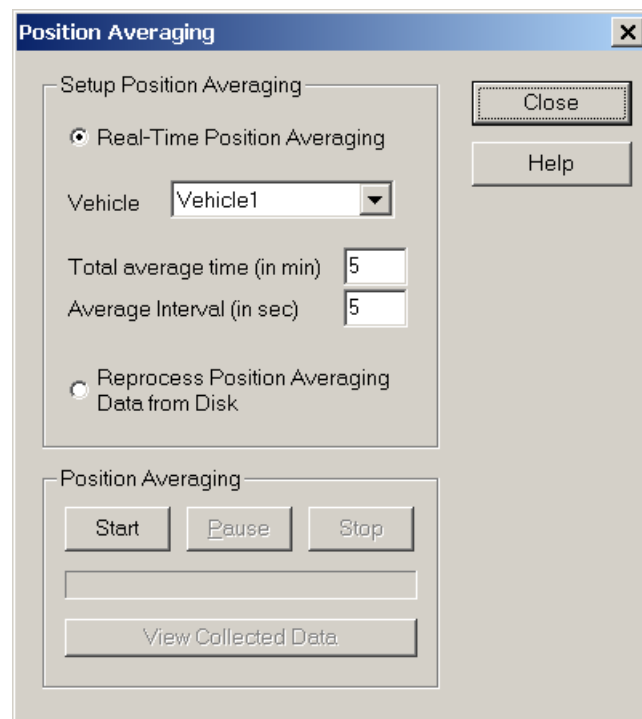
As mentioned above, you can configure the **Position Averaging** utility to record real-time positions of any WinFrog vehicle. It is important to remember that the position recorded is the chosen vehicle's **Tracked Offset** position and that **Tracked Offset** positions are filtered positions referring to the **Working Geodetic Datum**. You should confirm all configuration settings before any data recording is initiated.

Also, because the **Position Averaging** utility calculates mean survey line and waypoint tracking information, ensure that the correct survey line and waypoint are being tracked.

If an **.aep** file has already been recorded, skip ahead to the next section titled **To Load and View Average Position Data**.

To Record an .aep File

- 1 From the **Utilities** menu, select **Position Averaging**. The **Position Averaging** dialog box displays. This is a modeless dialog and therefore it is not necessary to close it in order to access other WinFrog windows and options. As a result, the data collection can be configured and executed without impeding normal WinFrog operation. It is important to note that the data collection will abort if this dialog is closed while collecting data. If the dialog is closed, you are prompted with this and given the option to return to the dialog so that the data collection may continue.



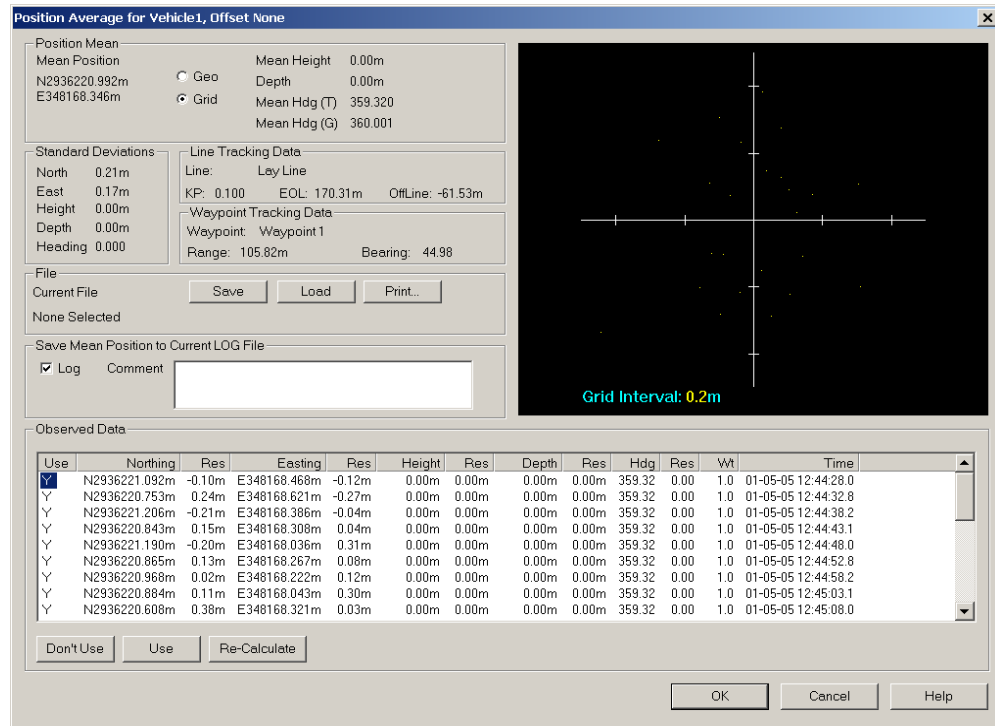
- 2 In the **Setup Position Averaging** portion of this window, ensure that the **Real-Time Position Averaging** radio button is selected.
- 3 Select the appropriate vehicle from the dropdown menu.
- 4 Enter a **Total average time** (in minutes) in the provided entry window.
- 5 Enter an **Average Interval** (in seconds) in the provided entry window. This defines the time interval between positions recorded in the **.aep** file.
- 6 Select the **Start** button at the bottom of the window. The “time increment bar” below the **Start** button will fill with blue bar sections as the data recording session is completed.

Note: if you have configured a long session (i.e. a large **Total average time**), the time increment bar will be slow to fill up. You may also notice that the first bar will not be drawn immediately, making you question whether data recording is occurring at all. You may have to wait up to 1 minute before the first bar is drawn.
- 7 If you wish to pause the data collection at any time you can click the **Pause** button. This button then changes to **Resume**, which can be clicked to continue collection. Alternatively, you may also click the **Stop** button, which will cause data collection to finish and the **View Collected Data** button to become enabled.
- 8 Once the specified **Total average time** has passed, the “time increment bar” will clear itself and the **View Collected Data** button will be enabled.

To Load and View Average Position Data

If you have just recorded **Average Position** data using steps **1** through **8** above, click the **View Collected Data** button in the **Position Averaging** dialog box and skip ahead to step **3** below.

- 1 You can load a previously recorded **.aep** file for review and editing of a vehicle’s average position data. From the **Position Averaging** dialog box, select the **Reprocess Position Averaging Data from Disk** radio button.
- 2 Click the **Load** button. (Note: this is the same button that was previously labeled **Start**). Browse to the appropriate directory and select the desired **.aep** file.
- 3 The **Position Averaging and Editing** dialog box now appears, as seen below.



- 4 The **Position Mean** portion of this window displays the **Mean Position**, as well as **Mean Height**, **Mean Depth** and **Mean Heading (True and Grid)** information.
- 5 The **Standard Deviations** portion of this window displays the calculated **Standard Deviations** for the **Mean Position**, **Mean Height**, **Mean Depth** and **Mean Heading** information.
- 6 The **Line Tracking Data** portion of this window displays the **Name** of the **Tracked Survey Line** and the calculated **Average KP (Kilometer Post)**, **EOL (End of Line)**, and **Offline** distances.
- 7 The **Waypoint Tracking Data** portion of this window displays the **Name** of the **Tracked Waypoint** and the calculated **Average Range** and **Bearing** to the **Tracked Waypoint**.
- 8 The **scatter plot** is a graphical display of the distribution of the used positions centered on the mean position. The axes are automatically scaled to encompass all used data.
- 9 The **Observed Data** portion of this window displays the following information, as found from left to right.

Use

Y - indicates that this observation is used in the mean calculations

N - indicates that this observation is **not** used in the mean calculations

Note: see the section immediately below for more information on the **Used** status.

Northing	the Grid Northing of this observation
res	the residual of this Northing observation (i.e. the difference between this observation and the calculated Mean Northing)
Easting	the Grid Easting of this observation
res	the residual of this Easting observation . (i.e. the difference between this observation and the calculated Mean Easting)
Height	the Height of this observation
res	the residual of this Height observation (i.e. the difference between this observation and the calculated Mean Height)
Depth	the Depth of this observation
res	the residual of this Depth observation . (i.e. the difference between this observation and the calculated Mean Depth)
Hdg	the Heading of this observation
res	the residual of this Heading observation . (i.e. the difference between this observation and the calculated Mean Heading)
Wt	the relative weighting accuracy value of this observation
Time	the date and time of this observation (mm-dd-yy hh:mm:ss.ss)

To Edit and Re-Calculate Average Position Data

This section details the steps required to modify the results of a position averaging (.aep) file. The editing of data should only be undertaken by qualified personnel who understand the repercussions of their actions. By default, WinFrog uses **all** observations in its calculation of **Mean** values. If the .aep file results have been questionably altered (i.e. points have been removed that perhaps should be included), simply return all observation data to the solution to “undo” any modifications.

- 1 The **only** way to modify the results in the **Position Averaging** window is to remove points from the **mean calculations**. This is typically based on the residual value for that observation. A high residual value suggests that this observation does not agree with the other observations used to calculate the mean value.

To remove an observation, select the desired row (highlighting that row) and click the **Don't Use** button. (You can also use the **Shift** [continuous] or **Ctrl** [discontinuous] keys to select multiple rows). Note: the **Used** status now changes to **N**.

This removes the observation from **all** mean calculations, i.e., you cannot remove only one part of an observation (such as a **Depth** or **Easting** that has a high residual).

- 2 Click the **Re-Calculate** button to initiate the re-calculation of the **Mean** values, using only those points whose **Used** status is **Y** (yes). **Note:** all of the results shown in the upper parts of the **Position Averaging** window will now change to reflect the new calculations.
- 3 Observations can be re-instated into the calculation data by simply highlighting the desired row and clicking the **Use** button. (That observation's **Used** status changes back to **Y**). The **Re-Calculate** button must be clicked again to utilize the values in the actual **Mean** calculations.

To Print and Save Average Position Data

Once **Mean** and **Standard Deviation** values have been obtained, you can print the results and also save the information to file.

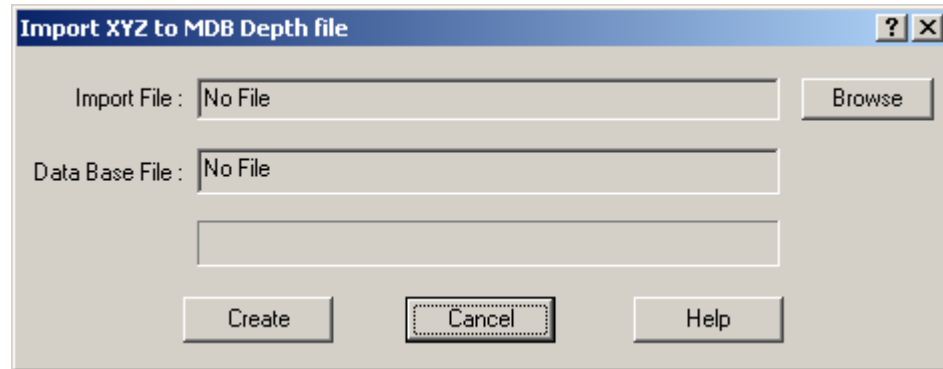
- 1 To **Print** the **.aep** file (including both **Observations** and **Results**) in its current state, click the **Print...** button in the top right corner of the dialog window.
- 2 To save the **Mean Position** to the **Working Logs (.log)** file, check the **log** box and enter a **comment**. When **OK** is clicked to close the **Position Averaging and Editing** window, this **Comment** and **Position** are written to the **Working Log (.log)** file.
- 3 To save the **.aep** file to disk, click the **Save** button (in the top right corner of the **Position Averaging and Editing** window), to bring up the **Select Position File** dialog box. Enter the **name** and browse to specify the location where the new **.aep** file will be created. Click **Save** to create this file and return to the **Position Averaging and Editing** dialog box.

Import Bathymetry

This WinFrog utility provides the ability to convert bathymetry in an ASCII x,y,z formatted file into a WinFrog soundings database file that can be displayed in the WinFrog Profile window.

The ASCII file to be imported is a simple format consisting of a header block and comma-delimited data records. It is important that the header block is completed with relevant survey information, and in particular, care should be taken to enter the correct information for Datum Name, Ellipsoid Name, General and Specific Projection Names, and Units. The ASCII file format is described below.

To import bathymetry data from an ASCII file, select **Utilities > Import Bathymetry**. This will open the Import File dialog shown below.



Browse for the ASCII import file. When this file is selected, the Data Base File will be set to the same name and directory as the ASCII import file with an .mdb extension. Click **Create** to build the database file. If the database file already exists, a warning is displayed with the option to overwrite the existing file or not. If no is selected, a new name for the database can be entered.

The file header is checked to ensure that the geodesy is compatible with that configured for the current project. The ASCII data bathymetry file header format is specified below. A message displays with information on the status of the import operation when the MDB file import is completed. Upon successful importation, the MDB file can then be loaded for display in the Profile window.

ASCII Bathymetry Header Format (with example data)

- * Winfrog uses the header to check the geodesy and units
- * Recognized units
- * meters (m)
- * feet (ft) = .3048 m;
- * US survey feet (ft) = (12./39.37)m
- * fathoms (fm) = (.3048*6)m
- * Imperial Feet = .3047994718 m

```
H,Date,          10/10/00,
H,Company Name,   Racal NCS,
H,Project Number, 2236,
H,Project Description, TLP Installation - Phase 1,
H,Survey Area,    Green Canyon 237,
H,Client,         McDermott,
H,Party Chief,    Travis John,
H,Vessel,         Seaway Rover,
H,Line Name,      1,
```

H,Ellipse Name, Clarke 1866,
H,Datum Name, NAD 27,
H,Projection General, U.S. State Plane 1927 (SPCS 27),
H,Projection Specific, Texas South Central,
H,Grid Units, US survey feet,
H,Depth Units, meters,
H,DAL Units, meters,

ASCII Bathymetry Record Format

Field	Data	Format	Comment
1	Easting	f.d	Grid units defined in Header
2	Northing	f.d	Grid units defined in Header
3	Depth	f.d	Depth units defined in Header
4	KP	f.d	DAL units defined in Header

Chapter 12: Simulator

WinFrog includes the capability to simulate input device data. The simulated devices are designed to mimic real devices as closely as possible. By adding simulated devices, a new (or experienced) user can experiment with WinFrog to learn about the software's capabilities and options without risking downtime on important projects.

Currently, WinFrog supports the following **Simulated Devices**:

- GPS (position only - no pseudorange simulation)
- Echosounder
- Gyrocompass
- USBL
- LBL Acoustic
- Speed Log
- Profiler (found in the ROV Device Category)
- SeaFlow (found in the ROV Device Category)
- Counter
- INS
- Range/Range

You can configure **Simulated Vehicle Operations** in two different ways:

- 1 Set the **Vehicle's Data Source** to **Simulated**.

Note: this option is not recommended as you are unable to control which devices are made available. Only basic navigation and survey abilities such as positioning, heading, and depth are available.

- 2 However, if you set the **Vehicle's Data Source** to **Real-Time** and add **Simulated Devices** from the list above you can configure each device. Each simulated real-time device has a configuration dialog box to define various operational parameters for that device type. Overall, this choice provides both more device choices and a more realistic simulation.

The following sections detail both methods.

Simulated Devices

To Set the Vehicle Data Source to Simulated

- 1 Open the **Configure Vehicles** dialog box by **1a** or **1b**.
 - 1a In the **Vehicle Text** window (**View > Vehicle Text**), right click then select the **Configure Vehicle Devices** button.
 - 1b In the **Configure Vehicles** dialog box (**Configure > Vehicles**), click the **Configure Vehicle Devices** button.
- 2 In the **Data Source** area of the **Configure Vehicles Devices** dialog box, click the **Simulated** radio button.

To Add a Simulated Real-Time Device

- 1 From the **View** menu, select **I/O Devices**.
- 2 With the mouse pointer in the left (white) portion of the **I/O Device** window, click the right mouse button and select **Add Device**.

A list of all of the different **Device Categories** available is displayed.

- 3 Click on the “+” beside the **Category** of the **Simulated Device** to be added (as per the list above). A list of the different supported models of that **Device Category** will now appear.
- 4 Click **OK**.
- 5 Select the desired **Simulated Device**.
- 6 Click **OK**.

The chosen **Simulated Device** is now added to WinFrog.

This device must still be “generically” configured, added to the appropriate vehicle, and configured specifically for that vehicle. Finally, the **Simulator Tools** must be enabled and configured to control the **Simulated Device** in real-time.

The following sections detail these steps in the order mentioned above.

To “Generically” Configure a Simulated Device

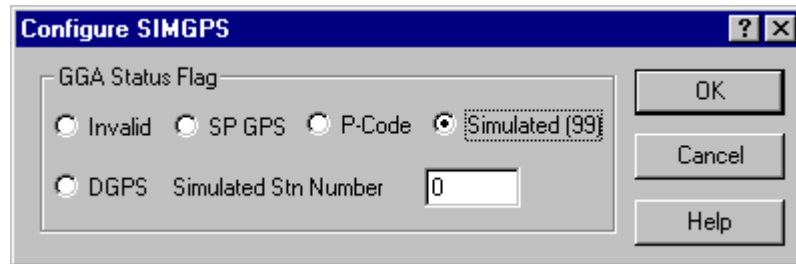
- 1 Highlight the appropriate **Simulated Device** in the **I/O Devices** window.
- 2 Click the right mouse button and select **Configure Device**.

Depending on the type of **Simulated Device** that you have selected, a **Configuration** dialog box may or may not appear, as per the following list;

- GPS - Configure SIMGPS
- Echo Sounder - No
- Gyrocompass - No
- USBL - Configure Sim USBL
- LBL Acoustic - No
- Speed Log - No
- Profiler - No
- SeaPlow - Plow Simulator
- Counter - Simulation Counter Configuration
- INS - Configure Simulated Attitude Sensor
- Range/Range - No

The following sections detail each of these **Configuration** dialog boxes in the order listed above.

To Configure the Simulated GPS Device



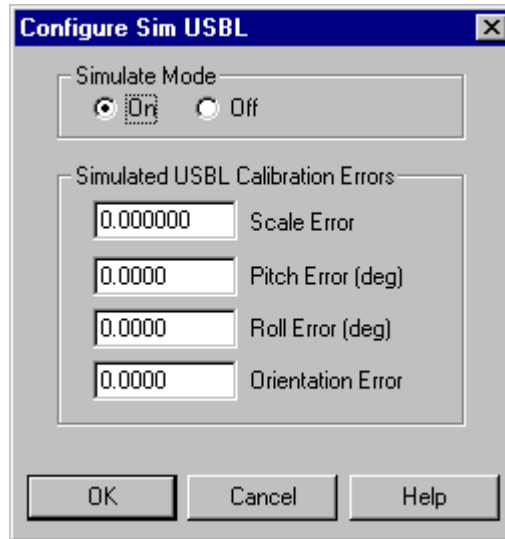
The **Configure SIMGPS** dialog box, as seen above, offers the following options.

Invalid	Simulates an invalid NMEA GGA GPS position. Status = 0.
SP GPS	Simulates a single point Non-Differential NMEA GGA GPS position. Status = 1.
P-Code	Simulates a P-code military precise GPS position or RTK position. Status = 3.
Simulated (99)	Simulates a Fugro proprietary status. Status = 99.
DGPS	Simulates a differentially corrected NMEA GGA GPS position. Status = 2.

Simulated Stn Number	Identifies the station number of the source of the DGPS corrections (for use with DGPS option above).

- 1 Select the radio button beside the desired choice.
- 2 Select **OK** to close the window and enact the changes.

To Configure the Simulated USBL Device



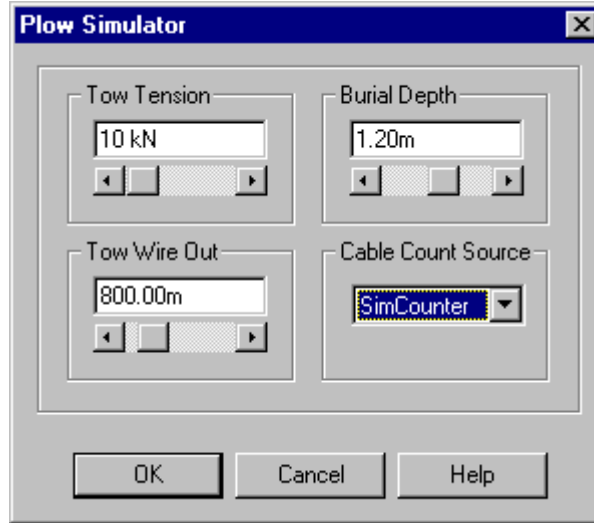
The **Configure SIMUSBL** dialog box, as seen above, offers the following options.

Simulate Mode	Use these to enable the USBL simulator.

Simulated USBL Calibration Errors	The four entry windows allow you to include various errors in the simulated USBL data string.

- 1 Select the **On** radio button to enable the USBL simulator.
- 2 Highlight the appropriate window and enter values as desired.
- 3 Select **OK** to close this window and enact the changes.

To Configure the Plow Simulator

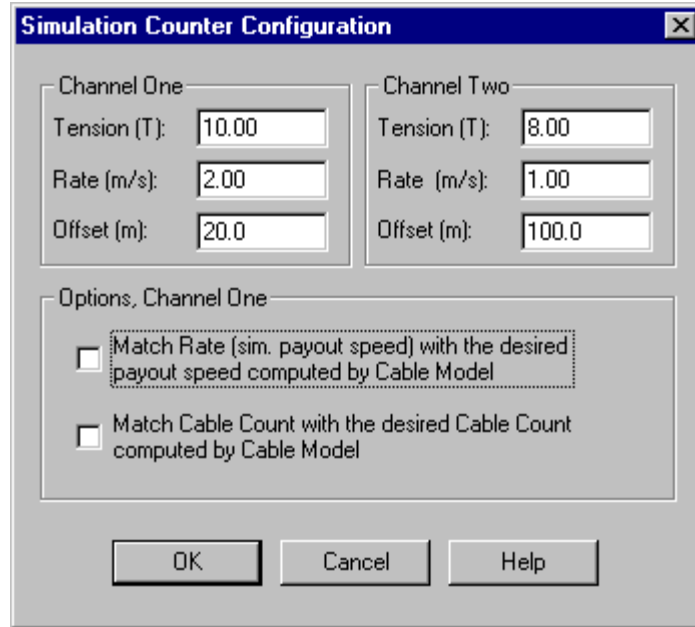


The **Plow Simulator** dialog box offers the following options.

Tow Tension	Entry window and slide bar allow you to change the Tow Tension value.
Burial Depth	Entry window and slide bar allow you to change the Burial Depth value.
Tow Wire Out	Entry window and slide bar allow you to change the Tow Wire Out value.
Cable Count Source	Lists the available options.

- 1 Either highlight the entry window and enter the required value or move the sliding bar (found below the entry window) to change the **Tow Tension** value.
- 2 Either highlight the entry window and type in the required value or move the sliding bar (found below the entry window) to change the **Burial Depth** value.
- 3 Either highlight the entry window and type in the required value or move the sliding bar (found below the entry window) to change the **Tow Wire Out** value.
- 4 Select a **Cable Counter** device from the options presented in the **Cable Count Source** dropdown box.
- 5 Select **OK** to close this window and enact the changes.

To Configure the Simulated Counter



The **Simulation Counter Configuration** dialog box, as seen above, offers the ability to configure 2 separate channels for the same (single) device. As well, additional options are presented for configuring Channel 1 to be controlled by the real-time cable model calculations.

Channel 1 and Channel 2

Tension	Entry window allows you to set the desired tension. units = tons
Rate	Entry window allows you to set the cable payout speed. units = meters/second
Offset	Entry window allows you set the offset value. unit = meters

Options, Channel 1

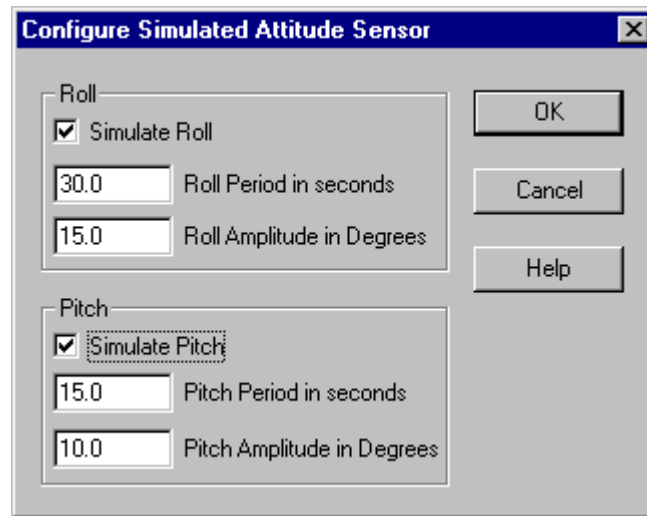
These options will supercede those values entered above.

Match Rate	This checkbox enables WinFrog's Cable Model to control the simulated rate of cable payout.
Match Cable Count	This checkbox enables WinFrog's Cable Model to control the simulated cable count.

- 1 Enter the desired tension (in tons) in the **Tension** entry window.

- 2 Enter the desired rate (in meters/second) in the **Rate** entry window to set the cable payout rate.
- 3 Enter the desired counter **Offset** value (in meters).
- 4 Check the **Match Rate** option to have WinFrog's Cable Model control the simulated rate of cable payout.
- 5 Check the **Match Cable Count** box if you want to have WinFrog's Cable Model control the simulated cable count.

To Configure the Simulated Attitude Sensor



The **Configure Simulated Attitude Sensor** dialog box, as seen above, allows you to configure the **Period** and **Amplitude** for **Simulated Pitch** and **Roll** data.

Roll

Simulate Roll	Enables the simulated roll data.
Roll Period in seconds	Entry window allows you to set the Roll Period .
Roll Amplitude in Degrees	Entry window allows you to set the Roll Amplitude .

Pitch

Pitch Period in seconds	Entry windows allows you to set the Pitch Period .
Pitch Amplitude in Degrees	Entry window allows you to set the Pitch Amplitude .

- 1 Check this **Simulate Roll** checkbox to enable the **Simulated Roll** data.
- 2 Enter the desired value in seconds in the **Roll Period** entry window.

- 3 Enter the desired value in degrees in the **Roll Amplitude** entry window.
- 4 Click in this window and type in the desired value.
- 5 Click in this window and type in the desired value.
- 6 Select **OK** to close this window and enact the changes.

To Add a Simulated Real-time Device to a Vehicle

- 1 Open the **Configure Vehicle Devices** dialog box by using method **1a** or **1b**.
 - 1a In the **Vehicle Text** window (**View > Vehicle Text**), click the **Configure Vehicle-Devices** button.
 - 1b In the **Configure Vehicles** dialog box (**Configure > Vehicles**), click the **Configure Vehicle-Devices** button.
- 2 Make sure the **Real-Time** radio button is selected in the **Data Source** area.
- 3 Click the **Add** button.
- 4 Select the desired **Simulated Real-time Device** in the **Select Data Items** dialog box.
- 5 Click **OK**. The **Simulated Real-time Device** is listed in the vehicle's **Devices** list of the **Configure Vehicle Devices** dialog box.
- 6 To add more **Simulated Real-time Devices**, repeat steps 2 through 5.

To Configure a Simulated Real-time Device for a Specific Vehicle

Once any device (real-time or otherwise) has been added to a WinFrog vehicle (as described immediately above), it must be correctly configured for that specific installation. The following section details how to access the configuration options for any device that has been added to a vehicle.

- 1 Open the **Configure Vehicle-Devices** dialog box by using method **1a** or **1b**.
 - 1a In the **Vehicle Text** window (**View > Vehicle Text**), click the **Configure Vehicle-Devices** button.
 - 1b In the **Configure Vehicles** dialog box (**Configure > Vehicles**), click the **Configure Vehicle-Devices** button.
- 2 Make sure the **Real-Time** radio button is selected in the **Data Source** area.
- 3 Highlight the appropriate device in the **Devices** list.
- 4 Click the **Edit** button.
- 5 A **Configuration** dialog box will appear for that particular device. See the

Peripheral (I/O) Devices chapter for more information on **Device Configuration**.

- 6 Configure the device as required, then click on the **OK** button to return to the **Configure Vehicle-Devices** dialog box.
- 7 Repeat steps **3 - 6** for each device listed in the vehicle's **Devices** list.
- 8 Click **OK** to close the **Configure Vehicle-Devices** window and enact the changes.

Controlling Simulated Devices

Once a **Simulated Device** has been added to a vehicle's **Device List**, WinFrog treats it just like any other device. Those devices designated as **Primary** will control or affect the vehicle just like a "real" device.

WinFrog allows you to control the behavior of several **Simulated Devices** through the use of **Toolbar** or **I/O Device Window Configuration** options.

The following section details those simulator tools found in WinFrog's toolbar; **Speed**, **Heading**, and **ROV Depth**.

See the section above named **To Generically Configure a Simulated Device** for details on controlling a device through the **I/O Device Window Configuration** options.

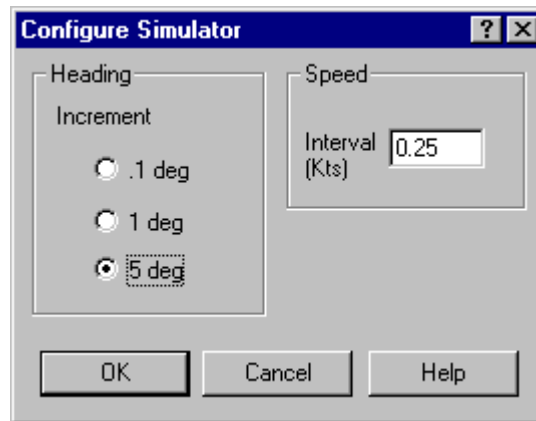
Controlling the Simulated Devices Via The Toolbar Buttons

You can control the **Position**, **Speed**, **Heading**, and **Depth** of a vehicle that has been configured with **Simulated** devices. This is accomplished through the toolbar buttons located below the WinFrog menu bar.

This section details the configuration and use of the **Simulator** buttons in the toolbar. For more information about the toolbar, see the **Toolbar** section of the **Introduction** chapter.

To Configure the Toolbar Button Controls

- 1 From the main menu item **Configure**, select **Simulator** to open the **Configure Simulator** dialog box.



The following parameters are configured using the **Configure Simulator** dialog box.

Heading - Increment

.1 deg radio button

Sets the simulated heading to change by one tenth (0.1) of a degree each time the toolbar's **Turn Left** button or **Turn Right** button is clicked.

1 deg radio button

Sets the simulated heading to change by one (1.0) degree each time the toolbar's **Turn Left** button or **Turn Right** button is clicked.

5 deg radio button

Sets the simulated heading to change by five (5.0) degrees each time the toolbar's **Turn Left** button or **Turn Right** button is clicked.

Speed

Interval (knts)

Enter a value that defines the amount that the vessel's Speed will change each time the toolbar's **Increase Speed** or **Decrease Speed** button is clicked.

Toolbar Simulator Controls

WinFrog's default configuration enables 6 simulator controls in the main toolbar. These buttons are shown in their default locations (27-32) below. All of the buttons in the toolbar are “dockable”, so the location of your **Simulator Controls** may differ.



To Use the Toolbar Simulator Control Buttons

This section details each of the **Simulator Control** buttons, in the order that they are found in the toolbar.

Turn Left (27)

The vehicle's **Simulated Heading** will turn to **left** (port) by the specified amount each time this button is clicked.

Turn Right (28)

The vehicle's **Simulated Heading** will turn to the **right** (starboard) by the specified amount each time this button is clicked.

Decrease Speed (29)

The vehicle's **Simulated Speed** will **decrease** by the specified amount each time this button is clicked.

Note: If you click this button too many times, the vehicle will start moving backwards.

Increase Speed (30)

The vehicle's **Simulated Speed** will **increase** by the specified amount each time this button is clicked.

Increase ROV Depth (31)

The vehicle's **Simulated Depth** will **increase** by 10 meters each time this button is clicked. Do not confuse this **Depth** of the **Vehicle** value as water depth.

Decrease ROV Depth (32)

The vehicle's **Simulated Depth** will **decrease** by 10 meters each time this button is clicked.

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Chapter 13: Positioning Using Range/Range Devices

WinFrog provides you with the capability to utilize **range/range** (R/R) devices for vehicle positioning. As the name implies, **range/range** devices utilize range (i.e. distance) measurements to derive positions. To resolve a position with no ambiguity, ranges must be measured to at least 3 control stations (points of known coordinates). In some range/range systems (such as Racal's MicroFix), the coordinates of the control stations are entered internally into the transceiver console, where an internal program then uses the observed ranges to calculate and, ultimately, output a position. WinFrog replaces these internal calculation routines, combining the raw ranges received from the transceiver unit with internally configured control station coordinates to calculate the final position.

This ability provides the flexibility to use two common (simpler) types of ranging systems (Syledis and Trisponder), as well as being able to better monitor the quality of the positioning derived by the system.

Additionally, using WinFrog to calculate the position provides the ability to apply Kalman or Median filtering to the data. In addition to this control, when using Kalman filtering, you can select the option of inputting the range data itself to the Kalman filter or the least squares position solution.

Working Control Station File

As mentioned above, the basis of **range/range** positioning is the measurement of ranges to control points of known coordinates. In WinFrog, control point information is found in the **Working Control Stations (.cls)** file. (The terms **Control Point** and **Control Station** are used interchangeably here). Before a range/range system can be used with WinFrog, you must create a **Working Control Stations** file, then add the appropriate **Control Station** information to that file.

See the **Creation of a Working Control Station** file in the **Working Files** chapter for complete details on creating a **Working Control Stations** file and adding **Control Station** information to that file.

Range/Range Devices

The application of range/range device data to a WinFrog vehicle requires the same configuration steps as any other real-time device: you must first add the device to WinFrog, “generically” configure the device (if possible - not required for range/range devices), then add the device to the appropriate vehicle and configure the device for that specific vehicle.

See the **Peripheral (I/O) Devices** chapter for more information about using and configuring peripheral devices with WinFrog.

To Add a Range/Range Peripheral I/O Device

- 1 From the **Configure** menu, choose **I/O Devices... > Add**.
- 2 From the **Add Devices** dialog box, select the “+” beside **RANGE/RANGE**.
- 3 Double-click on the desired option.
- 4 Configure the various parameters in the **Device I/O Parameters** dialog box to suit the range/range device.

The device must also be configured properly to output the correct data required by WinFrog. Refer to the manufacturer’s manual for directions. It is necessary to configure the unit to output range data.

The Syledis SR3 can also be configured to output a position in either geographic (latitude and longitude) or map projection (Northing and Easting) coordinates. WinFrog supports both ranges and positions output from the Syledis. It is important to note that the range data from the Syledis SR3 are to the nearest meter, while the Trisponder range data are output to decimeter level accuracy.

- 5 Click **OK** to close the **Device I/O Parameters** dialog window.
- 6 If not already enabled, select **View > I/O Devices**. Highlight the newly added range/range device and view the **Decoded Data** to make sure that range data are, in fact, being received correctly.

To Add a Range/Range I/O Device to a Vehicle

- 1 Make sure that the range/range device has been correctly added to WinFrog, as detailed in the section immediately above.
- 2 Open the **Configure Vehicle-Devices** window for the desired vehicle. This can be accomplished in two ways:
 - 2a With the mouse pointer located within the limits of the **Vehicle Text** window

(and with the appropriate vehicle data displayed in this window) click the right mouse button. Select the **Configure Vehicle-Devices** option.

Or

- 2b From the main menu select **Configure > Vehicles**. Highlight the appropriate vehicle, then select the **Configure Vehicle-Devices** button.
- 3 Ensure that the **Data Source** for this vehicle is set to **Real-Time**.
- 4 Click the **Add** button on the right side of the **Configure Vehicle Devices** dialog box.

All **I/O Devices** that have been added to WinFrog are displayed in the **Available Data Items** list in the **Selected Data Items** dialog box.

- 5 Select the **Range/Range** device.
- 6 Click **OK**.

The selected range/range device now appears in the **Devices** list at the bottom of the **Configure Vehicle Devices** dialog box.

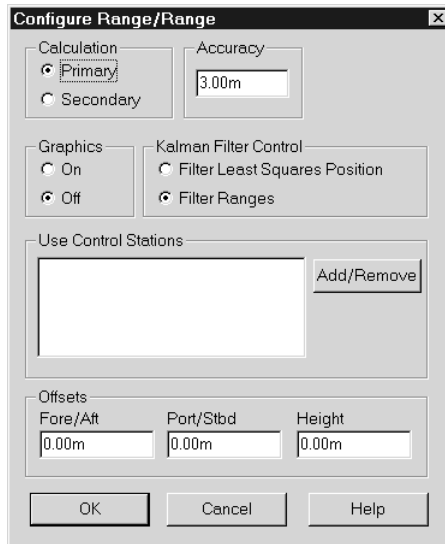
Configuration of a Range/Range Device

As per all **I/O Devices**, once the range/range device has been added to a vehicle, it must be configured for that specific application. This configuration is accomplished via the **Configure Vehicle-Devices** dialog box.

To Configure the Range/Range Device

- 1 Open the **Configure Vehicle-Devices** dialog box. (See steps 2a and 2b in the section immediately above for instructions on accessing the **Configure Vehicle-Devices** window.)
- 2 Select the **Range/Range** device displayed in the **Devices** list at the bottom of the **Configure Vehicle-Devices** dialog box.
- 3 Click the **Edit** button.

The **Configure Range/Range** window opens, as seen below.



- 4 Configure the following parameters in the **Configure Range/Range** dialog box.

Calculation

Primary/Secondary

Select the appropriate option.

Accuracy

Entry field

Enter the estimated range accuracy. Do not be overly optimistic since this can impact the velocity determination. **Note:** the default of three meters is recommended for Trisponder or Syledis systems.

Graphics

On/Off

Select the **On** radio button to initiate plotting of the calculated (onboard) transponder location in the **Graphics** windows.

Kalman Filter Control

Filter Lease Squares

Position/Filter Ranges

Select how Kalman filtering will be applied to the data:

If **Filter Least Squares Position** is selected, a position is solved using the raw range data (using a least squares adjustment of the raw ranges) and the “raw” position is then put into the **Kalman Filter**.

If **Filter Ranges** is selected, the ranges are entered into the **Kalman Filter** before they are

used to calculate a position. **Note:** it is recommended that the **Filter Ranges** option is selected.

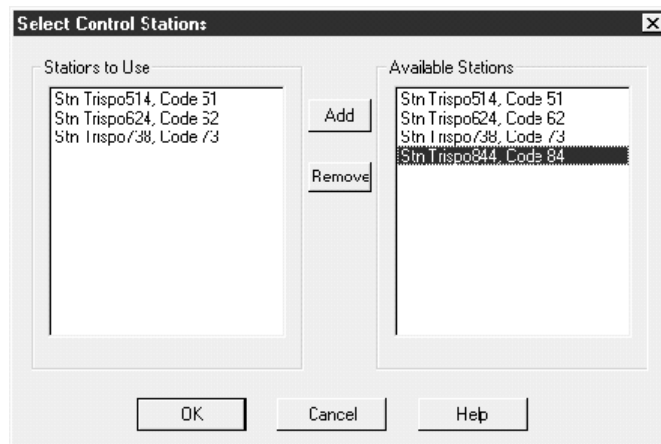
Use Control Stations

Window

This window lists the **Control Stations** currently selected for use in the position determination calculations. In order to utilize a received range, WinFrog must be able to match the **code** from a received range data string to a control station **code** in this list.

This “two step” method of Control Station selection isolates the contents of the **Control Stations (.cls)** file from those stations to be used in the solution. This is useful in those cases where you may have numerous stations configured in the **Control Station** file that are not to be used in the current calculations.

Click the **Add/Remove** button to open the **Select Control Stations** dialog box, as seen below.



Available Stations List

List

displays all control stations in the **Working Control Stations (.cls)** file. Up to eight stations can be selected for use at any one time.

To Add a Station to the Solution

Select it from the **Available Stations** list and click the **Add** button.

To Remove a Station from the Solution

Select it from the **Stations to Use** list and click the **Remove** button.

Note: even though a station is selected and displayed in the **Stations to Use** list, it remains displayed in the **Available Stations** list.

- 5 Once all required control stations have been added, click **OK**.

Offsets

Enter the **Offsets** as measured from the vehicle CRP to the onboard transponder. A sensor **Height** relative to MSL must be entered in the **Height** field. This value is used in conjunction with the **Control Station MSL Elevation** to reduce the ranges to horizontal.

- 6 Click **OK** to close the **Configure Range/Range** dialog box once it has been configured satisfactorily.
- 7 Click **OK** to save the configuration changes and close the **Configure Vehicle-Devices** dialog box.

Editing Range Use in the Solution

The range data available for use in the position solution are determined by the control station selections. The actual use of the data from these control stations is controlled by several other WinFrog configuration options.

Range Gating

A “**Range Gate**” can be used to have WinFrog remove unsuitable ranges from inclusion in position calculations. The **Range Gate** configuration is found in the **Configure Vehicle-Devices** dialog box.

By default, the **Range Gate** is set to **Off**. To enable the **Range Gate** “uncheck” the **Off** box, then use the sliding bar to select the desired range gate value (this can be set to a value between 5 and 100 meters). The range data are then monitored. If a new range exceeds the expected range by the value entered in the range gate, that new range is not used in the solution for that data cycle.

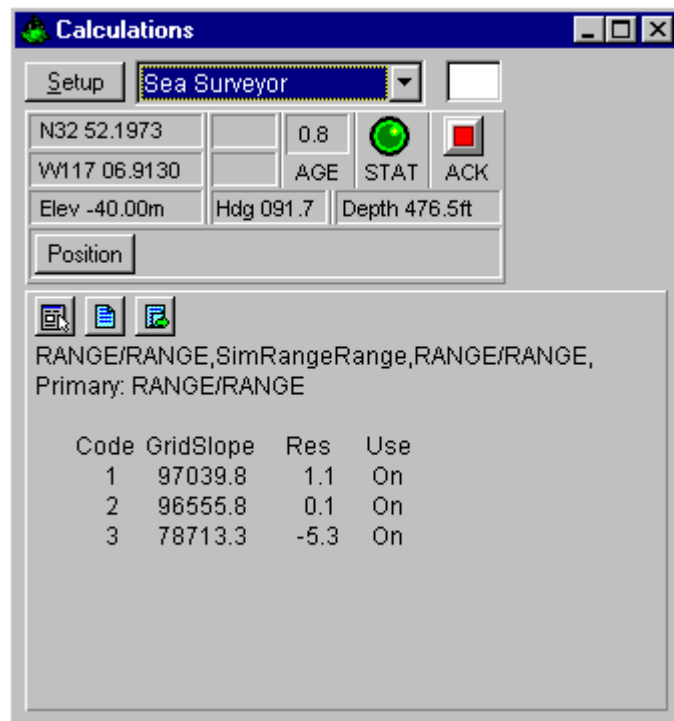
Note: selecting too small a range gate value can result in the exclusion of valid data, particularly if the vehicle’s speed is high or inconsistent.

Range Use

WinFrog’s **Calculations** window allows you to monitor range/range data and to manually add or remove ranges from the position solution as required.

To Monitor Range/Range Data in the Calculations Window

- 1 Enable the **Calculations** window (select the main menu item **View** > **Calculations**). See the **Calculations Window** section in the **Operator Display Windows** chapter for details about configuring this display.
- 2 Select the appropriate vehicle from the provided dropdown menu.
- 3 Click the **Setup** button.
- 4 In the **Included Views** section of the **Setup Calculation Views** window, select **Position** and **Data Item Text**.
- 5 Highlight the **Range/Range** device from the device listing provided.
- 6 Click on the **On** button just below the device list.
- 7 Click **OK** to close this window and return to the **Calculations** window.



The **Calculations** window now displays **Station Code**, **Grid Slope Distance**, **Residual**, and **Use status**.

The **Use** status displays one of the following:

On

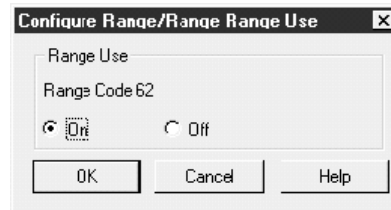
The range is enabled in the solution.

Gated

The range is **on**, but it has been gated out of the solution due to exceeding the specified range gate.

Bad	The range is turned off and is not used in the solution.
Off/Gated	The range is off and has failed the gating monitoring.

In the **Calculations** window, beside each range is an **up arrow**. Click one of these, to view the **Configure Range/Range Range Use** dialog box.



Range Use

On/Off

If the **Off** radio button is selected for a particular range code, that code is not used in the solution under any circumstances. If the **Range Gate Off** box in **Configure Vehicle Calculations** dialog box is not checked, the off range will still be monitored for exceeding the range gate limits.

If the **On** radio button is selected for a particular range code, that code is used in the solution unless it is determined to be bad (**0** in the input) or gated. In both cases, the residual is calculated and displayed.

Chapter 14: GPS Calculations Extension Module

One of WinFrog's add-on modules is the **GPS Calculations Extension Module (GPS Calcs)**. Configured with this module, WinFrog is able to do the following:

- internally calculate positions from raw pseudorange measurements
- apply corrections from up to 5 RTCM sources into a DGPS solution
- provide UKOAA statistical testing of the GPS results
- Reference Station Integrity Monitoring (RSIM) for RTCM sources
- GPS pod positioning using inverse DGPS solutions

This functionality is only available through the **GPS Calculations Extension Module**. The core WinFrog software package is only able to provide positioning information in real-time if: a separate device is internally calculating a position, is correctly interfaced to WinFrog, and is outputting positioning information in a recognized format.

The **GPS Calcs** module utilizes the same basic methodology to calculate a position as most GPS receivers; by measuring distances to numerous points (satellites) of known coordinates, then combining the information into a least squares solution to get the final coordinates.

GPS receivers measure the distance to each satellite (termed a pseudorange) by observing the time it takes for a signal to travel from the satellite to the receiver. The positions of the satellites are known based on mathematical predictions made as a result of the observations made by GPS control stations located around the earth. By combining at least four ranges to four satellites of known positions, the receiver's latitude, longitude, and ellipsoidal height can be determined.

This is a very simplified explanation of how a position is derived by GPS. The following sections provide further detail on how GPS works and how WinFrog GPS calculations are configured to calculate a position using GPS.

Pseudorange Positioning

Pseudoranges are GPS time measurements that are not corrected for the lack of synchronization between the clocks onboard the GPS satellites and the clock onboard the GPS receiver.

The distance to a satellite is based on the time it takes for the signal to travel from the satellite to the receiver. If the clock on the receiver is not on the exact

same time reference as the satellite clock, the time measurement will be in error. Since the signals transmitted by the satellites travel at the speed of light (186,000 miles per second), even the slightest error in the timing will result in a substantial error in the range measured to the satellite. The use of these “uncorrected” GPS measurements will obviously result in an inaccurate position solution. The receiver clock error must be removed before an accurate position can be determined. This is accomplished in most GPS receivers (and the WinFrog GPS calculations) by utilizing measurements made simultaneously to numerous satellites. An approximate three-dimensional (3D) position is derived by combining pseudoranges from at least four satellites. Mathematically, the position can be derived by using only three pseudoranges. The fourth pseudorange provides a mathematical redundancy to allow for the calculation of the receiver clock error. By applying an adjustment to the observed pseudoranges, the receiver clock error is resolved and, ultimately, removed.

Numerous additional errors also exist in a standalone GPS position solution, requiring additional corrections to be applied. If no corrections are applied, the positioning accuracy of GPS is approximately no better than 100 meters. This is far below what is required for most survey applications. The methods used to correct a single point position are described in further detail in the following sections.

With the **GPS Calculations Extension Module**, WinFrog partially takes the place of the GPS receiver. WinFrog allows for the configuration of satellite cut-off elevation angles, minimum **Dilution Of Precision (DOP)** values, and minimum **Signal-to-Noise** ratios. In addition, WinFrog can be configured to apply RTCM format differential corrections to improve positioning accuracy and to apply carrier phase smoothing to the code solution, resulting in GPS position solutions with reduced noise.

By taking over the calculations from the GPS receiver, the **GPS Calculations** module provides you with much greater control over the way the GPS position is calculated and, subsequently, much greater positional quality assurance.

WinFrog relies on third party hardware to provide the pseudorange information and the “ephemeris” required to calculate a position. **Ephemeris** is a set of satellite orbit parameters used by the GPS receiver to calculate precise GPS satellite positions and velocities. The ephemeris predicts where the satellites are at every instant of time.

Not all GPS receivers made are able to provide the pseudorange and ephemeris information required by WinFrog’s **GPS Calcs**.

WinFrog currently supports the following GPS devices:

- Ashtech Sensor II
- Magnavox MX9400
- NavStar XR5
- NavStar PR
- NovAtel Console
- NovAtel Tele
- NovAtel RS232
- GPS Pod (see the section entitled **GPS Pod Positioning** for more information)
- Trimble Cyclic
- Trimble TSIP

See the section below named **Adding GPS Devices** for more information on using these devices with WinFrog's **GPS Calcs Module**.

Differential GPS (DGPS)

As mentioned above, standard GPS positioning does not provide the accuracy required for most survey applications. The application of **Differential GPS (DGPS)** corrections can improve positional accuracy to acceptable (meter) levels.

As the name implies, DGPS measurements utilize the differencing of GPS observations between receivers to improve accuracy. The basis in the theory behind DGPS corrections is that the mobile GPS receiver is experiencing the same positional errors as the **Base Station (AKA Reference Station)** GPS receiver. In standard **C/A Code** DGPS positioning, the base station GPS receiver is placed on a fixed point of known coordinates. Approximately every second, the base station receiver calculates its position and compares it to an entered known position. It then calculates the correction required to be added to each of the pseudoranges (in meters) so that the calculated position would match the known position.

These corrections are called **Pseudorange Corrections**, sometimes abbreviated as **PRC**. These corrections, as well as **Rate of Range Correction (AKA RRC)** data are transmitted in real-time and applied by the rover GPS receiver as they are received. Typically, the DGPS data are transmitted and received via a UHF or MF radio link. The resulting corrected rover (mobile) position is then referred to as a DGPS position.

RTCM Data

In order to enable the use of more than one brand of GPS receiver for DGPS positioning (for either **Base Station** or **Rover** applications), a standard message format was introduced to which almost all GPS receiver manufacturers conform. This format is called **RTCM**, which is an acronym for the name of the committee that created it: the **Radio Technical Commission for Maritime Services**. The RTCM standard defines not just **PRC** and **RRC** data, but a total of 64 messages related to GPS and marine navigation. RTCM Message types **1** and **9** provide the most relevant data for meter-level DGPS positioning systems as they include PRC, RRC, and satellite health information.

With the universality of the RTCM message format, numerous sources of DGPS corrections are available, depending on the user's location. One source of RTCM corrections is the United States Coast Guard Navbeacon Service. This service consists of several networks of **Medium Frequency (MF)** DGPS transmitting stations, covering almost all of the United States coastal areas. These corrections are transmitted 24 hours a day, 365 days a year, and are available at no cost to the user, save for the cost of the MF receiver.

RTCM corrections are also available in larger metropolitan areas from several commercial sources. These systems often utilize existing FM radio frequencies to broadcast the corrections. Fugro SkyFix offers RTCM corrections from a worldwide network of more than 60 reference stations, broadcast using the INMARSAT satellite communications system.

DGPS Solutions in WinFrog

As mentioned previously, WinFrog's **GPS Calculations Extension Module** can implement RTCM format DGPS corrections into its calculations to increase the resultant positional accuracy. This implementation is not limited to utilizing corrections from only one DGPS reference station. The GPS Calcs module can use the RTCM corrections from up to five different reference stations, combining them to produce what is referred to as a "**Multi-Ref**" (short for Multiple Reference Station) solution. WinFrog independently applies the corrections from each reference station to the observed pseudoranges, resulting in the same number of independent solutions. These independent solutions are then combined in a least-squares weighted calculation to produce a single, final position. The weighting of the individual solutions in the final position solution is based on relative standard deviation values entered by the user in the Select DGPS Reference Stations dialog box. This value is used as a scalar (multiplicative) factor, applied to the standard deviations calculated for the latitude, longitude, and height for each reference station solution. The scaled

standard deviations are then used as the weight for the respective unknown in the determination of a weighted mean value; the higher the standard deviation, the less accurate that value is deemed to be and, hence, the less weight that will be applied to that observation in relation to the others of the same type.

Multi-Ref solutions can also be obtained by adding multiple RTCM receivers to WinFrog. For example, adding 2 or 3 U.S. Coast Guard beacon receivers (each set to receive a different set of RTCM corrections) will allow for a Multi-Ref solution.

Multi-Ref solutions offer three distinct advantages over a single RTCM source solution:

Increased Reliability

a DGPS solution is still available if one of the RTCM base stations fails. Independent solutions can be removed from the mean position calculations if they are unstable or of questionable quality.

Increased Accuracy

In remote areas, combining corrections from multiple surrounding base stations removes any local biases from the rover's DGPS position.

Quality Control

If the RTCM DGPS corrections being received are being generated by another WinFrog system located at the Base Station, WinFrog's **GPS Calcs Module** can utilize Reference Station Integrity Monitoring (RSIM) data to verify the quality of the DGPS position.

To Configure GPS Calculations

This section details the steps required to configure GPS Calculations in WinFrog, including the addition and configuration of all required devices. As per any device used in WinFrog, these devices must first be added to the WinFrog system (and "generically" configured), then added to the specific vehicle's device list and configured for that specific application.

To Add a GPS Device to WinFrog

As mentioned briefly above, WinFrog's **GPS Calculations Extension Module** requires GPS pseudorange and ephemeris data to generate a position. Not all

GPS receivers are capable of providing this information, nor is WinFrog currently capable of using the data from every GPS device that can generate this information. See the section named **Pseudorange Positioning** above for a list of those devices that are currently supported by WinFrog.

Some GPS receivers require more than one serial port to provide all of the required information to WinFrog. For example, **Trimble 4000** receivers pass the ephemeris data to WinFrog via the **RCI** option (the **Trimble RCI** device in WinFrog) and the pseudorange data via the **Cycle Printouts** option (the **Trimble Cyclic** device). Each of these data types is treated as a separate device by WinFrog and, as such, must be connected to an independent serial port and added to WinFrog as a separate device.

In many Fugro Pelagos WinFrog installations, **Novatel** PC card GPS receivers are also used to provide ephemeris and pseudorange data to WinFrog. This is typically added to WinFrog by adding the **NOVATEL CON** GPS device to the WinFrog system.

See the **Peripheral (I/O) Devices** chapter for more information about adding GPS devices to WinFrog. Since the Trimble 4000 and NovAtel GPS Card are the most commonly used devices (in Fugro Pelagos installations) for providing information to the **GPS Calculations Extension Module**, their specific details are shown below.

- 1 Choose **Configure > I/O Devices > Add**.
- 2 Click the “+” beside the GPS group.
- 3 Double-click the appropriate device.

For the **Trimble 4000 DL** receiver, add the **Trimble RCI** and **Trimble CYCLIC** devices.

For a **NovAtel GPSPC card**, add the **NovAtel Con** device.

- 4 Configure the appropriate parameters.
- 5 Choose **OK**.

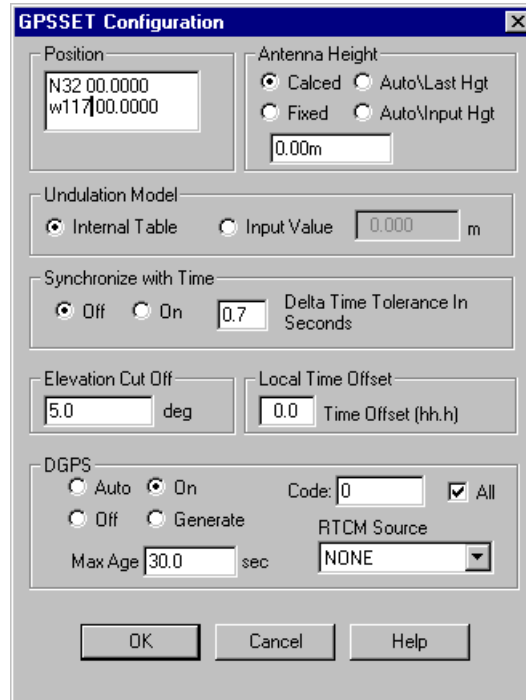
To Generically Configure a GPS Device

With the required GPS device(s) now added to WinFrog, you must “generically” configure each device. **Note:** not all devices require this “generic” configuration, but it is best to attempt this configuration on **all** devices until you become familiar with the devices. The generic configuration of a device is accomplished easiest through the **I/O Devices** window.

- 1 Select **View > I/O Devices**.
- 2 Highlight the appropriate device then click the right mouse button and

select **Configure Device**.

A dialog box opens for those devices requiring “generic” configuration, such as the NovAtel GPS Console device, as seen in the next figure.



The image shows a 'GPSSSET Configuration' dialog box with the following fields and controls:

- Position:** Latitude: N32 00.0000, Longitude: W117 00.0000
- Antenna Height:** Radio buttons for 'Calced' (selected), 'Auto\Last Hgt', 'Fixed', and 'Auto\Input Hgt'. A text field shows '0.00m'.
- Undulation Model:** Radio buttons for 'Internal Table' (selected) and 'Input Value'. A text field shows '0.000' m.
- Synchronize with Time:** Radio buttons for 'Off' (selected) and 'On'. A text field shows '0.7' Delta Time Tolerance In Seconds.
- Elevation Cut Off:** A text field shows '5.0' deg.
- Local Time Offset:** A text field shows '0.0' Time Offset (hh.h).
- DGPS:** Radio buttons for 'Auto' (selected), 'On', 'Off', and 'Generate'. A text field shows '0' Code. A checkbox is checked for 'All'. A text field shows '30.0' Max Age sec. A dropdown menu shows 'NONE' for RTCM Source.
- Buttons:** OK, Cancel, and Help.

To Add a GPS Device’s Data Items to a WinFrog Vehicle’s Devices List

The addition of a peripheral I/O device’s **Data Items** to a WinFrog vehicle is a straight-forward process and is detailed in the **Peripheral (I/O) Devices** chapter. The only additional concern when dealing with GPS devices to be used by the **GPS Calcs Module** is the fact that some of these GPS devices provide up to 3 separate **Data Items** that must be added to a vehicle; **Pseudorange**, **Ephemeris**, and **TimeDate**.

Since the **Trimble 4000** and **NovAtel GPS Card** are the most commonly used devices (in Fugro Pelagos installations) for providing information to the **GPS Calcs Module**, their specific details are found below.

When using a **Trimble 4000** GPS receiver:

- Add the **GPS,Trimble RCI**, **EPHEMERIS** and **GPS,Trimble Cyclic**, **PSEUDORANGE** data items. (The **GPS,Trimble Cyclic**, **TIMEDATE** device is optional and requires additional wiring.)

For a **NovAtel GPS PC** card:

- Add the **GPS,CONSOLE,PSEUDORANGE** and **GPS,CONSOLE,EPHEMERIS** data items. The **GPS,CONSOLE,POSITION** data item is the position as calculated

internally by the NovAtel GPS Card. This can be added for use as a backup (redundant) positioning source, but is not required for **GPSCEM** purposes.

To Configure a GPS Device for a Vehicle Using GPS Calcs Module

It is an absolute necessity that you edit the “specific” configuration of a GPS **Pseudorange** device that is to be used with the **GPS Calcs Module**. This “editing” provides access to many important configuration options that will affect the quality of the positioning as calculated by the **GPS Calcs Module**.

The steps required to configure a device for a specific vehicle are detailed in the **Peripheral (I/O) Devices** chapter. The following paragraphs detail the dialog boxes that display when you edit a **Trimble GPS Pseudorange** device added to a vehicle’s device list.

- 1 Open the **Vehicle Text** window (**View > Vehicle Text**). Place the mouse pointer within the boundaries of the **Vehicle Text** window, then click the right mouse button, and select **Configure Vehicle-Devices**.

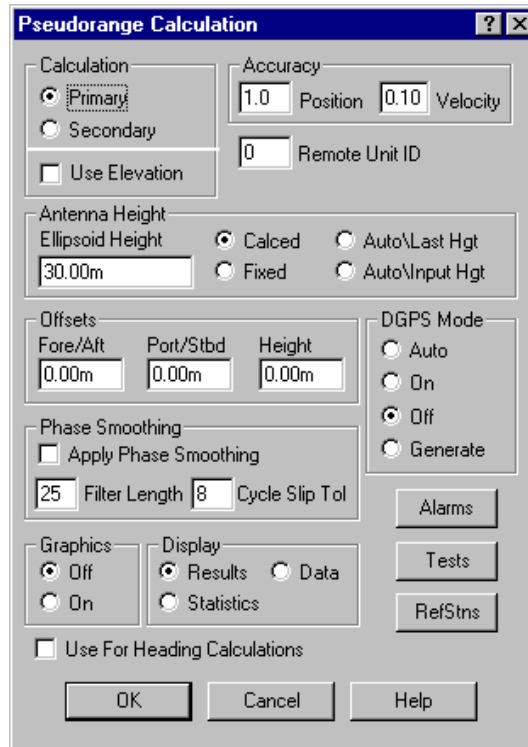
- 2 Highlight the **GPSPSEUDORANGE** device.

If a **Trimble 4000** is used, this is the **GPS, Trimble CYCLIC, PSEUDORANGE** device.

If a **NovAtel GPS PC** card is used, select the **GPS, CONSOLE,PSEUDORANGE** device.

- 3 Click the **Edit** button.

The **Pseudorange Calculation** dialog box opens, as seen below.



- 4 In the **Calculation** area at the top of the **Pseudorange Calculation** dialog box, select either the **Primary** or **Secondary** radio button.

Primary

If selected, the pseudorange-derived solution is used in the Kalman filter to produce a position solution. More than one positioning device can be configured as **Primary**. WinFrog will combine the positions from all **Primary** devices into a weighted solution based on the accuracy value of each device. The lower the accuracy number (the higher the accuracy), the more weight applied to that device.

Secondary

If selected, the pseudorange-derived position is simply monitored and is not utilized in the Kalman filter for real-time positioning.

Note: In the case of **Primary** device failure, WinFrog does **not** automatically use the **Secondary** devices for Kalman filtered position computations. You must manually change the **Secondary** devices to **Primary** Calculation status.

- 5 In the **Accuracy** area, enter a value in the **Position** field.

This is the expected accuracy of the **Pseudorange** derived position and is used in the weighting of this device in the Kalman filter.

See the manufacturer's manual for the stated accuracy value.

- 6 In the **Accuracy** area, enter a value in the **Velocity** field.

This is the maximum acceleration allowed in the Northing and Easting components of the pseudorange-derived position (in meters/second ²). This entry affects how dynamic the calculated GPS receiver's positioning can be.

See the manufacturer's manual for the stated accuracy value.

- 7 Enter a value in the **Remote Unit ID** field.

This parameter is used when receiving pseudoranges from a remote GPS device, such as a **GPS Pod**. Typically, remote stations utilize radio telemetry networks to transfer their pseudoranges to WinFrog. This requires that each member of the network have a unique ID or code to be identifiable.

Unless the Pseudoranges are coming from a network source, the **Remote Unit ID** value should be left at 0.

- 8 Enabling the **Use Elevation** feature affects the **Water Depth** value that is recorded in WinFrog's data files (i.e. the automatic and manual files).

Rather than record simply the water depth value received from the echosounder (with applied offsets), WinFrog will derive the **Ellipsoidal Height** of the bottom. WinFrog will use the derived **GPS Antenna Ellipsoidal Height** and **subtract** the **GPS Antenna Height Offset**, the **Echosounder Depth Offset**, and the **Observed Water Depth** values.

This option is required in those circumstances where there is no constant vertical reference to which depth measurements can be referred, such as is the case when surveying a river. This feature should only be used when a high accuracy (centimeter-level) RTK GPS system is used.

- 9 In the **Antenna Height** area, the following parameters are configured:

Ellipsoid Height field	Enter the Height of the antenna with respect to the WGS84 Ellipsoid .
Calced radio button	WinFrog uses a pseudorange-derived Ellipsoid Height as the antenna's Ellipsoid Height . In this mode, WinFrog requires a minimum of four satellites in order to calculate a valid position and elevation.

Fixed radio button	Fixes the Antenna Height to the Ellipsoid Height entered in the Ellipsoid Height field. In this mode WinFrog is able to calculate valid positions using a minimum of three satellites.
Auto\ Last Hgt radio button	WinFrog calculates a valid 3D position if four or more satellites are available. If only three satellites are available, the Antenna Height is fixed to that of the last valid Calculated Ellipsoid Height value. In this mode WinFrog is able to calculate valid positions using a minimum of three satellites.
Auto\ Input Hgt radio button	WinFrog calculates a valid 3D position if four or more satellites are available. If only three satellites are available, the Antenna Height is fixed to the value entered in the Ellipsoid Height field. In this mode, WinFrog is able to calculate valid positions using a minimum of three satellites.

Note: the **Antenna Height** entered in the **Pseudorange Calculation** dialog box is always referenced to the **WGS84 Ellipsoid**. In some other WinFrog dialog boxes, heights may be referenced to **MSL** (mean sea level) or the user-defined vertical reference point.

- 10 In the **Offsets** area, enter the offsets of the GPS antenna from the CRP using the **Fore/Aft**, **Port/Stbd**, and **Height** entry fields.

These values are defined as the antenna position as measured from the **Common Reference Point**. Remember that forward and starboard positions are entered as positive numbers, while aft and port are entered as negative numbers. Ensure that the units of measure are entered correctly.

- 11 Select the appropriate radio button in the **DGPS Mode** area.

There are four different **DGPS Modes**:

Auto radio button	WinFrog will apply differential corrections to its GPS pseudorange-derived position calculations when those corrections are available to the vehicle. If no RTCM corrections are available, WinFrog computes a single point (+/- 100 meters) solution.
On radio button	WinFrog must receive RTCM differential corrections. If no DGPS corrections are available, WinFrog does not compute a

Off radio button	position. WinFrog does not use RTCM differential corrections in its pseudorange-derived position computations, even if they are available. Only a single point GPS position will be calculated in this mode.
Generate radio button	Reserved for future development.

12 Configure the parameters in the **Phase Smoothing** area.

If the **Apply Phase Smoothing box** is checked, set the **Filter Length** and **Cycle Slip Tolerance**.

WinFrog has the capability to use GPS Carrier Phase measurements to smooth GPS Code positioning.

The GPS system works by modulating the standard C/A code information onto two carrier frequencies identified as L1 and L2. These carrier frequencies have a wavelength of 19 and 24 centimeters, respectively, and carry no timing or navigation information. Some high precision, survey-grade GPS receivers can lock onto either L1, L2, or both L1 and L2 frequencies. Most GPS receivers typically utilize only the L1 frequency.

Since the carrier frequencies carry no timing information, there is no method of analyzing the time difference from signal transmission at the satellite to signal reception at the receiver and, hence, no way to use the signal by itself to solve for a position.

However, once the GPS receiver has locked onto the carrier frequency, it is able to count the change in the number of carrier phase wavelengths that has occurred since lock. This provides the basis for WinFrog's Carrier Phase Smoothing.

This technique works by using a weighted combination of Code and Carrier Phase observations in the final GPS position solution. The relative weights of the two measurements changes with time. When Phase Smoothing is initially turned on, WinFrog utilizes only the Code measurements in the position solution. Based on the calculated C/A Code position, WinFrog then calculates the number of L1 frequency wavelengths between the receiver and each of the satellites and attempts to calculate a position based on these new ranges. Because there are multiple satellites to consider, and the fact that the C/A code position is not usually better than plus or minus 1 meter, there are several possible solutions to each satellite's Carrier Phase count.

Numerous combinations are attempted, until a solution with the best fit of all ranges is obtained. As mentioned above, as long as the satellite's carrier frequency remains in lock, the GPS receiver can observe the incremental or

decremental count in the Carrier Frequency wavelengths. This allows the Carrier solution to remain intact despite the fact that the satellites and the GPS receiver are both moving.

Over time, the smoothing filter begins weighting the Code measurements less and relying more on the Carrier Phase measurements. After a user-definable number of epochs (an epoch can be considered to be approximately equal to 1 second) WinFrog relies almost exclusively on the Carrier Phase measurements.

Because the Carrier Phase solution (i.e. the carrier wavelength counts) are determined only by the C/A Code position, no gain is made in terms of overall positional accuracy. However, because the individual pseudorange observations are now being made to greater accuracy (i.e. fractions of a 19 cm wavelength), positional stability is improved.

This state of improved stability remains intact as long as the GPS receiver is able to maintain lock on the satellites and therefore able to continue to utilize the initial Carrier Phase wavelength count changes. However, if the GPS receiver loses lock on a satellite's Carrier frequency (called a "Cycle Slip"), it must re-calculate the total number of wavelengths to that satellite. The GPS receiver provides this Cycle Slip information to WinFrog. If the number of Cycle Slips exceeds the user-specified tolerance, WinFrog returns to the C/A Code position and re-calculates the number of Carrier Phase wavelengths to each satellite.

To Configure the Phase Smoothing Filter

- With the **Pseudorange Calculation** dialog box still open, select the **Apply Phase Smoothing** box in the **Phase Smoothing** area of the **Pseudorange Calculation** dialog box.
- Enter a value in the **Filter Length** field.

The **Filter Length** value sets the number of epochs (approximately the same as seconds) over which WinFrog switches from a position based on Code measurements to a position based on the Carrier Phase measurements.

For example, if the filter length is set to 25, it takes 25 epochs before the GPS Calcs Module position will rely almost exclusively on the Carrier Phase measurements.

- Enter a value in the **Cycle Slip Tol** field.

The **Cycle Slip** tolerance parameter sets the sensitivity of the **Cycle Slip** detection routine. This routine works by using **Doppler Phase Rates** to predict phase measurements from epoch to epoch. This prediction is compared with the actual measurement. If the difference between the prediction and the actual measurement is greater than the **Cycle Slip tolerance**, then WinFrog assumes that a **Cycle Slip** has occurred and the

smoothing filter is reset. WinFrog's ability to predict phase measurements depends heavily on the vehicle's dynamics. **Note:** in highly dynamic situations, it may be necessary to **increase** the **Cycle Slip Tolerance**.

- 13 In the **Graphics** area of the **Pseudorange Calculation** dialog, select either the **On** radio button or the **Off** radio button.

If **Graphics** are turned **On**, a labeled cross representing the raw (unfiltered) location of the antenna (as calculated by the **GPS Calcs Module**) is plotted in the **Graphics** and **Bird's Eye** windows. This feature allows a comparison of raw versus filtered positions between different sources. This also provides a check of the offset values entered.

- 14 In the **Display** area, select one of the three radio buttons.

This parameter sets which type of information is displayed in the pseudorange device's **Calculation** window. It can be set to one of the following modes:

Results	Displays the Results of the GPS Calculations.
Data	Displays information about Carrier Phase Smoothing.
Statistics	Displays Statistical data. See the Monitoring of Statistical Tests section below for more information.

For more information about the different Pseudorange displays, see the **GPS Calculation Displays** section later in this chapter.

- 15 The **Ref Stns** button is used to configure which DGPS Reference stations will be used to provide **RTCM** corrections to the vehicle's pseudorange position solution. The following sections will detail all steps required to configure WinFrog for DGPS pseudorange positioning.
- 16 The **Alarms** button is used to access the **GPS Alarms** configuration dialog box. More details are found in the **Alarms** section later in this chapter.
- 17 The **Tests** button is used to configure statistical tests. More details are found in the **UKOOA Statistical Testing** section later in this chapter.

Applying RTCM Corrections to WinFrog Pseudorange Position Calculations

WinFrog **Pseudorange Calculations** (i.e. the **GPS Calculations Extension Module**) can solve for a standalone (non-DGPS corrected) position, a single reference station DGPS solution, or a multiple reference station (**Multi-Ref**) DGPS solution.

The previous sections detail the addition and configuration of GPS Pseudorange devices for standalone positioning. The following sections explain how to apply DGPS corrections from a single RTCM source or multiple RTCM sources to WinFrog pseudorange calculations.

To Add RTCM Device(s) to WinFrog

- 1 From the **Configure** menu, choose **I/O Devices... > Add**.
- 2 Choose **RTCM** from the devices list.
- 3 Click **OK**.
- 4 Configure the following serial port communication parameters in the **Comm Data** dialog box:

Name:	should be a unique name for the RTCM correction to distinguish this device from other RTCM devices.
Baud Rate	enter the same value as the RTCM device
Data Bits	enter the same value as the RTCM device
Parity	enter the same value as the RTCM device
Comm Port	selects the operating system's communication port to which the device is connected, (not the Digiboard TM port number, although they may be the same in some cases).

Consult the RTCM device's manual for more information on communication settings for the device.

- 5 Once the communication parameters are set, click **OK**.

If multiple RTCM receivers are used, they must each be interfaced separately, and added to WinFrog individually with a unique identifier (i.e. RTCM1, RTCM2, etc.). In other words, repeat steps 1 through 6 above for each RTCM device.

If a Fugro **SkyFix** receiver is used, it is interfaced to the WinFrog computer as a **single** RTCM device, despite the fact that a single SkyFix receiver can provide RTCM corrections from up to 5 different reference stations in its data string. The individual RTCM **ID**'s are later added to the vehicle's position separately. This concept is explained below.

- 6 From the WinFrog menu bar select **View > I/O Devices**.
- 7 Highlight the appropriate **RTCM** device(s) and ensure that the **SV**, **PRC**, **RRC**, and **IOD** data are updating at regular intervals.

Most RTCM systems should be updating this information approximately every 3-5 seconds.

To Add an RTCM Device to a Vehicle's Device List

The next step is to add the **RTCM** Device(s) to the vehicle's **GPS Calcs Module's** position calculations.

- 1 Ensure that the appropriate vehicle **Name** is displayed in the **Vehicle Text** window. Place the mouse pointer in the **Vehicle Text** window (**View > Vehicle Text**), click on the right mouse button, and select **Configure Vehicle-Devices**.
- 2 Click the **Add** button.
- 3 Select the **RTCM,*,DGPS-COR's** device from the list of **Available Data Items**.
- 4 Click **OK**.

The **RTCM, *,DGPS-COR's** device now appears in the vehicle's **Devices** window.

- 5 Repeat steps 1-4 for each reference station to be used in the position calculations.

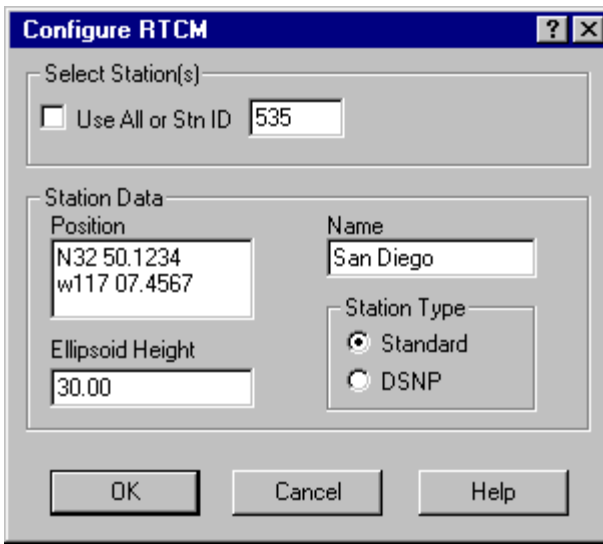
For example, Fugro's SkyFix system sends RTCM corrections for up to 5 reference stations on the same data string. Selecting **Use All** with a SkyFix device removes the ability to control (i.e. add or remove) the RTCM stations individually. It is better to add the SkyFix **RTCM** device to the vehicle's device list multiple times (once for each station used), and configure the **Station Id (Stn ID)** of each RTCM "device" to reference one of the **Codes** in the SkyFix data string. WinFrog allows a maximum number of five RTCM sources to be used in a vehicle's GPS Calcs Module position calculations.

The next step is to configure the RTCM device for use with the **GPS Calculation Extension Module**.

To Configure an RTCM Device in a Vehicle's Device List for use with the GPS Calcs Module

- 1 Ensure that the appropriate vehicle name is displayed in the **Vehicle Text** window. Place the mouse pointer in the **Vehicle Text** window (**View > Vehicle Text**), click on the right mouse button, then select **Configure Vehicle-Devices**.
- 2 Highlight the **RTCM,*,DGPS-COR's** device from the appropriate vehicle's **Devices** list and select the **Edit** button. The **Configure RTCM** dialog box displays, as seen below.

- 3 Enter the appropriate values in the **Configure RTCM** dialog box:



Select Station(s)

Use All

As mentioned above, this setting is not preferred. If the **Use All** box is checked, WinFrog uses all of the reference stations data available with this **RTCM** device.

Stn ID

If the **Use All** box is not checked, WinFrog uses the specific reference station associated with the **ID** entered in this field.

Station Data

Position

Enter the Reference Station's **WGS 84 latitude, longitude, and ellipsoid height**. This information is not used in the weighting of the reference stations in the Multi-Ref calculations. Although the distance to each reference station is, in fact, calculated and displayed in the Calculations window. This is for general information purposes only.

Note: If the RTCM source includes a **Type 3** message (including the station's coordinates), WinFrog will "read" this information and update this entry window accordingly. SkyFix, for example provides this information for each reference station approximately every 2 minutes.

Name

Enter the name of the **Reference Station** used. This will allow you to immediately identify the station if it fails, rather than have to reference the station's code to the location.

Station Type

These options are for future development and are not currently enabled.

- 7 Click **OK** to close the **Configure RTCM** dialog box.

To Enable/Remove an RTCM Source in WinFrog's Pseudorange Calculations

- 1 From the vehicle's **Configure Vehicle-Devices** menu, highlight the **GPS, name, PSEUDORANGE** device and select **Edit**.
- 2 Select the **RefStns** button in the lower right corner of the dialog box. The **Select DGPS Reference Stations** dialog box opens, as seen below.

ID	Off	Use	Monitor	Relative Std. Dev.
500	☐	☒	☐	1
520	☐	☒	☐	1
540	☐	☒	☐	1
550	☐	☒	☐	1
535	☐	☒	☐	1

- 3 There are two ways to enable the DGPS reference stations that have been added to the vehicle's device list.

Use All Available Stations

Select this option to instruct WinFrog to use all of the RTCM Sources that have been added. As mentioned above, this method does not provide you the control over the station selection that you have if you add the stations individually.

Select Individual Stations and Settings

Select this option to select and control which reference stations are used or simply monitored in the **GPS Calcs Module** position calculations.

ID	Enter the individual reference stations' ID in the available windows.
Off	Select this option to turn this station Off in the MultiRef Position calculations.
Use	Select this option to Use this station in the MultiRef Position calculations.
Monitor	Select this option to simply Monitor the position determined by using this Reference Station's RTCM corrections. This DGPS position is not used in the Multi-Ref station solution. Typically, a station's ID is set to Use unless that individual position solution becomes unstable and must be removed (i.e. set to Off or Monitor) from the overall Multi-Ref solution.
Relative Std. Dev.	Enter the Relative Standard Deviation values in the entry windows at the right side of the dialog box (in meters).

By default, each DGPS position calculation is given a standard deviation value of 1 meter. This means that each of the individual positions calculated using the individual reference station corrections are treated equally when combined in the Multi-Ref solution. The weighting is inversely proportional to the number entered. In other words, entering a higher value in this window actually lessens the amount of weight that that position will have in the Multi-Ref solution. For example, entering a standard deviation of 2 will specify that that position will have a weight of ½ compared to the other stations.

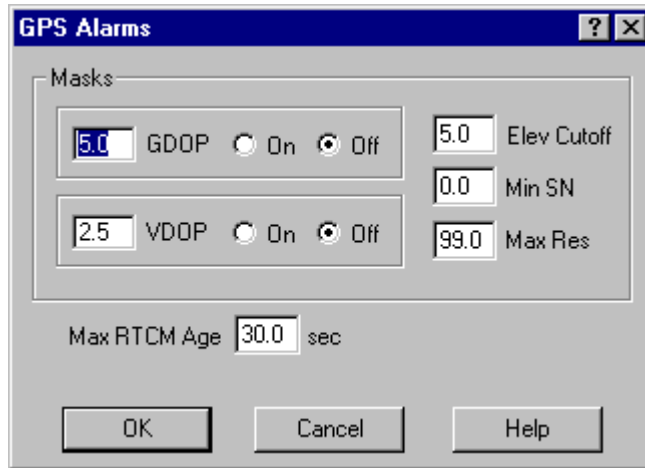
- 4 Click **OK** to close the **Select DGPS Reference Stations** dialog box.

WinFrog should now be calculating a DGPS pseudorange solution. View the individual solutions and the weighted mean position information using the **View > Calculations** window. See the **GPS Calculations Displays** section later in this chapter for details about the data displayed in the **Calculations** window.

Alarms

In addition to these standard configuration parameters, WinFrog can also be used to set various alarms to provide additional control over the GPS pseudorange calculations. Alarms are set to warn of the degradation in the accuracy of a solution.

Select the **Alarms** button in the **Pseudorange Calculation** dialog box. The **GPS Alarms** dialog box appears as seen below.



Dilution of Precision (DOP)

Dilution of Precision (DOP) refers to the strength of the geometry of the visible GPS satellites with respect to the GPS receiver. Using satellites that are clustered together will typically produce a high **DOP** (i.e. a lower accuracy) value while using satellites that are found spread in all quadrants around the GPS receiver will provide a low **DOP** (i.e. high accuracy) value.

The **DOP** can be considered a multiplying factor of the sum of the other errors inherent in GPS positional calculations. An ideal geometry would provide a DOP value of 1. Since there are currently 24 satellites in use, and most GPS receivers are able to utilize between 6 and 12 channels simultaneously, an over-determined solution is sometimes available; in this case the **DOP** value can be less than 1.0.

DOP values are determined for all aspects of a GPS derived position: horizontal, vertical, and time components.

Geometric Dilution of

Precision (GDOP)

combines the horizontal, vertical, and time components

Vertical Dilution of Precision

(VDOP)

this value refers only the dilution to the vertical component of the solution.

Masks

WinFrog can set masks to provide additional control over pseudorange calculations.

Elev (i.e. Elevation) Cutoff

is used to limit the usage of satellite pseudoranges from satellites that are too close to the horizon. Signals sent from satellites near the horizon have longer travel

MinSN (Minimum Signal to Noise) ratio

times through the atmosphere, resulting in lower signal strength and increased (unpredictable) propagation delays.

this value specifies what minimum signal strength value will be accepted. If the satellite's signal is not clearly received by the GPS receiver the coded information may be misinterpreted, resulting in ranging and, subsequently, positioning errors.

Max Res (Maximum Residual)

WinFrog uses the entry made here to decide if a satellite's pseudorange will be used in the position's solution. If the satellite range does not agree with the calculated position by less than the entered value, it will not be included. The **Max Res** value is always entered in meters.

To Configure Alarms

- 1 With the **Pseudorange Calculations** dialog box still open, click the **Alarms** button. (To open the **Pseudorange Calculations** dialog box from the Vehicle's **Configure Vehicle-Devices** dialog box, highlight the **GPS, name, PSEUDORANGE** device and select **Edit**).

The following parameters are configured in the **GPS Alarms** dialog box:

GDOP (Geometric Dilution of Precision)

This parameter is calculated from satellite geometry and gives an indication of the expected accuracy of the 3D position and time components of the final GPS solution. If you select the **On** radio button and the calculated **GDOP** exceeds the value entered in the **Masks** field, WinFrog displays the following warning in the **Calculations** window: **Rejected, GDOP Gating**.

VDOP (Vertical Dilution of Precision)

This parameter is calculated from satellite geometry and gives an indication of the expected accuracy of the vertical component of the GPS position solution. If the **On** radio button is selected and the calculated VDOP exceeds the value entered by the user in the **Masks** field, WinFrog displays the following

Elev Cutoff (Elevation Angle Cutoff)

warning in the **Calculations** window: **DGPS, VDOP Height Fixed**.

In position computations, WinFrog will not use measurements from any satellites with elevation angles below the value entered by the user in the **Elev Cutoff** field. Any satellites that are below the value entered in the **Elev Cutoff** field are indicated by the text changing from black to magenta on the reference station page of the **Data Item Text** view in the **Calculations** window.

Min SN (Minimum Signal to Noise) ratio

Use this to set the minimum signal to noise ratio for the pseudorange calculations. If a satellite's signal to noise ratio falls below the entered value, it is not used in position computation by WinFrog. Satellites not used in the position computation are indicated by the text changing from black to magenta on the reference station page of the **Data Item Text** view in the **Calculations** window.

Max Res (Maximum Measurement Residual)

In its pseudorange position computations, WinFrog will not use any satellite measurement with a residual greater than the value entered in the **Max Res** field. Satellites not used in the position computation due to measurement residuals are indicated by the text changing from black to magenta on the reference station page of the **Data Item Text** view in the **Calculations** window.

Max RTCM (Maximum RTCM Differential Correction Age)

The value entered in the **Max RTCM** field sets the maximum age of real-time differential corrections. If the age of a satellite's corrections exceeds the entered value of the max RTCM age, the **STAT** light in the **Position** portion of the **Calculations** window turns yellow, indicating that the data are not used in the solution. Click the **ACK** button to acknowledge this alarm.

UKOOA Statistical Testing

WinFrog pseudorange calculations include UKOOA statistical testing. This incorporates the basic GPS pseudorange position solution, QC (w-test, F-test), statistical analysis, and testing as detailed in the document, *Guidelines for the use of Differential GPS in Offshore Surveying*, September 1994, Issue #1, UKOOA.

Note: it is not recommended to use UKOOA statistical testing over long DGPS baselines. A DGPS baseline is the distance between the fixed, known DGPS reference station and the vehicle's position.

w-Test

WinFrog's GPS pseudorange calculations combine pseudoranges from numerous satellites to calculate latitude, longitude, and height. In a perfect world, the distance from the calculated position to any of the satellites would be exactly the same as the measured pseudorange distance. However, in reality, a least-squares adjustment must be made to the observed distances to obtain the final position. This adjustment produces "residuals" in the pseudoranges. Residuals are the amount of error that remained after the pseudorange was adjusted to fit the mean solution.

The **w-test** entails normalizing the residuals of a GPS pseudorange solution and testing these against a 99% confidence limit for "outliers". An outlier is a pseudorange residual that falls beyond an acceptable limit. This limit is 2.576 times the standard deviation of the GPS device position. The standard deviation of most survey-grade GPS receivers can be approximated to be approximately 1 meter. If outliers are found, they are removed and the solution is re-executed, excluding that satellite data pertaining to the outlier. If more than one satellite is found to produce a residual outlier, only that satellite with the largest normalized residual is eliminated. This continues until no outliers are present or until the exclusion of any more data would result in insufficient data for a solution (four satellites for 3D and three for 2D). Since the normalized residuals tend towards being equal with reduced redundancy (as the number of satellites used in the solution approaches the minimum required), it is unlikely that WinFrog will ever have to stop the exclusion of data due to insufficient satellites. Nonetheless, WinFrog still checks for this condition.

F-Test

The **F-test** is a check of the **Unit Variance** of the GPS pseudorange solution. This confirms the validity of the model used for the solution and the weighting of the observations used. **Note:** it is only a confirmation check; no data or solution results are "thrown out" based on the results of the test.

The unit variance should be unity. If the unit variance is consistently different

from unity, it indicates that there may be a problem with the stochastic model used, or there is an unmodeled bias in the data.

Calculation Notes for Statistical Testing

It is important to note that although WinFrog solves for position, clock, and velocities and drift, only the **Position** and **Clock** components of the solution are used for the **w-test** and the **F-test**.

The residuals pertaining to the position and clock unknowns are normalized and tested against the 2.576 limit. If any outliers occur, the maximum outlier is flagged and WinFrog then excludes the respective satellite data. This repeats until one of three conditions are met: no outliers are detected, further rejection of data would result in insufficient data for a solution, or five satellites have been excluded.

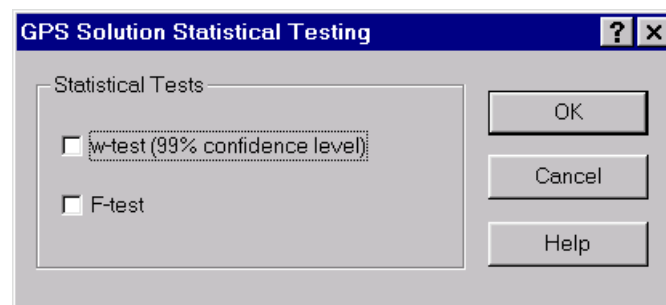
The normalization of the residuals, the determination of the maximum normalized residual, and the computation of the RMS are executed regardless of the w-test mode setting. However, outliers are only rejected if the w-test mode is on. Once the solution is finalized, the F-test is executed if the F-test mode is on.

WinFrog then proceeds with the calculation of the solution's standard deviations and error ellipses, both at the 95% confidence level.

To Configure Statistical Tests

- 1 With the **Pseudorange Calculation** dialog box still open, click the **Tests** button. (To open the **Pseudorange Calculations** dialog box from the **Vehicle's Configure Vehicle Devices** dialog box, highlight the **GPS, name, PSEUDORANGE** device and select **Edit**. See **To Configure a GPS Device for a Vehicle Using GPS Calcs Module** earlier in this chapter.)

The **GPS Solution Statistical Testing** dialog box appears.



By default both the **w-test** and the **F-test** are not enabled.

- 2 Click either the **w-test** (99% confidence level) checkbox, the **F-test** checkbox, both, or neither.
- 3 Click **OK**.

Monitoring of Statistical Tests

To Display the Results of the Statistical Testing

- 1 With the **Pseudorange Calculation** dialog box still open, select the **Statistics** radio button in the **Display** area.

The associated **Calculations** window displays statistical data in the Reference Station page. For more details, refer to the **GPS Calculation Displays** section earlier in this chapter.

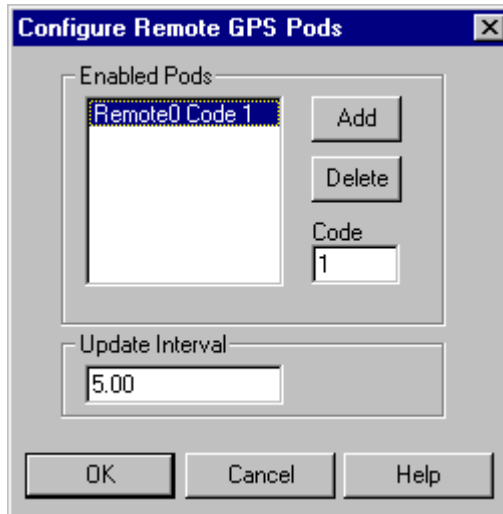
GPS Pod Positioning

WinFrog has the capability to track remote vehicles transmitting GPS pseudorange measurements through a UHF token ring telemetry link. This is done via the use of a Fugro Pelagos GPS “Pod”, which consists of a GPS receiver and a radio transmitter. Raw pseudorange measurements are transmitted from the remote GPS Pod to a radio receiver connected to the WinFrog computer. WinFrog then uses these pseudoranges to calculate a position for the pod in a manner similar to that described previously. RTCM corrections can also be applied to these pseudoranges to determine a DGPS position for the “Pod”.

All **Masks** and **Alarms** that can be used for a local GPS pseudorange device can also be used for a remote GPS Pod.

To Track a GPS Pod in WinFrog

- 1 Select **View > I/O Devices**.
- 2 With the mouse pointer in the left (white) portion of the **I/O Devices** dialog box, right-click and choose **Add Device**.
- 3 Click the “+” symbol beside the **GPS** category and select **GPS Pod**.
- 4 Click **OK**.
- 5 Configure the **Device I/O Parameters** dialog box to suit the telemetry device’s current configuration. Be sure to include the GPS Pod’s **Baud Rate**, **Data Bits**, **Stop Bits**, **Parity**, and **Communication Port Number**, along with a **Name** for the pod.



- 6 Click **OK** to close this dialog box and save the changes.
- 7 In the **I/O Devices** window select the **GPS Pod** device, then right-click and select **Configure Device** from the options presented. The **Configure Remote GPS Pods** dialog box displays.
- 8 Select the **Add** button in the **Configure Remote GPS Pods** dialog box. A **Remote** is added to the **Enabled Pods** list.
- 9 The **Remote Unit Code** number must be entered. Each GPS Pod must have a unique **Remote Code** (also referred to as a **Remote Unit ID**) associated with it. This number must match the binary number configured on the GPS Pod's internal DIP switches.

Note: the **Code** cannot be zero as this is reserved for local (non-telemetry) GPS units.

- 10 Highlight the value in the **Code** entry window, then enter the **Code** as per above. Now click on the **Remote** (as found in the **Enabled Pods** portion of the window) to update the newly entered code value.
- 11 The **Update Interval** must be entered. This value should reflect realistic requirements and also the capabilities of the telemetry network. A value of **5.00** seconds is typically more than adequate.
- 12 Repeat steps 7-10 to add additional pods found in the **Token Ring Network**.
- 13 Click on **OK** to close this dialog box and save the changes.
- 14 Ensure that the data from the pod(s) are updating regularly in the **Decoded Data** portion of this dialog box. The **Decoded Data** window shows the time since the **Last Range Record**, **Last Ephemeris Record**, and **Last Almanac Record** were received. It is important to ensure that all three of these fields are updating. **Ephemeris** and **Almanac** data update intervals may extend to

tens of minutes, whereas **Range** information should be updating with each telemetry update received.

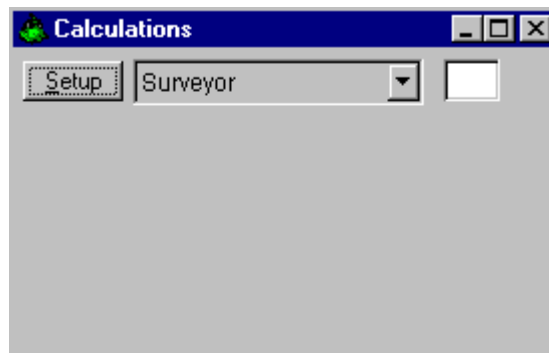
- 15 Select the main menu item **View > Vehicle Text**. Ensure that the correct vehicle name is shown and, with the mouse pointer within the limits of the **Vehicle Text** window, click the right mouse button and select the **Configure Vehicle - Devices** option.
- 16 Click the **Add** button found beside this vehicle's device list.
- 17 Select the **GPS,*pod*,PSEUDORANGE** device from the list of **Available Data Items**.
- 18 Click **OK**. The GPS Pod is now added to the vehicle's calculations.
- 19 Select the just added **GPS,*pod*,PSEUDORANGE** device from the **Devices** list.
- 20 Click the **Edit** button to display the **Pseudorange Calculation** dialog box.
- 21 Enter the appropriate **Code** for the GPS Pod that will be used to position this vehicle.
- 22 Configure the other **Pseudorange Calculation** dialog box options as per the previous section.

GPS Calculation Displays

After a pseudorange device has been added to a vehicle's calculations, WinFrog can display information pertinent to the pseudorange positioning calculations. This information is displayed in the **Calculations** window.

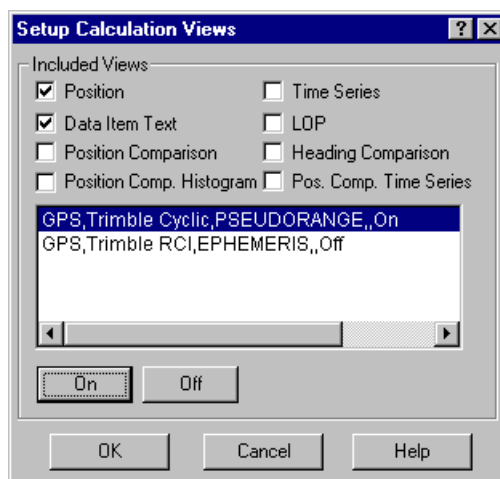
To View Pseudorange Calculation Data

- 1 From the **View** menu, choose **Calculations**.



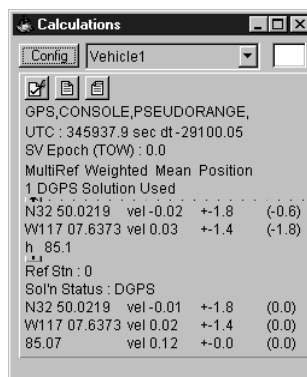
- 2 Select the desired vehicle from the dropdown list at the top of the **Calculations** window.

- Click the **Setup** button. The **Setup Calculation Views** dialog box opens.



- Select the **GPS,*,PSEUDORANGE** device.
- Click the **On** button.
- In the **Included Views** area, select **Data Item Text**. (You can also select **Position**, but this is optional.)
- Click **OK**.

The **Calculations** window opens to display a summary of the Multi-Ref Position solution. (Shown below without the **Position** option enabled).



The **Calculations** window contains several pages of pseudorange calculations information; click the  button (the third button of the three small buttons presented in this section of the **Calculations** window) to scroll between pages:

Multi-Ref Summary page

This opening page displays a summary of this vehicle's Multi-Ref Pseudorange position solution. See the **Multi-Ref Summary** section immediately below for details.

Reference Station page(s)

These pages display information concerning a specific reference station. There is one page for each reference station used. In addition, three different types of information can be displayed in one of these windows, depending on the radio button selected in the **Display** area of the **Pseudorange Calculation** dialog box:

Results

Data

Statistics

Note: if there are no RTCM Differential GPS corrections available, or the **Off** radio button is selected in the **DGPS Mode** area of the **Pseudorange Calculation** dialog box, there will be no reference station pages in the **Calculations** dialog box, only the general page.

Multi-Ref Summary Page

The **Multi-Ref Summary** page contains information pertaining to the individual solutions that are used to generate a Multi-Ref position. The following information is displayed:

- UTC
- Satellite Time of Week
- Status of the Multiple Reference Station solution.
(See the section entitled Multiple RTCM Solutions for more information.)
- The number of DGPS solutions used in the Multi-Ref position calculations
- The Position and Velocities of the Multi-Ref solution
- Ellipsoid Height (in meters)
- If enabled, the results of the w-test and F-test are also displayed. (See the previous section entitled UKOAA Statistical Testing for more information.)

In addition, the following information is displayed for each Reference Station:

- Reference Station ID and Name.
- Status of the solution. (i.e. the status of the DGPS solution for the given Reference Station)
- Vehicle Position and Velocity as computed from the reference station.
- Difference between this individual solution and the combined (Multi-Ref) solution in meters. This value is given in the brackets ().

Individual Reference Station Display Page(s)

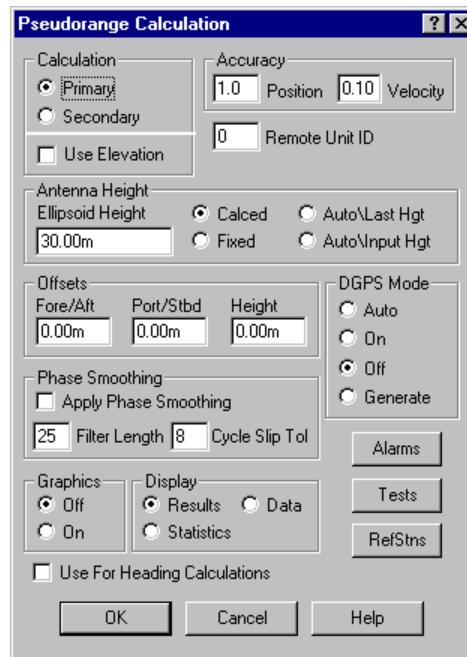
In addition to the Multi-Ref Summary page, WinFrog also provides a page of information for each individual DGPS Reference Station solution (to toggle through the available pages, click on the page button). This allows you to examine various details of each individual DGPS solution, depending on which option has been selected in the **Display** area of the **Pseudorange Calculation** dialog box: **Results**, **Data**, or **Statistics**.

Pseudorange Calculation Results Page

As the name implies, selecting the **Results** option will display information regarding the results of an individual station's pseudorange position calculations.

To Display Pseudorange Calculation Results in the Calculations Dialog Box

- 1 In the **Calculations** window, click the left most of the three **Data Item Text** option buttons to shortcut to the vehicle's **Pseudorange Calculation** dialog box.



- 2 Select the **Results** radio button in the **Display** area.
- 3 Click **OK** to close this dialog box and save the selection.
- 4 Click the right most “page” button of the three **Data Item Text** buttons in the **Calculations** dialog box to scroll from the Multi-Ref Summary page. The **Results** data for an individual solution will show in the **Calculations** dialog box similar to the display seen below. The top area repeats the **Summary** information mentioned above.

SV	Res	Cor'n	Age	EI	S/N	H	IOD
18	0.1	-26.0	7.1	72	37	1	D4
14	0.7	28.8	4.7	26	35	1	EC
22	-0.4	28.5	4.7	16	27	1	27
19	0.2	34.1	7.1	53	39	1	2D
03	0.6	-35.9	4.7	23	31	1	32
31	-0.7	49.1	8.9	22	33	1	CB
16	-0.5	-15.8	7.1	51	39	1	EE
00	0.0	0.0	0.0	00	00		
00	0.0	0.0	0.0	00	00		
00	0.0	0.0	0.0	00	00		
00	0.0	0.0	0.0	00	00		
00	0.0	0.0	0.0	00	00		
00	0.0	0.0	0.0	00	00		

N32 50.0215 vel 0.03 (0.00)
 W117 07.6372 vel 0.04 (0.00)
 h 92.8m vel 0.11 (0.00)
 GDOP 3.63 HDOP 1.48 VDOP 2.75
 Bias 146.58 Drift -0.26

Top Area

- Name of Pseudorange device.
- QC Results for w-test and F-test. (See the UKOAA Statistical Testing section earlier in this chapter for more information).
- Satellite Time of Week.
- Reference Station ID Number and Name.
- Status of the Multiple Reference Station solution. See the section entitled Multiple RTCM Solutions for more information.
- The number of DGPS solutions used in the Multi-Ref solution.

Column Area

SV

Satellite PRN

Res

(Satellite Pseudorange Residual) If this value exceeds the maximum residual entered in the **GPS Alarms** dialog box, the text changes from black to magenta.

Cor'n

Correction to the raw pseudorange (as received from this DGPS reference station). If no RTCM corrections are available, then all values will be zero.

Age

Age of RTCM corrections. If the DGPS mode is set to **On** and the **Age** exceeds the **Maximum RTCM Correction Age** entered in the **GPS Alarms** dialog box, the text changes from black to magenta.

EI		(Elevation angle of satellite) If the satellite drops below the Elev Cutoff angle entered in the GPS Alarms dialog box, the text changes from black to magenta.
S/N		(Signal to Noise ratio) If this value exceeds the Minimum Signal to Noise value entered in the GPS Alarms dialog box, the text changes from black to magenta.
H		(Satellite Health Status)
	1	SV healthy, valid ephemeris, DGPS differential corrections available, DGPS solution.
	G	SV healthy, valid ephemeris, no differential corrections available, single point GPS solution.
	N	SV healthy, valid ephemeris, no differential corrections available, DGPS solution.
	E	Valid ephemeris not available (usually displayed when the receiver has just locked onto a satellite).
	L	Satellite is below elevation cutoff.
	H	SV is unhealthy.
	S	SV SNR is below the minimum limit.
	w	satellite observation determined to be an outlier. (See the UKOAA Statistical Testing section earlier in this chapter for details.)
IOD		(Issue of Data) This is a hexadecimal representation of the code transmitted with the ephemeris to be used to match satellite data, i.e. differential corrections computed using the same ephemeris at the reference station as being used at the remote. If the IOD for a calculated range correction does not match that of the satellite at the remote site, the correction is not applied. Type 2 RTCM messages are employed to provide a transition when new ephemeris are downloaded (usually at the top of the even UTC hour).

Bottom Area

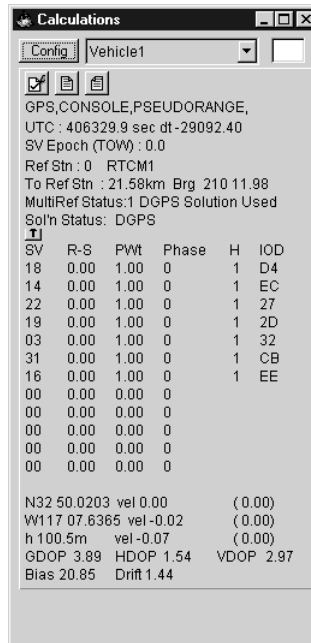
- Vehicle Position and Velocity as computed using this reference station data.
- Difference between the individual solution and the combined solution in meters. This value is given in the brackets ().
- GDOP, HDOP, and VDOP values.
- Clock Bias and Drift

Pseudorange Calculation Data Page

When the **Data** option is selected in the **Display** area of the **Pseudorange Calculations** dialog box, the individual **Pseudorange Calculation** pages display information pertinent to **Phase Smoothing**. See the **Phase Smoothing of Pseudorange Measurements** section earlier in this chapter for more information on configuring **Phase Smoothing**.

To Display Pseudorange Calculation Data in the Calculations Dialog Box

- 1 In the **Calculations** window, click the left most of the three **Data Item Text** option buttons to shortcut to the vehicle's **Pseudorange Calculation** dialog box.
- 2 Select the **Data** radio button in the **Display** area.
- 3 Click **OK**.
- 4 Click the right most "page" button of the three **Data Item Text** buttons in the **Calculations** dialog box to scroll from the Multi-Ref Summary page. The data for an individual solution will appear in the **Calculations** dialog box similar to the display seen below. The top area repeats the **Summary** information mentioned above.



The following details the information displayed in the **Calculations** dialog box when the Data option has been selected.

Top Area

- Name of Pseudorange device.
- QC Results for w-test and F-test. See the section entitled UKOAA Statistical Testing for more information.
- Satellite Time of Week.
- Reference ID Number and Name.
- Status of the Multiple Reference Station solution. See the section entitled Multiple RTCM Solutions or more information.
- The number of differential solutions used.

Column Area

SV

Satellite PRN

R-S

the difference between the **Raw** pseudorange and the **Smoothed** pseudorange in meters.

PWt

the **weighting** for the pseudorange measurements. When **Phase Smoothing** is turned on, as the number of sequential phase observations for a given satellite increases, the weight given to the phase observations increases, and the weight given to the raw pseudorange observations

decreases. The value in this column is the weighting applied to the **Raw Pseudorange**. One minus this value gives the weight applied to the phase observation. The minimum weight that WinFrog will give to pseudoranges is 0.01.

Note: if there is loss of lock on a given satellite, the **PWt** value will reset to one and restart the **Phase Smoothing** for that satellite.

Phase		number of epochs since last filter reset
H		Satellite Health/Status:
	1	SV healthy, valid ephemeris, DGPS differential corrections available, DGPS solution.
	G	SV healthy, valid ephemeris, no differential corrections available, single point GPS solution.
	N	SV healthy, valid ephemeris, no differential corrections available, DGPS solution.
	E	valid ephemeris not available (usually displayed when the receiver has just locked onto a satellite).
	L	Satellite is below elevation cutoff.
	H	SV is unhealthy.
	S	SV SNR is below the minimum limit.
	w	satellite observation determined to be an outlier. See the UKOAA Statistical Testing section earlier in this chapter for more information.
IOD		(Issue of Data) This is a hexadecimal representation of the code transmitted with the ephemeris to be used to match satellite data,(i.e. differential corrections computed using the same ephemeris at the reference station as being used at the remote). If the IOD for a correction does not match that of the satellite at the remote site, the correction is not applied. Type 2 RTCM messages are employed to provide a

transition when new ephemeris are downloaded (usually at the top of the even UTC hour).

Bottom Area

- Vehicle position and velocity as computed from the reference station.
- Difference between the individual solution and the combined Multi-Ref solution in meters. This value is given in the brackets ().
- GDOP, HDOP, and VDOP.
- Clock Bias and Drift.

Pseudorange Calculation Statistics Page

When the **Statistics** option is selected in the **Display** area of the **Pseudorange Calculations** dialog box, the individual **Pseudorange Calculation** pages display information pertinent to the **w-test** and the **F-test**. See the **w-test** and **F-test** sections earlier in this chapter for more information.

To Display Pseudorange Calculation Statistics in the Calculations Dialog Box

- 1 In the **Calculations** window, click the left most of the three **Data Item Text** option buttons to shortcut to the vehicle's **Pseudorange Calculation** dialog box.
- 2 Select the **Statistics** radio button in the **Display** area.
- 3 Click **OK**.
- 4 Click the right most "page" button of the three **Data Item Text** buttons in the **Calculations** dialog box to scroll from the Multi-Ref Summary page. The **Statistics** data for an individual solution will appear in the **Calculations** dialog box similar to the display seen below. The top area repeats the **Summary** information mentioned above.

Calculations					
GPS, CONSOLE, PSEUDORANGE,					
UTC : 406471.9 sec dt-29092.38					
SV Epoch (TOW) : 0.0					
Ref Stn : 0 RTCM1					
To Ref Stn : 21.59km Brg 210 11.51					
MultiRef Status: 1 DGPS Solution Used					
Sol'n Status: DGPS					
SV	Sd	RVar	NRR	Marge	H
18	0.41	3.28	-0.21		1
14	0.43	3.89	-0.58		1
22	9.00	4.48	0.49		1
19	0.31	3.38	-0.28		1
03	0.67	4.03	-0.40		1
31	0.65	4.11	0.35		1
16	0.36	3.38	0.58		1
00	0.00	0.00	0.00		
00	0.00	0.00	0.00		
00	0.00	0.00	0.00		
00	0.00	0.00	0.00		
00	0.00	0.00	0.00		
Std DevError Ellipse @ 95% Confidence					
dLat: 2.90m		Ellip: 5.37m		GDOP 3.7	
dLon: 4.90m		Ellip: 3.52m		PDOP 3.2	
dAlt: 0.00m		Ellip: 99.00		HDOP 1.5	
				VDOP 2.8	
Redundancy: 3		Unit Variance: 0.00			
Max Corr'n Age: 9.1		Residual RMS: 0.57			
Bias 141.84		Drift 1.07			

Top Area

- Name of Pseudorange device.
- QC Results for w-Test and F-Test.
(See the UKOAA Statistical Testing section above for more information.)
- Satellite Time of Week.
- Reference ID Number and Name.
- Status of the Multiple Reference Station solution. See the section entitled Multiple RTCM Solutions for more information.
- The number of Differential solutions used in the Multi_Ref position.

Column Area

SV	Satellite PRN
Sd	Satellite pseudorange standard deviation (in meters) computed by WinFrog's pseudorange algorithms
RVar	Pseudorange variance (in meters) as determined by WinFrog calculations
NRR	Normalized Pseudorange Residuals
Marge	For future development, will display the Marginally Detectable Errors of the pseudorange.

H		Satellite Health/Status:
	1	SV healthy, valid ephemeris, DGPS differential corrections available, DGPS solution
	G	SV healthy, valid ephemeris, no differential corrections available, single point GPS solution.
	N	SV healthy, valid ephemeris, no differential corrections available, DGPS solution.
	E	ephemeris not available (usually displayed when the receiver has just locked onto a satellite).
	L	satellite is below elevation cutoff.
	H	SV is unhealthy.
	S	SV SNR is below the minimum limit.
	w	satellite observation determined to be an outlier. See the UKOAA Statistical Testing section earlier in this chapter for more information.
IOD		(Issue of Data) This is a hexadecimal representation of the code transmitted with the ephemeris to be used to match satellite data, (i.e. differential corrections computed using the same ephemeris at the reference station as being used at the remote). If the IOD for a correction does not match that of the satellite at the remote site, the correction is not applied. Type 2 RTCM messages are employed to provide a transition when new ephemeris are downloaded (usually at the top of the even UTC hour).

Bottom Area

- Standard Deviations for Latitude (dLat), Longitude (dLon) and Height (dAlt) at the 68% confidence level
- 95% Confidence Error Ellipse semi-major axis (Ella), semi-minor axis (Ellb) and the orientation of the semi-major axis (Ellt)
- The GDOP, PDOP, HDOP and VDOP values, color-coded based on use of alarm limits as on previous displays
- Solution Redundancy = Number of Observations (Pseudorange

- Measurements) Used - Number of Unknowns (4 for 3D, 3 for 2D)
- Unit Variance computed from the Pseudorange residuals
- Maximum Age of all DGPS Corrections used in the solution
- Residual RMS for the solution
- Clock Bias and Drift

Reference Station Integrity Monitoring (RSIM) Features

Most GPS companies manufacture hardware that can be used to generate RTCM format DGPS corrections from a reference station set up at a point of known coordinates. These corrections can then be applied to pseudorange measurements at mobile stations to produce accurate real-time DGPS positions. Unfortunately, most GPS differential hardware manufacturers include little or no quality assurance information with these corrections, which could potentially result in inaccurate results at the mobile stations. WinFrog features an innovative and efficient approach for QA of the pseudorange corrections that takes advantage of a dual reference station configuration. This is called **Reference Station Integrity Monitoring (RSIM)**.

WinFrog has the capability to provide **real-time RSIM**. When this feature is used, WinFrog takes RTCM corrections from a reference source and performs quality assurance calculations to produce a quantifiable error estimate as to the accuracy of the differential position. WinFrog then broadcasts the error estimate information along with the RTCM corrections. A mobile WinFrog system can then be configured to inform the user of a problem with the RTCM corrections if the error exceeds a set tolerance. With this additional integrity information, the mobile user can monitor the quality of the corrections, allowing for accurate real-time differential GPS with quality assurance.

WinFrog allows for a great deal of flexibility in RSIM setup and allows for various configurations of Reference Stations and Integrity Monitors. For example, WinFrog can be configured to operate as a DGPS Reference Station and as an RTCM Integrity Monitor station at the same time. This setup can be used to provide a redundant RSIM Base Station or provide a network of two or more RSIM Base Stations. (**Note:** the terms Base Station and Reference Station are used interchangeably in this document).

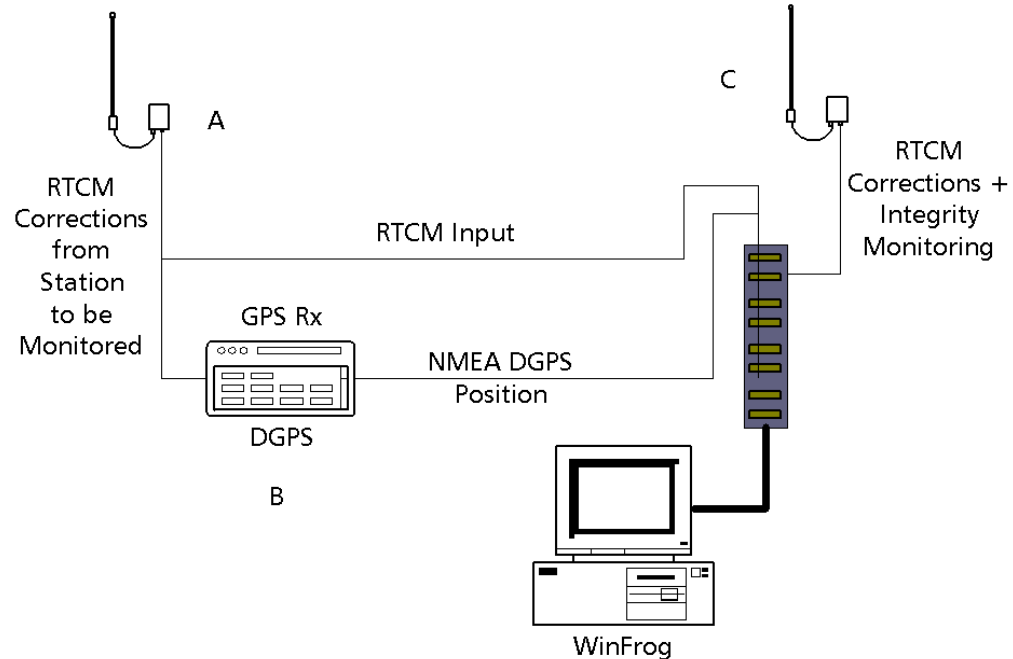
The next section discusses the features of WinFrog's RSIM and is divided into two parts: the **Reference Station** and the **Remote Station**.

Reference Station Configurations

Three types of **RSIM** setups will be discussed in this section: **Single**, **Redundant**, and **Multiple** Reference Stations.

Single Reference Station

The graphic below is a schematic drawing of a **Single Reference Station** approach where one DGPS position source is used by WinFrog to develop RSIM message data.



As shown above, a single base station RSIM system requires three main components:

A An RTCM Source

There are 3 options for acquiring RTCM corrections:

- 1) Set up a survey grade GPS receiver over a known point and generate RTCM corrections using the factory configured algorithms. These corrections could be interfaced to WinFrog via a radio telemetry link, modems connected to dedicated phone lines, or even wired directly to WinFrog if the receiver is physically close enough.
- 2) Use RTCM corrections received from an external source, such as the U.S. Coast Guard, Fugro SkyFix, or any one of several commercially available sources.
- 3) Use a GPS receiver (with the antenna over a point of known coordinates) that is able to provide pseudorange and ephemeris data to WinFrog. WinFrog's GPS Calculations Extension Module could then be used to calculate positions, compare them to the known coordinates, and generate DGPS corrections which could then be re-inserted into another WinFrog I/O port as RTCM corrections.

- B A GPS Receiver set up over a known point**, near enough to the WinFrog RSIM computer to allow a direct connection between the two. This receiver must be configured to either:
- 1) Receive and apply the RTCM corrections to produce a DGPS corrected position, which is output to WinFrog.
 - 2) Output raw pseudoranges and ephemeris data to WinFrog. In this case, WinFrog's GPS Calculations Extension Module would then add the RTCM correction from device **A** to internally calculate a DGPS-corrected position for monitoring purposes.
- C An RTCM Output Device** capable of transmitting the RTCM format corrections and the integrity message to the mobile receivers. This could be a radio telemetry system or perhaps modems connected to dedicated phone lines.

The **Single Base Station RSIM system** works as follows:

- 1 RTCM corrections are received from source **A** (figure above).
- 2 These are used by GPS receiver **B**, or internally by WinFrog's GPS Calcs Module to produce a corrected position.
- 3 WinFrog compares this position to the known station position and calculates delta latitude, delta longitude, and delta height values.
- 4 WinFrog formats and broadcasts the deltas as **Type 16 RTCM** messages. WinFrog also transmits **Type 1** RTCM pseudorange corrections at the same time.
- 5 The **Type 1** data are received and applied at the mobile stations, be it to an external GPS receiver or to WinFrog using the GPS Calcs Module. The RTCM receiver must also be configured to provide at least the **Type 16** RTCM data to the mobile WinFrog system. This will provide the mobile WinFrog system with the delta position data required by the Integrity Monitoring routine.

Single Reference Station Component Configuration

A single Reference Station RSIM requires configuring the three components **A**, **B**, and **C** outlined above. For the sake of simplicity, in the sections below **Component B** is an external GPS receiver configured to input RTCM corrections and output a DGPS position to WinFrog. (See the sections above for further details on setting up WinFrog's GPS Calcs Module if an internal GPS device is to be used.)

Component A: RTCM Source

The **RTCM** source must be able to provide correct data on a consistent basis. The data must be of a recognized **RTCM** format message type, specifically the **RTCM Type 1** (along with the required **Type 2**), or **Type 9**. Ensure that all communications parameters are set the same on both **Component A** and WinFrog.

Component B: DGPS Positioning

The GPS receiver used for **RSIM** must be configured to input **RTCM** corrections from **A** and output a DGPS corrected position.

To Configure a GPS Receiver for DGPS Positioning

- 1 Use a serial **Y** cable to split the RTCM corrections from **Component A** so that it can be connected to both the GPS receiver input and to WinFrog at the same time.

If WinFrog's GPS Calculations Extension Module is being used to generate the Monitor Position (instead of an external GPS receiver), only a single RTCM output is required from the RTCM device.

- 2 Configure the GPS receiver to input and apply the RTCM corrections and subsequently output a DGPS corrected position to WinFrog.

Consult the GPS receiver manual for more information on setting up for real-time DGPS operations.

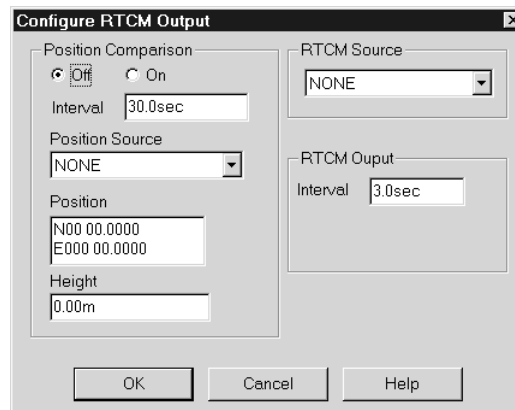
- 3 Connect the DGPS Position Output to a WinFrog communication port.
- 4 Add the appropriate GPS device to WinFrog (From the **Configure** menu, choose **Devices > Add...**).
- 5 Select **GPS**.
- 6 Click **OK**.
- 7 Select the appropriate GPS device. Typically this would be the **NMEAGPS** device.
- 8 Click **OK**.
- 9 Configure the communications parameters in the **Device I/O Parameters**.
- 10 View the data being received from the GPS device to ensure that the position being received is a DGPS position (i.e. its **Status** is 2).

Component C

Component C is the RTCM Output device. As mentioned above, this could be a radio transmitter or perhaps a modem connected to a dedicated phone line. In order for output of RTCM/ RSIM data via the computer's serial port ensure that all communications parameters are set the same on both **Component C** and WinFrog.

To Configure RTCM Output

- 1 From WinFrog's **Configure** menu, choose **I/O Devices > Add...**
- 2 Click on the "+" beside **OUTPUT**.
- 3 Highlight the option **RTCM-104**.
- 4 Click **OK**.
- 5 Configure the communication parameters to match those of the device that will be used to transmit the RTCM data. Note which serial port is selected.
- 6 Click **OK**.
- 7 Connect the transmitting device to the above chosen serial port.
- 8 In the **I/O Devices** window, highlight the **RTCM-104 Output** device.
- 9 Click the right mouse button, then select the **Configure Device** option.



- 10 In the **Position Comparison** area of the **Configure RTCM Output** dialog box, select the **On** radio button.
- 11 Set the **Position Comparison Interval**.

This value determines how frequently WinFrog computes and outputs delta latitude, longitude, and height information. These delta values are formatted and output as a **Type 16 RTCM** message to form the **RSIM** message.

Note: the data transmitting device may encounter problems if this interval is

made too small. It is suggested to leave the value at the default of 30 seconds.

- 12 From the **Position Source** dropdown menu, select a source.

This will be the GPS device that provides the monitor station with its DGPS corrected position (i.e. Device **B**).

- 13 Highlight and enter the known latitude and longitude in the **Position** entry field.

Note: the coordinates may be in either degrees-minutes-seconds (ddd mm ss.sss or degrees-minutes-decimal minutes (ddd mm.mmmm) format.

- 14 Enter the ellipsoidal height in the **Height** field.

Note: this is ellipsoidal height, not mean sea level height. Also, this entry is for the ellipsoid height of the GPS antenna, not the control point over which the antenna is set up.

- 15 From the **RTCM Source** dropdown menu, select a source. This is the name of the RTCM input device (i.e. Device **A**).

- 16 Click **OK**.

At this point **RSIM** is enabled and is including integrity monitoring information in the RTCM messages output to Device **C**.

Redundant Reference Stations

A single WinFrog system can be used as both a **Reference Station** and an **Integrity Monitoring Station** at the same time. This provides the mobile stations with the benefit of RSIM as well as redundancy in RTCM sources.

At this time, this configuration works only with a NovAtel GPS card installed in the WinFrog computer. The NovAtel GPS card console device can be configured to output both pseudorange and ephemeris information as well as self-generated RTCM corrections based on an entered reference position. A cable must be connected from the NovAtel GPS card comm port to the appropriate WinFrog (i.e. DigiboardTM) comm port in order for WinFrog to be able to receive the RTCM corrections from the NovAtel card. The pseudorange and ephemeris information are transferred from the NovAtel card to WinFrog directly through the PC bus.

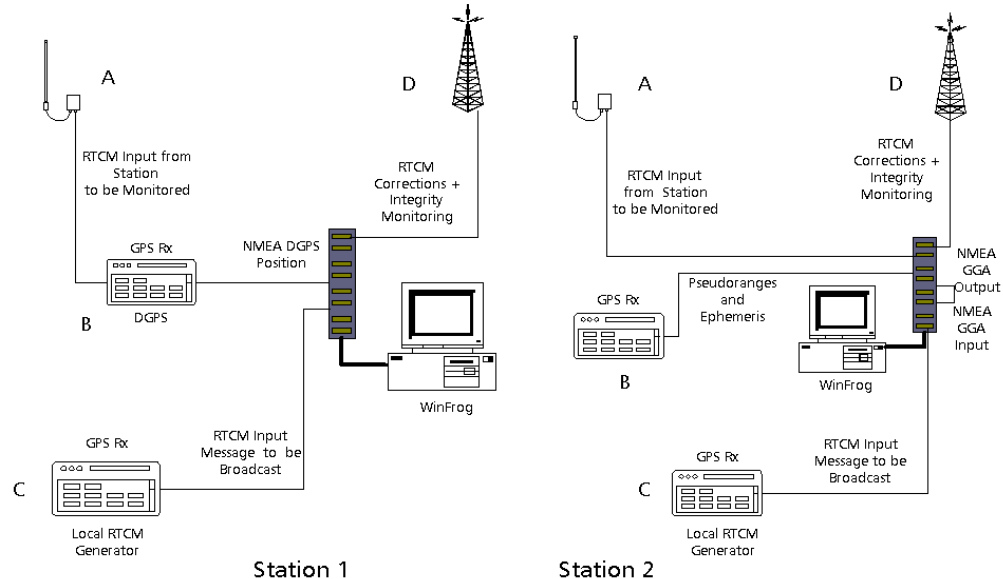
WinFrog's GPS Calcs Module applies these NovAtel-generated RTCM corrections (or the externally generated RTCM corrections) to the NovAtel provided pseudorange and ephemeris information to calculate a DGPS position.

The **RTCM Output** device can then be configured to use this DGPS NovAtel pseudorange position as the **Position** source, and either the NovAtel RTCM or the external RTCM source as the **RTCM** source.

Multiple Reference Stations

With the proper equipment, you can setup a network of two or more Base Stations, each generating RTCM and RSIM information. This system also provides the RTCM redundancy mentioned in the previous section.

Below is a schematic drawing for two stations providing RSIM.



Station 1: DGPS position computed by GPS receiver

Station 2: Pseudorange position calculated by WinFrog

A multiple Base Station configuration requires five components at each site:

- Two GPS receivers set up over known points (both close enough to allow for direct interfacing to the WinFrog computer).

Note: these are labeled as components **B** and **C** in the diagram.

- A WinFrog system
- A Transmitter for the transmission of the RTCM corrections and RSIM information. This communications link can be a direct cable connection or an RF link.

Note: this is labeled as component **D** in the diagram.

- A Receiver for reception of RTCM corrections and RSIM information.

Note: this is labeled as component **A** in the diagram.

The system works as follows:

- 1 RTCM corrections are generated by GPS receiver **C** at **Station 1**.

- 2 These corrections, along with RSIM data from GPS receiver **B** at **Station 1**, are transmitted via the communication link **D** at **Station 1** to **A** at **Station 2**.
- 3 The RTCM messages are received by telemetry device **A** at **Station 2** and sent to **Station 2** WinFrog.
- 4 The **Type 16** RSIM message is read by the **Station 2** WinFrog and an alarm is sounded, if required. The RTCM corrections are applied within WinFrog to the raw pseudorange measurements from the GPS receiver **B** at **Station 2** to calculate a corrected position at that site.
- 5 WinFrog's **RSIM** compares this position with the station's known coordinates and computes delta latitude, longitude, and height.
- 6 This RSIM information is formatted into a special case of the Type 16 RTCM message and output along with the RTCM corrections from local GPS receiver **C** at **Station 2**.
- 7 This information is then broadcast by transmitter **D** at **Station 2**.

These processes are occurring simultaneously in the opposite direction. RTCM messages generated by the GPS receiver **C** at **Station 2** are received by telemetry device **A** at **Station 1** and input into WinFrog and the GPS receiver **B** at **Station 1**. The Type 16 RSIM message is read by the **Station 2** WinFrog and an alarm is sounded, if required. These RTCM corrections are applied to the raw pseudoranges from **Station 1** to calculate a corrected position. This position is then output to WinFrog at **Station 1** where the RSIM calculates Delta latitude, longitude, and height. **Station 1** WinFrog then outputs the RSIM message as a Type 16 RTCM message along with the RTCM corrections from the local RTCM generator **C** at **Station 1**. This information is then broadcast by transmitter **D** at **Station 1**.

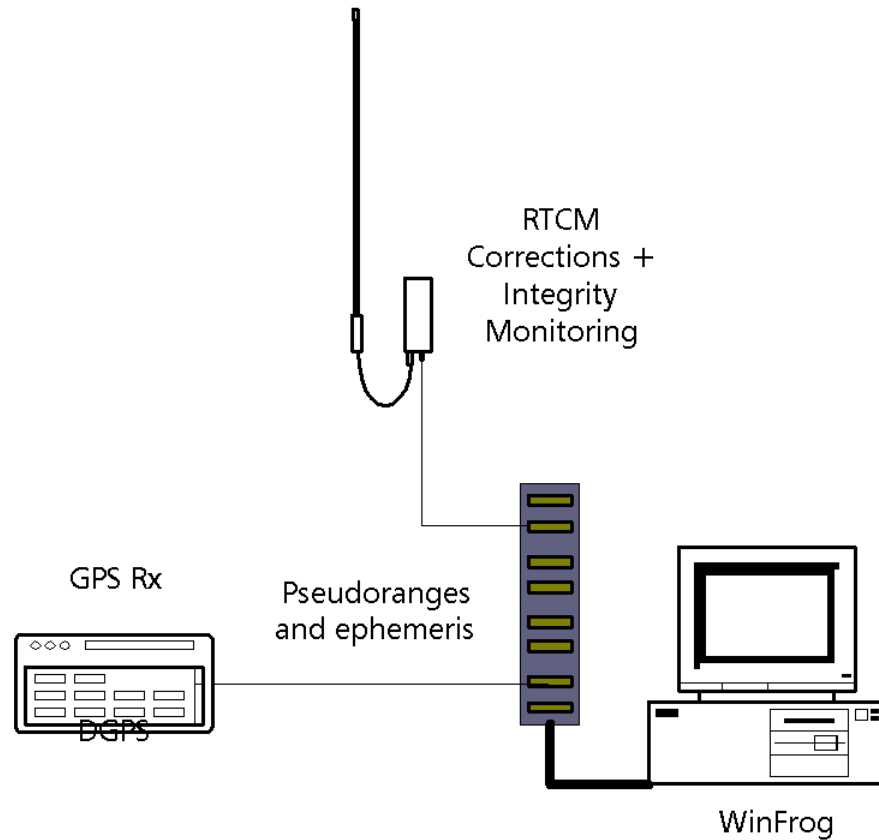
Use of RSIM at the Remote Station

When WinFrog broadcasts RTCM format data containing RSIM and DGPS corrections data, all WinFrog Remote Stations capable of receiving the transmission will be able to access the integrity monitoring information. This provides the Remote Stations with a quantifiable error associated with the given corrections and the ability to sound an alarm to notify the user when the error exceeds a set tolerance. If multiple RTCM correction (and hence RSIM) sources are used, a tolerance can be configured for each source.

Note: it is not necessary for the **Remote Station** to be calculating its own position to be able to monitor the RSIM positional accuracy information. In other words, a computer could be set up to simply observe the RSIM information. However, typically, the **Remote Station** is applying the RTCM pseudorange corrections at the same time as it is monitoring the RSIM data.

The following section describes only those steps required to setup **Remote RSIM Monitoring**. See the paragraphs above for setting up a remote station for pseudorange calculations.

The physical setup for RSIM information at the **Remote Station** is shown in the schematic below.



The system works as follows:

The **Remote WinFrog** system receives RTCM corrections along with RSIM integrity information from the **Reference Station**. (This is typically accomplished via a radio telemetry link.) Simultaneously, GPS measurements in the form of raw pseudoranges and satellite ephemeris are being output from the Remote GPS receiver to WinFrog. WinFrog takes the raw pseudorange measurements and applies the RTCM corrections to calculate a DGPS-corrected position.

When the remote WinFrog system receives a RSIM message, the deltas are combined and compared with a configurable tolerance level. If the RSIM positional error exceeds the tolerance, WinFrog changes the status light in the **Calculations** window to red and sounds an alarm. (This occurs only if the **Calculations** window is open and correctly configured.) Click the **Ack** button in the **Calculations** window to silence the alarm.

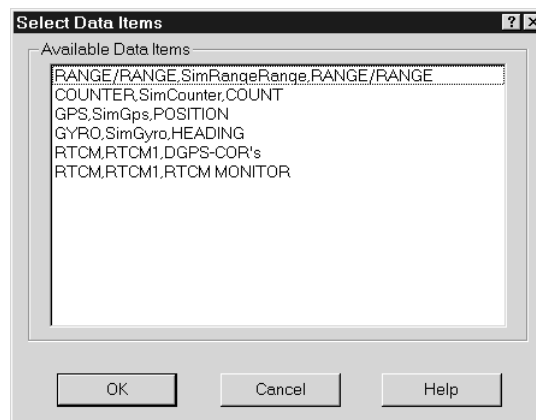
To Configure a Remote Station to Use RTCM/ RSIM Data

- 1 Connect the RTCM radio input to a WinFrog communications port.
- 2 Add an RTCM device to WinFrog.
- 3 Configure the WinFrog communication parameters to correspond to those of the RTCM device.

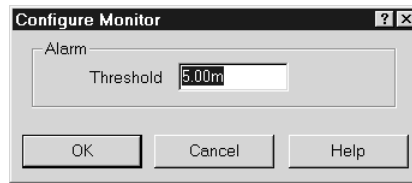
The next step is to add an **RTCM Monitor** device to a **new** vehicle's device list.

Note: do not add the **RTCM Monitor** to an existing vehicle. The RSIM message contains the Reference Station's coordinates, which will be accepted as the Vehicle's position. If this device is added to a vehicle, that vehicle's position will jump to the Reference Station's position.

- 4 With the mouse pointer in the limits of the **Vehicle Text** window, click the right mouse button then select the **Configure Vehicles** button.
- 5 Click the **Add Vehicle** button along the right side of the **Configure Vehicles** dialog box.
- 6 Configure the newly added vehicle, as described in **Vehicles** chapter. Specifically, enter a unique **name** to identify this as the RSIM "vehicle".
- 7 With the new vehicle highlighted in the **Vehicle List** in the **Configure Vehicles** dialog box, click the **Configure Vehicle-Devices** button.
- 8 Click the **Add** button to add a device to the vehicle's Devices list. This opens the **Select Data Items** dialog box.



- 9 Select the **RTCM,* ,RTCM MONITOR** device.
- 10 Click **OK**. The RSIM monitor now appears in the **Devices** box in the **Configure Vehicle-Devices** dialog box.
- 11 In the devices list, highlight the **RTCM,* ,RTCM MONITOR** device.
- 12 Click the **Edit** button to open the **Configure Monitor** dialog box.

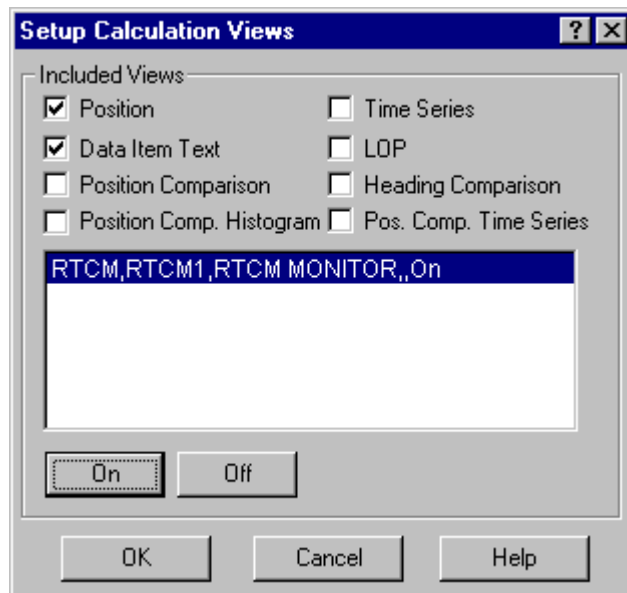


13 Enter an **Alarm Threshold**.

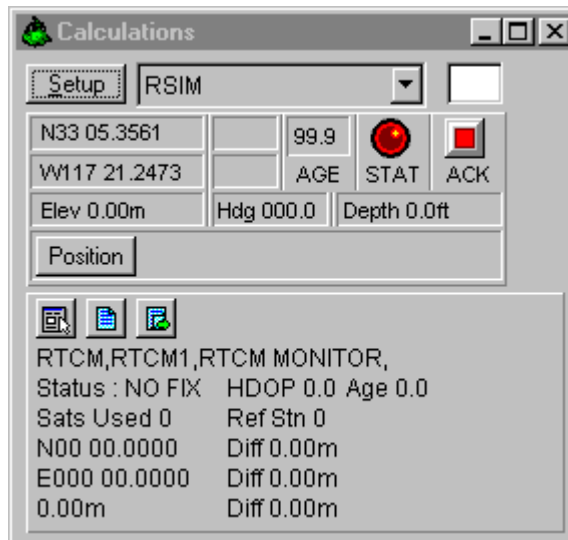
This parameter sets the threshold error for the delta latitude and delta longitude RSIM data. If the **combined** delta latitude, longitude, and height errors exceed the value entered in the **Threshold** field, WinFrog changes the vehicle **Status** in the **Calculations** window to **red** and sounds an alarm. Click the **Ack** button to silence the alarm. See the following section for more information on setting up the **Calculations** window.

To Turn on the Audible and Visual Alarms

- 1 From the **View** menu, choose **Calculations**.
- 2 From the dropdown menu, select the vehicle with the **RTCM Monitor** device.
- 3 Click the **Setup** button. The **Setup Calculation Views** dialog box appears as seen below.



- 4 In the **Included Views** area, check the **Position** box and the **Data Item Text** box.
- 5 Select the **RTCM,*,RTCM MONITOR** device.
- 6 Click the **On** button.
- 7 Click **OK** to close the dialog box and save the changes.



The **Calculations** window displays the following information for a “vehicle” configured with the RSIM device:

Vehicle Position	latitude, longitude, height. (heading, and depth of vehicle not relevant in this case).
AGE	Time since last position update.
STAT light	Shows current status of the position solution:
Green	Valid position.
Yellow	Potentially invalid position (more than 20 seconds since last position update).
Red	Invalid position. If the Reference Station positional difference exceeds the value set in Alarm Threshold in the Configure Monitor dialog box, the position is invalid.
ACK button	Press this button to silence alarms.
Data Item Text	
Status	Solution Status at Base Station. This can have the following values:
DGPS	Valid Differential GPS position
SP GPS	Single Point position (no DGPS)
NO FIX	No position calculated.
UNKN	Unknown Status.
HDOP	Horizontal Dilution of Precision at the Base Station.

Age	Age of DGPS corrections from the Base Station.
Sats Used	Number of satellites used in the DGPS solution at the Base Station.
Ref Stn	Base Station ID number.
Base Station Position	The calculated latitude, longitude, and ellipsoidal height of the Base Station
Base Station Differences	Delta latitude, longitude, and height in meters. If the square root of the sum of the squares of these position differences exceeds the value set in Alarm Threshold in the Configure Monitor dialog box, the STAT light turns red and an audible alarm sounds.
Time Series Option	This Calculations window option can be used to display the positional delta values relative to time. Enable this display by clicking the Calculations window's Setup button, then check the Time Series box. Click OK to return to the Calculations window. You can change the vertical scale (which shows the positional differences in meters) and the horizontal scale (which shows Time) by clicking on the provided arrows.

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Chapter 15: Multi-Vehicle Positioning and Telemetry Extension Module

WinFrog supports wireless communications between multiple WinFrog systems. This feature, called the **WinFrog Multi-Vehicle Positioning and Telemetry (MVP&T) Extension Module**, provides the communications medium for simple multiple vehicle tracking and display by each individual vehicle and extended multiple vehicle **remote control** operations.

The WinFrog MVP&T Module has three operational modes to select from: an automatic self-monitoring token ring network, a manually controlled token ring network, and a point-to-point network. The module also supports file transfers and the transmission of DGPS RTCM corrections.

Multiple telemetry devices can be added to a WinFrog system enabling the operation of multiple radio network cells. This feature is of particular use for the **remote control** application where there is a Master system that provides the link between cells so that any vehicle, on any cell, can track any vehicle regardless of the cell on which that vehicle is operating.

This chapter describes the Multi-Vehicle Positioning & Telemetry module's capabilities and the associated simple tracking of multiple vehicles. In this mode, WinFrog is able to transmit positional information and waypoint targets between vehicles. The remote control capability is detailed in the **Remote Control** chapter.

Note: see the **GPS Calculations** chapter for a discussion about raw pseudorange calculations, differential GPS positions, and RTCM corrections.

A typical multiple vehicle telemetry configuration would consist of a primary vessel mobilized with a multiple RTCM source in addition to the standard GPS receiver, gyro, radio modem and other supporting peripherals, and several support vessels mobilized with a GPS receiver, gyro, radio modem, and other supporting peripherals. The primary vessel would use the RTCM for its own multi-station DGPS solution and re-broadcast one RTCM station over the telemetry. The support vessels would receive the RTCM corrections and use them for their single station DGPS solution. All of the vessels would, in turn, transmit their positional information which would allow the other vessels to track not only themselves, but all of the other vessels as well.

Network Functionality

The functionality of each **Network** mode is discussed here before detailing the configuration of the **Telemetry** device, because it is important to understand these concepts in order to make the decisions required for the configuration.

Note: for all network operations, each WinFrog system must have a unique identity code (ID) within that network.

All stations in the network must be configured the same way with respect to the network settings in order for the network to perform reliably. The only exception to this is the **Master** and **Slave** settings for the **Point-to-Point** mode.

Token Ring Network

Briefly, a **Token Ring Network** is comprised of systems, or stations, that constantly pass data packets from one to the next in a specific sequence. This sequence is determined by the order that the stations are allotted space in the network. The station at the end of the list passes its packet to the station at the top of the list, thus forming a **ring**.

The data packets may contain specific network messages and/or data to be used at the receiving end for navigational purposes. Each station must transmit a data packet when it is its turn. If there are data in its transmit queue, the data are transmitted. If there are no data to be transmitted, a **token** is transmitted as a placeholder for where the data would have been, thus the **Token Ring Network**.

It is important to note that in the WinFrog application of the Token Ring Network, all stations listen and decode all data packets transmitted. If the packets contain information required by any station, regardless of that station's position in the sequence and originator of the transmission, the packet is decoded and the information used. For example, the positional information for any vessel is only transmitted by that vessel (the exception is the Remote Control feature). Therefore, any other vessel that is to track that vessel must decode the data packet and extract the positional information contained in it.

The list of stations in the network is critical to its performance. This list can be created in two ways.

Automatic Mode

In **Automatic** Mode, the network itself maintains the list of those stations in the network.

An integrity message is broadcast by one station. This message contains information about the station itself. As each successive WinFrog station on the network receives the message, the station ID number is added to the message.

This continues until all stations have included their ID numbers to the original integrity message. When the integrity message has successfully passed around the network twice, with no changes, the network is considered stable. In this way, the network is periodically checked for stations that have been added or dropped out of the network.

Though all stations may originate the integrity message, each station resets its timer controlling the transmission of an integrity message when a successive integrity cycle has been completed, regardless of the originator of the cycle.

This operational mode is very flexible and permits a dynamic network where vessels can enter and leave the work area with optimal cycle times.

A limitation of this approach is that all vehicles utilizing the telemetry system must be within radio visibility. Otherwise, as vehicles move to the extremes of the operation area or are blocked by other structures in the work area, they may not be able to receive the station preceding them in the token ring. As a result, they can lose their spot in the network. Since they will continue to transmit in an attempt to re-establish a spot in the network, radio collisions can occur, negatively affecting the operation of the telemetry network.

Manual Mode

In **Manual Mode**, the operator manually enters the IDs of the stations that are to operate in the network. No integrity messages are used and the maintenance of the network members is performed by the operator.

The advantage of this operational mode is that the token ring is artificially maintained and the requirement of all vehicles remaining in the work area within range of the telemetry system's radios is eliminated.

This is at the cost of flexibility, as the telemetry network is now unable to add and remove vehicles automatically. A change in the vehicles operating in the network necessitates a change to the telemetry configuration on all vehicles.

Point-to-Point Network

A point-to-point network, also referred to as a point-to-multipoint network when there are more than two stations, involves a **Master** station specifically communicating with one **Slave** station at a time. When there are multiple **Slave** stations, each one is communicated with in a continuous cycle.

The **Slave** stations have no knowledge of other **Slave** stations, the **Master** is the only station with knowledge of all stations in the network. At the **Master** station, you enter the IDs of the **Slave** stations with which to communicate. No entry of IDs is required at the **Slave** stations, other than the ID for that specific station.

As a result, although the detection of stations in the work area and the

maintenance of the network station list can not be automatic, it is a very easy network mode to manage. The only changes required are made at the **Master** station. These take affect immediately.

The **Master** specifically sets the ID of the intended receiver of the data packet in the packets header and transmits a data packet. If there are data in the transmit queue, the data are transmitted. Otherwise, a **token** is transmitted. The intended **Slave** responds in the same manner, that is, if there are data in its transmit queue, the data are sent. If not, it responds with a token.

As was the case in the **Token Ring Network**, in **Point-to-Point** mode all stations listen and decode all data packets that are transmitted. If the packets contain information required by any station, regardless of that station’s position in the sequence and originator of the transmission, the packet is decoded and the information used. For example, the positional information for any vessel is only transmitted by that vessel (the exception is the **Remote Control** feature). Therefore, any other vessel that is to track that vessel must decode the data packet and extract the positional information contained in it.

Data Packet Types

There are several data packets that are used by the telemetry device. These are summarized here.

Token Message	This message contains the ID of the transmitting and destination station. It is used to maintain the communications from one station to the next in the Token Ring Network and between the Master and a Slave in the Point-to-Point Network.
Integrity Message	This message is passed around a Token Ring network to determine what stations are present and to update the station list at all stations.
Link Message	This message contains the contents of the file being transmitted between stations. Note: this does include the file transfer initiated from within the Remote Control window (see the Remote Control chapter).
Link Ack Message	This message is sent by the receiving station to the station transmitting a file to acknowledge the reception of the last Link Message.

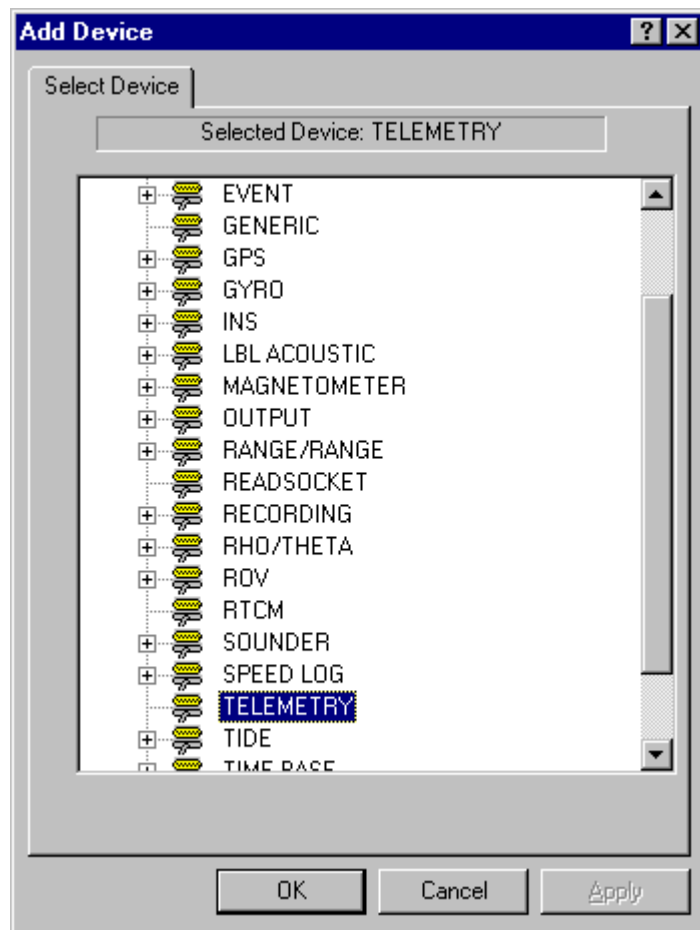
Broadcast Message

This message contains navigational data. This may be Position data, Target data, RTCM data or in the case of the Remote Control operation, general ASCII data (see the Remote Control chapter).

Telemetry Setup

To Add the Telemetry Device

- 1 Connect the radio modem to a WinFrog com port or Digiboard port.
- 2 Select **Configure > I/O Devices... Add**

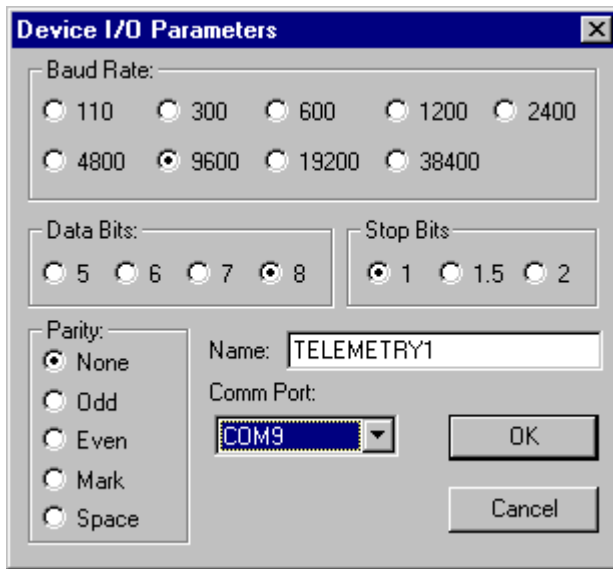


or

from within the **I/O Devices** window, click the right mouse button and choose **Add Device** from the pop-up menu.

- 3 From the **Devices** list, select **TELEMETRY**.

- 4 Click **OK**.



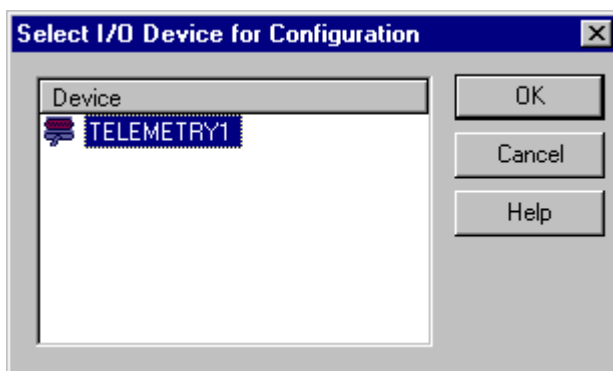
- 5 Enter a name for the device in the **Name:** field.
- 6 Set all of the communication parameters to match those of the radio modem.
- 7 Click **OK**.

At this point the device has been added to WinFrog.

To Configure the Telemetry Device

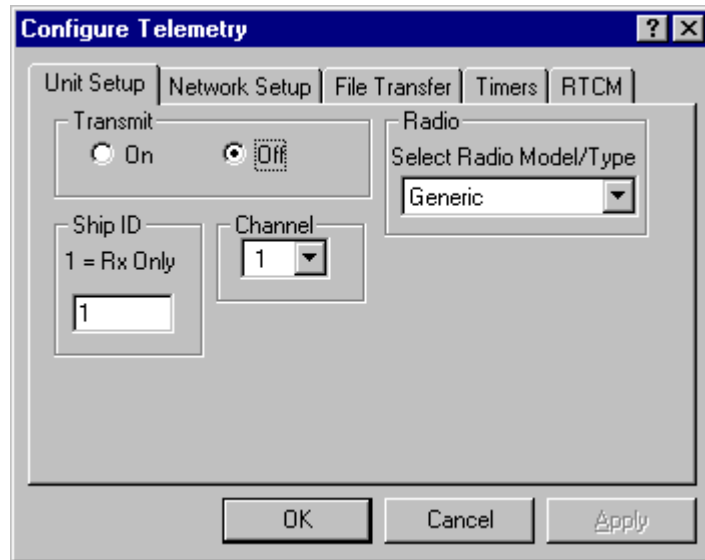
The configuration of the telemetry device, unlike many devices, requires comprehensive configuration at the device level. The following details only those configurations required for the Telemetry device to operate, specifically Unit Setup, Network Setup and Timers. Other configuration issues, specifically File Transfer and RTCM transmission, will be covered separately.

- 1 Select **Configure > I/O Devices... > Configure**. Select the **Telemetry** device and click **OK**.

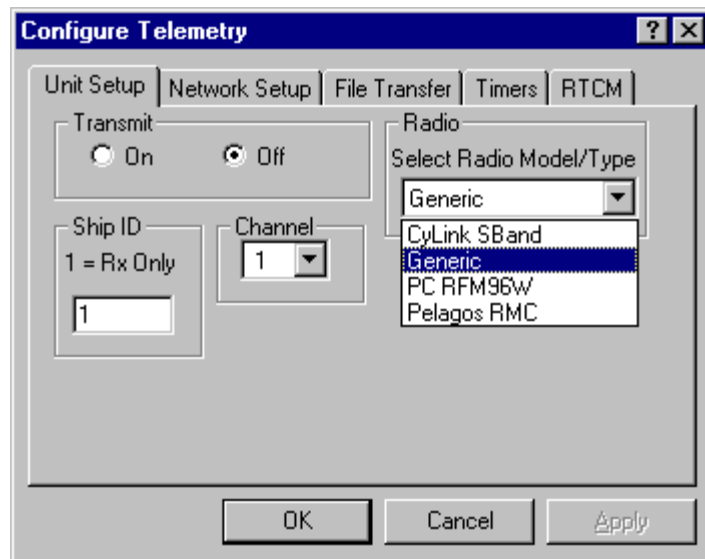


or

from within the **I/O Devices** window, select the **Telemetry** device and click the right mouse button. Click on **Configure Device** in the pop-up menu.



- 2 The next step is to configure the **Unit Setup**. You select the specific radio modem and configure how this WinFrog will be seen by other WinFrog systems in the telemetry network. Click on the **Unit Setup** tab.



Transmit

On/Off radio buttons

Turns the Telemetry device on and off.

Radio

Select Radio Model/Type

Different radio modems support different interfacing methods. To support this, WinFrog provides you the choice of several specific radios.

Cylink Sband Generic

A point to multi-point radio modem system. Provides connection support for most radio modems utilizing the RTS/CTS lines to control radio transmissions.

PC RFM96W

Pacific Crest blue bricks. These do not utilize the RTS/CTS lines.

Pelagos RMC

In house Radio Modem Controllers used to perform the necessary RTS/CTS line controls of radios. These were used when the **Telemetry** feature was first implemented are generally not required now.

Ship ID

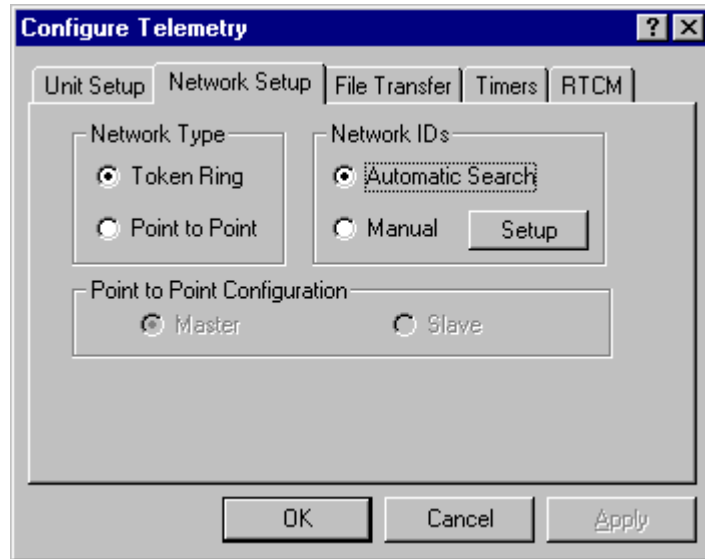
Each WinFrog system in a given telemetry network requires a unique identifier, as well as a unique identifier for each vehicle whose position is to be transmitted. Each WinFrog station can transmit up to 5 vehicle's positions. This can be a number from 1 to 32. The ID of 1 is special in that it sets that WinFrog system to be a "listener" only. The ID selected here must also be assigned to one (and only one) of the vehicles whose position is to be broadcast. (See Transmitting/Receiving Positions.) In the **Remote Control** mode, this ID provides the address of the remote WinFrog system to which the controller is to communicate.

Channel

If a radio modem supports multiple channels (frequencies), use this dropdown list to select the channel that WinFrog will instruct the radio to use.

The next step is to configure the Telemetry Network Setup. The actual operation of the network as configured here is covered more fully later in this section.

3 Click on the **Network Setup** tab.



Network Type

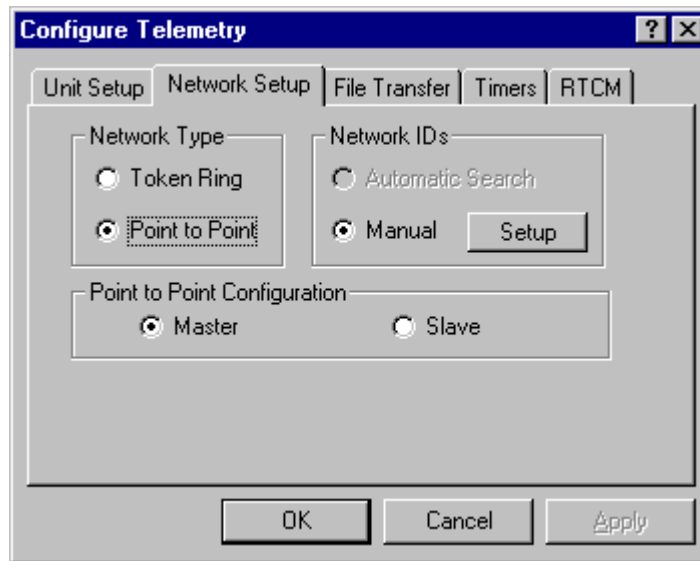
The telemetry network can support several operation modes.

Token Ring

WinFrog maintains a network by passing a data packet between vehicles in a specific sequence, resulting in, essentially, a “ring” of communications. This packet contains data if there are any in the transmit queue. If no data are in the queue, a token maintains its place in the network.

Point-to-Point

WinFrog maintains a **Master** system and **Slave** systems. The **Master** repeatedly, sequentially interrogates the **Slaves**, transmitting data to all **Slaves** in the process. Only certain options are available in this mode as indicated by the following figure.



Network IDs

There are two methods of determining the identities of the WinFrog systems in a given network.

Automatic Search

WinFrog operates a self-monitoring token ring network. No previous knowledge of the identities of other WinFrogs that will operate in the network is required. As vessels enter the network area, their presence is detected and they are added to the ring. As vessels leave the network area, their departure is detected and they are removed from the ring.

Manual

WinFrog uses an operator-entered list of the identities of the vessels that will operate in the network.

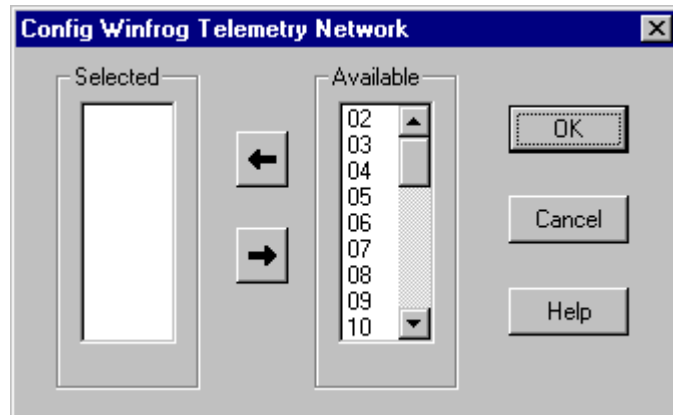
In the case of a **Token Ring** network, the identities of all of the WinFrog systems that are to be part of the network, including the identity of the WinFrog being configured here, are entered. The network does not automatically monitor and maintain its own list of vessels in the network in this mode.

In the case of **Point-to-Point**, at the **Master** WinFrog, you enter the identities of the **Slave** systems that are to be interrogated. Editing of this list at the **Master** enables full control of the network. At the **Slaves**, no knowledge of other systems in the network

Setup

is required, thus, no identities of other vessels are entered.

Click this button to access the **Config WinFrog Telemetry Network** dialog, which enables you to add and remove the identities of the vessels in the network, as described above.



Add to Network

Select an identity from the **Available** list and click the **left** arrow.

Remove from Network

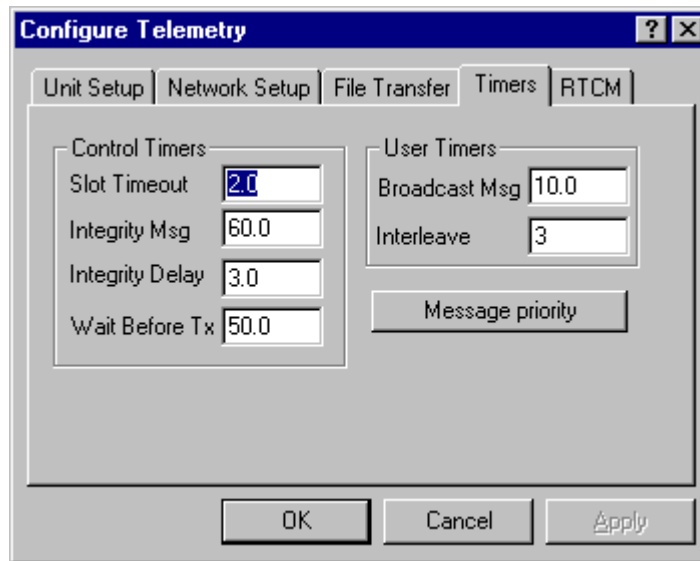
Select an identity from the **Selected** list and click the **right** arrow.

Point-to-Point Configuration

Master/Slave buttons

The **Point-to-Point** mode requires that there be one (and only one) **Master** system. All the remaining systems in the network are **Slaves**. It is recommended that the central WinFrog system be set to be the **Master**, such as the WinFrog on a rig and the work tugs are set to be the **Slaves**.

- 4 The next step is to configure the **Timers**. Click on the **Timers** tab.



Control Timers

Slot Timeout

In a **Token Ring** network, this is the length of time in seconds that a WinFrog system will wait for the preceding system in the ring to transmit its message before proceeding with its own transmission.

In the case of a **Point-to-Point** network, this is the length of time a **Master** will wait for a **Slave** to respond before moving to the next **Slave** in the list. As in the case of the **Broadcast Message**, this interval must not be set to a value shorter than what the telemetry system can support. **Note:** for 9600 baud radio modems, 1 second is reasonable.

Integrity Msg

The number of seconds between transmitted integrity messages. This is only applicable in a **Token Ring** network, configured for **Automatic** mode. It is recommended that the station that is expected to remain in the work area for the longest duration of time have this parameter set to an interval several magnitudes smaller than the other stations. In this way, it can be expected that this station would always be the originator of the **Integrity Message** and thus act as a network manager. **Note:** it is recommended that this setting for the manager be 60 seconds, and all other stations be set to 600 seconds.

Integrity Delay

The time, in seconds, that is to elapse after receiving any message **before** transmitting an **Integrity Message**.

Wait Before Tx

The delay in milliseconds between the WinFrog initiating a transmission by the radio and the message actually being sent to the radio. This permits the stabilization of the radio's transmission frequency and is therefore radio-dependent. For example, the Rnet 9600 radios require a 50ms delay, whereas the Teledesign radios require a 0ms delay. This is not applicable to the Pacific Crest RFM96W radios.

User Timers

Broadcast Msg

This is the time interval, in seconds, at which **Broadcast Messages** are to be transmitted. This directly controls the fastest possible position update rate of the vessels in the network as tracked by other vessels. It is important that this setting not be shorter than the telemetry system can support and may have to be adjusted in order to achieve the optimum performance. This setting should be the same on all vessels in the network. **Note:** for a 9600 baud radio modem, a setting between 1 and 5 is reasonable. For example, for the Pacific Crest RFM96W a setting of 1 second provides for a fast, robust telemetry network.

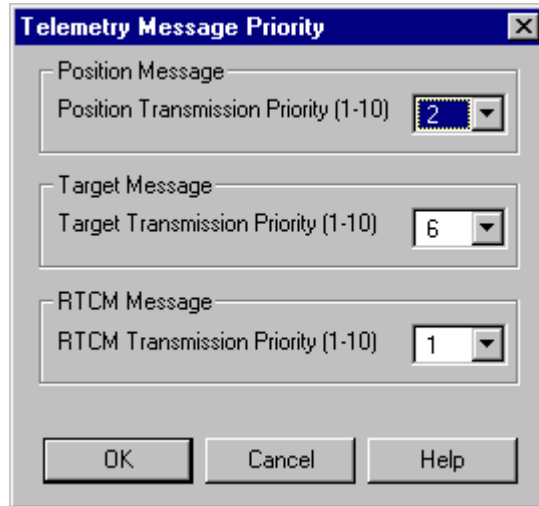
Interleave

The number of **Link Messages** that will be sent before the **File Transfer Link** may be interrupted to allow the transmitting station to send out a **Broadcast Message**. This is to ensure that other stations in the network continue to receive broadcast data from the transmitting station throughout a long file transfer. If the interleave is set to **0**, broadcast messages are sent out as soon as they are generated. This setting is only used by the station transmitting the file.

Message Priority

This button opens the **Telemetry Message Priority** dialog box, allowing you to set the

priority of the broadcast messages to be transmitted. A setting of **1** is the highest priority and **10** the lowest. These values default to the recommended settings.



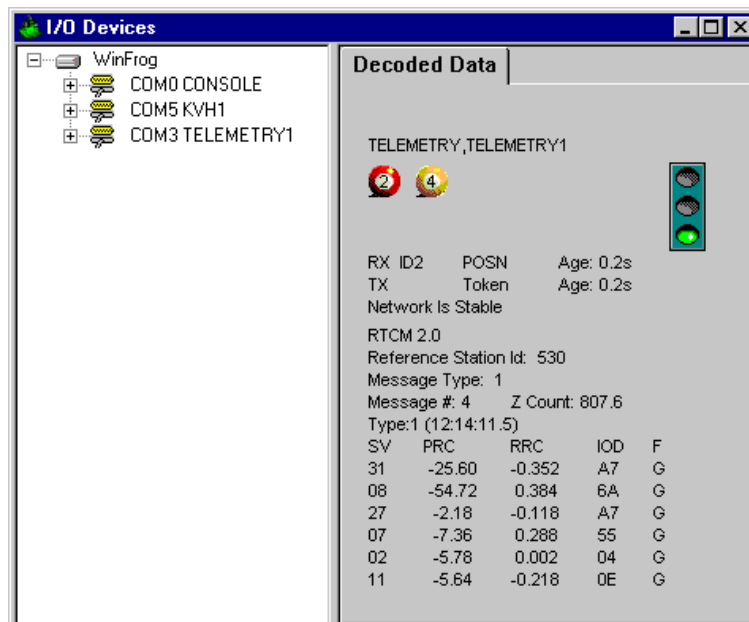
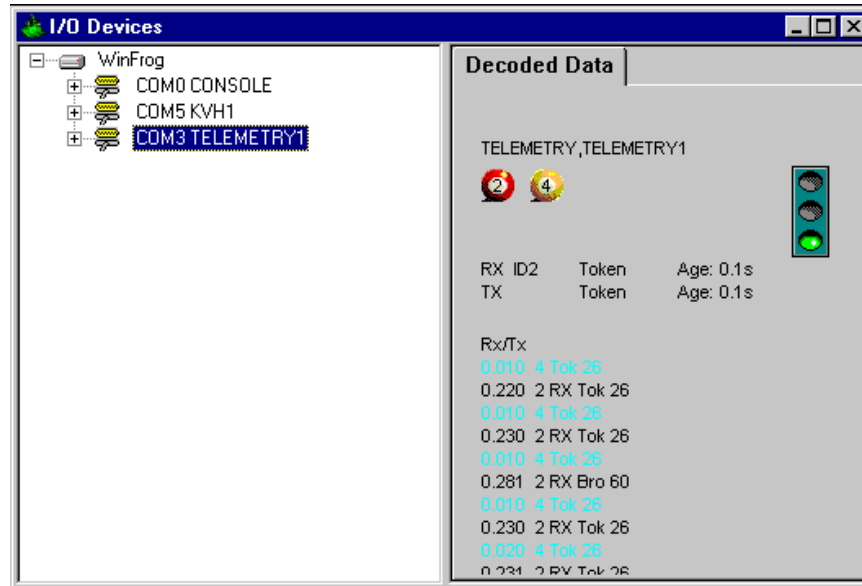
The different messages to be transmitted are generated by different WinFrog functions. As each is generated, it is sent to a queue. The priority of a message determines when it is actually sent. When it is time for a WinFrog system to transmit a message, the queue is checked and the message with the highest priority is sent. The default settings give the RTCM corrections top priority because without them, the receiving vehicles would be unable to position and navigate to the required accuracy.

Note: the priority for the messages used for the **Remote Control** feature are not operator-configurable. However, they are impacted by the settings here if that operational mode is to be mixed with another telemetry feature, specifically the transmission of the RTCM corrections.

I/O Devices Dialog Box

The performance of the telemetry system can be monitored from the **I/O Devices** window. The information displayed can be toggled between the standard telemetry information and the RTCM data being received.

The following details the information displayed. The first figure illustrates the display of the standard telemetry information and the second shows the display of the RTCM data.



To Toggle Between Standard Telemetry and RTCM Displays

- 1 Move the cursor to the data information portion of the **I/O Devices** window.
- 2 Click the right mouse button. The pop-up menu allows the selection of either **Telemetry** or **RTCM Data**. Select the item you wish to display.

Colored Light

A colored light is displayed for the local station and for each remote WinFrog station that is detected transmitting information via telemetry. The number at the center of the light shows the Ship ID that the light represents. The color of the light indicates the status of the station.

The following are status options:

Blue	inactive
Red	transmitting
Yellow	receiving
none	telemetry is turned off

“Traffic Light”

A traffic light style display shows the current status of the network. The light color of the display indicates the following:

Red	Telemetry network problem
Yellow	Searching for other WinFrog Stations transmitting via Telemetry
Green	Telemetry network stable Note: that in Manual Mode this is always the status of this indicator.
Black	Telemetry network turned off at local station

Status Line

A status line for each the receive and transmit state is displayed for the local station.

These lines includes the following information from left to right:

TX/RX	TX is a transmit message, used to represent the local station. An RX is a received message followed by a Ship ID number, identifying the originating transmitting station.

The type of message that was last received or transmitted:

Token	Token ring message
Link	Link message
Link Ack	Link Acknowledgment message
Integrity	Telemetry Network integrity message
RTCM	RTCM correction information message
POSN	Position information message
TRGT	Target information message
ASCII	Remote Control message
Elapsed time	The elapsed time (in seconds) since the last Tx or Rx message

Network Messages

The general network status is indicated in a line displaying either the type of message (only those pertinent to the monitoring of the network) that is being transmitted or the actual state as determined by the last sequence of relevant messages. The following messages for normal network operation may be displayed along this line:

Originate Integ Msg	Indicates that the local station has originated an integrity message.
Confirmation Integ Sent	Indicates that the local station has sent an integrity message.
Additional Integ Sent	Indicates that the local station sent an integrity message and that, due to changes detected in the returned integrity message, an additional integrity message has been sent.
Network Updated	Indicates that an integrity message was sent and that the network has been updated.
Network Is Stable	Indicates that an integrity message was sent and received successfully and that the network is stable.
ID Added To Message	Indicates that an integrity message has been received and that the local station's ID has been added to the message and the message forwarded.
Network Unchanged	Indicates that the second pass of the integrity message has been received and that the network is unchanged.
IDs Dropped From Net	Indicates that the IDs for one or more stations have been dropped from the network.

New Station Is Found	Indicates that a new station has been detected by the network.
ID Added on Further Pass	Indicates that the integrity message has gone once around and that a Ship ID number has been added to the integrity message on a subsequent pass.

In addition to these messages, other messages may be displayed when receiving or sending a file via telemetry. These messages are discussed in the **File Transfer** section.

Scrolling Display

A scrolling display, similar to the TX/RX status line, is shown. The difference is that the time shown is the elapsed time since the previous message, regardless of whether it was a receive or transmit type message. The size of the packet is also listed and if the packet type is a Broadcast (indicated by the term Bro) and the data is compressed, the size of the packet as compressed is given in brackets. Each station is displayed in a different color.

RTCM Corrections

If the telemetry is being used to transmit or receive RTCM corrections, the RTCM corrections for each station transmitted are displayed.

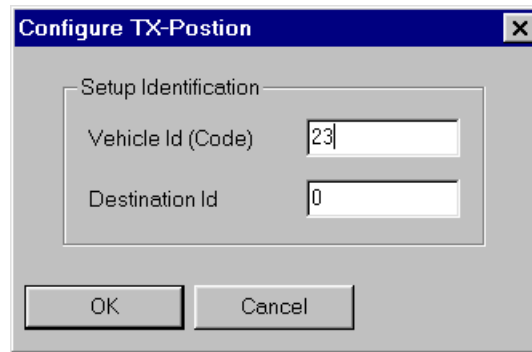
Transmitting/Receiving Positions

A WinFrog station can be configured to broadcast the position of up to 5 vehicles being directly positioned at the WinFrog station. This position information includes the vehicle identification, latitude, longitude, speed, elevation, and heading. This information is then available to all other WinFrog stations on the telemetry network. The position is received and associated with the vehicle having the same identification. This allows a WinFrog station to track multiple remote WinFrog vehicles in real-time, several of which may be coming from one “source” WinFrog.

To Configure WinFrog to Transmit Position Information

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle
- 2 Click the **Add** button.
- 3 Select the **TELEMETRY, *, TX-POSITION** data item from the **Available Data Items** list.

- 4 Click **OK**.
- 5 Select the same device within the devices list of the **Configure Vehicle-Devices** dialog box.
- 6 Click the **Edit** button. The **Configure TX-Position** dialog box opens.



Vehicle Id (Code)

For one and only one vehicle, the Vehicle Id (Code) must match the Ship ID for this Telemetry device. Each and every vehicle in the entire network must have a unique ID. If only one vehicle's position is to be broadcast then it must be assigned the Ship ID value. See the section **To Configure the Telemetry Device** (Unit Setup tab) earlier in this chapter.

Destination Id

This is currently not used. Leave at 0.

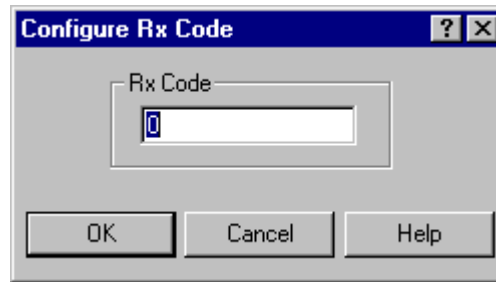
WinFrog starts broadcasting the vehicle's ID, longitude, latitude, elevation, North component of the horizontal velocity, East component of the horizontal velocity, and heading. Other WinFrog stations on the telemetry network can then use this information.

Since the ID numbers are unique, any receiving WinFrog can distinguish between each vehicle. The IDs are assigned as described below.

To Configure WinFrog to Receive a Position

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle
- 2 Click the **Add** button.
- 3 Select the **TELEMETRY, *, RX-POSITION** data type from the **Available Data Items** list.
- 4 Click **OK**.

- 5 Select the same device within the devices list of the **Configure Vehicle-Devices** dialog box.
- 6 Click the **Edit** button. The **Configure Rx Code** dialog box opens.



- 7 In the **Rx Code** entry field enter the vehicle Id number as set in the **TX-POSITION** data item for the WinFrog station transmitting the desired vehicle position.
- 8 Click **OK**. The vehicle is updated with the received position.

Note: if the computer clocks are not synchronized to GPS on the transmitting and receiving WinFrog computers, the position displayed in the **Vehicle Text** window may indicate an old position even though the data are current and valid. This is due to the apparent age of the data due to difference in the clocks exceeding tolerances.

Transmitting/Receiving Targets

A WinFrog Station can be configured to broadcast a specific target for a specified vehicle. This Target information includes the target name, latitude, and longitude. The receiving vehicle automatically assigns this target as its active waypoint, drawing it in the Graphics window (if waypoints are checked in the Graphics configuration) as a bulls eye with 3 m rings.

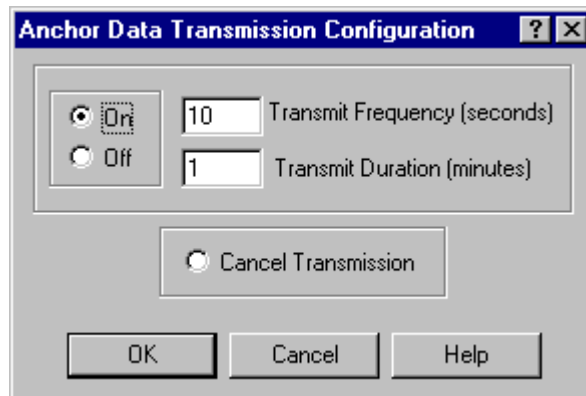
Note: there are two things to consider when attaching a **RX-TARGET** and/or a **TX-TARGET** data type to a vehicle:

- 1 The **TX-TARGET** data type is added to a vehicle on the WinFrog station controlling the target data. It is added to the vehicle on that station that is to ultimately receive and use the target data. For example, on a barge-based WinFrog system configured to track anchor tug(s) using the telemetry, the **TX-TARGET** data type is added to the vehicle(s) assigned as the anchor tug(s) on the barge WinFrog system.
- 2 The **RX-TARGET** data type is added to any vehicle that is to receive and use target messages on any system that it is desired to monitor the waypoint tracking status of that vehicle. For example, in the aforementioned situation,

the **RX-TARGET** data type is added to the vehicle(s) assigned as anchor tug(s) on the anchor tug(s) WinFrog system(s). In addition, it can also be added to the anchor tug(s) vehicle(s) on the barge WinFrog system. This configuration enables the WinFrog systems on all of the vessels included in the telemetry network to monitor the target data being sent to and used by any tug.

To Configure WinFrog to Transmit a Target Position

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **TELEMETRY, *, TX-TARGET** data type from the **Available Data Items** list.
- 4 Click **OK**.
- 5 Select the newly added **TX-TARGET** data type within the **Devices** list of the **Configure Vehicle-Devices** dialog box.
- 6 Click the **Edit** button.



- 7 Configure the following parameters in the **Anchor Data Transmission** Configuration dialog box:

On/Off

The transmission of the target data can be turned on or off, providing control without having to remove and add the data type for a given vehicle.

Transmit Frequency

The user enters the interval in seconds at which the target data will be put into the telemetry transmit queue.

Transmit Duration

The user enters the length of time in minutes that the target data will repeatedly be placed in the telemetry transmit queue.

Cancel Transmission

Not used.

- 8 Click **OK**.

The actual target transmission is done from the **Anchor Handling** window. See **Anchor Handling Window** section in **Operator Display Windows** chapter.

To Configure WinFrog to Receive a Target Position

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **TELEMETRY, *, RX-TARGET** data type from the **Available Data Items** list.
- 4 Click **OK**.

There is no configuration associated with this data type once attached to a vehicle.

Transmitting/Receiving RTCM Corrections

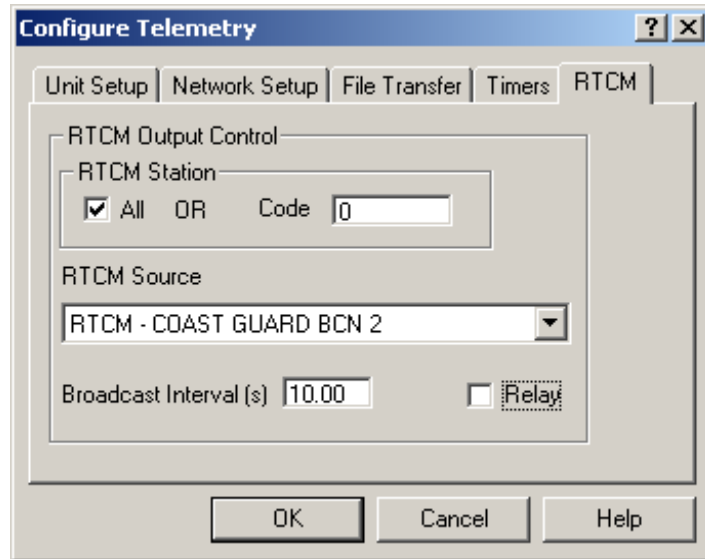
The WinFrog system can be configured to transmit and receive RTCM corrections over the telemetry network. Therefore, a station receiving RTCM corrections from another source can re-broadcast the corrections via the telemetry network. These corrections can then be used by all other WinFrog stations on the network.

To Configure WinFrog to Transmit RTCM Corrections

- 1 Select **Configure > I/O Devices... > Configure**, select the telemetry device, and click **OK**.

or

from within the **I/O Devices** window, select the telemetry device, and click the right mouse button. Click on **Configure Device** in the pop-up menu.
- 2 Click the **RTCM** tab in the configuration dialog.



- 3 Select the RTCM device from all available RTCM devices listed in the **RTCM Source** dropdown menu.
- 4 In the **RTCM Station** area, either check the **All** box or enter the ID of a specific station in the **Code** field.

Note: this can be changed at any time and the new setting is initiated immediately as you select **OK** to exit this window.

- 5 Enter a transmit interval in seconds.

WinFrog will only re-broadcast RTCM corrections after this interval has elapsed since the last RTCM re-broadcast. This permits control of the re-broadcast rate in cases where the RTCM source provides corrections at a high update rate. If the interval is too small, the telemetry will be unable to interleave position and target broadcast messages, thus eliminating this functionality.

The RTCM data broadcast is always the last received by the selected RTCM source.

- 6 The **Relay** checkbox configures this station to re-broadcast the RTCM data upon receiving it. This feature is for situations where not all vehicles in the network can hear the originating station for RTCM data. It should only be used if necessary, since it will impact the transmission of position and target data by the relay station in a similar manner as described in Step 5.
- 7 Click **OK**.

The WinFrog station starts broadcasting the RTCM corrections over the telemetry network.

It is recommended that if the RTCM device selected supports the input of

multiple RTCM Reference Stations, only one be selected for re-broadcast over the telemetry. If the **All** option is selected, the telemetry will become slow with poor position update rates due to the time required for the transmission of the multiple RTCM corrections sets.

To Configure a WinFrog Station to Receive and Apply RTCM Corrections

- 1 Any WinFrog station on the network automatically receives the RTCM corrections. These corrections can then be applied to other stations on the telemetry network.
- 2 The application of the RTCM corrections at the remote WinFrog stations is then done the same way as for any other RTCM device. Two points to keep in mind:
 - When selecting the RTCM received via the telemetry as a device, such as the case of configuring the RTCM-104 output device, the RTCM source to select will appear in the list as the operator assigned name for the telemetry device.
 - When adding the RTCM received via the telemetry as a data type, select **TELEMETRY,*,DGPS-COR's** where the * is the operator assigned name for the telemetry device.

For further information refer to the **GPS Calculations Extension Module** chapter.

File Transfer

WinFrog's telemetry capabilities can be used to send files over a telemetry network. This allows the user to send data from one computer to be received by a specific remote computer on the network. Any file type is supported. This is a convenient way to transfer working files and daily reports.

Note: this functionality is independent of the **Working File Transfer** supported by the **Remote Control** operation (see **Chapter 16**).

File transfers use the **Link** and **Link Ack** type of broadcast messages. The former contains the file segments (see below, Step 3)

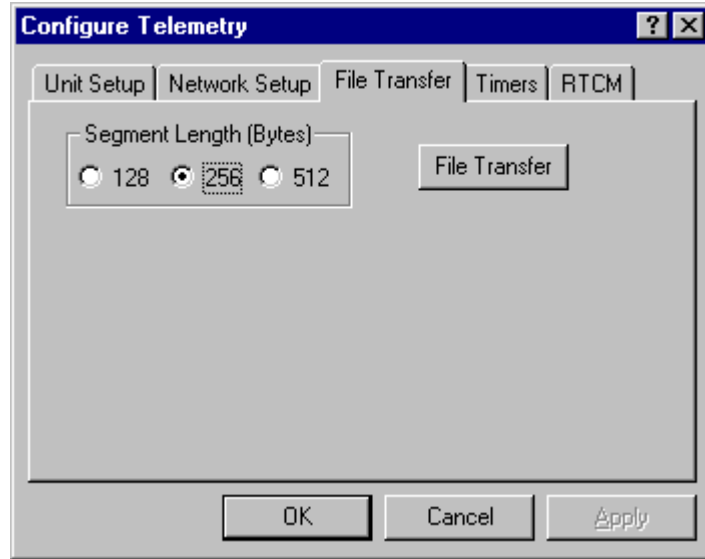
To Send a File via Telemetry

- 1 Select **Configure > I/O Devices... > Configure**, select the telemetry device and click OK .

or

from within the **I/O Devices** window, select the Telemetry device and click the right mouse button. Click on **Configure Device** in the pop-up menu.

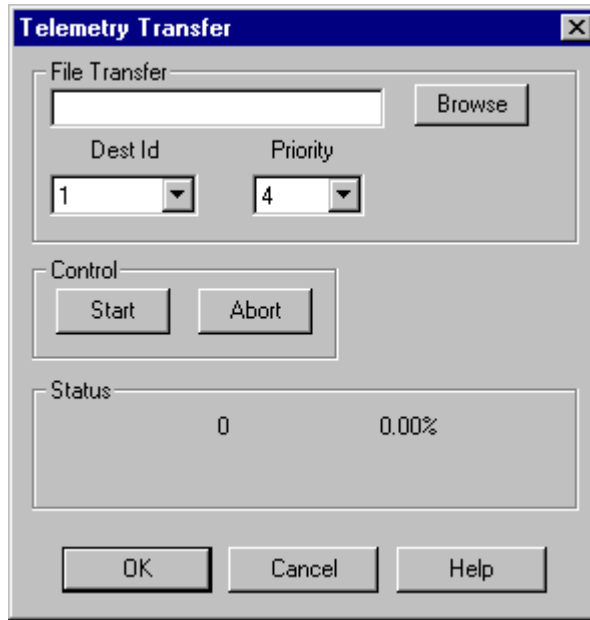
- 2 Click the **File Transfer** tab in the configuration dialog.



- 3 Select the desired **Segment Length (Bytes)**.

A file is transferred in multiple segments, one segment per transmission, until the complete file is transmitted. This controls the size of each segment of the file that is being transferred. The larger the segment size, the faster the file transfer. However, the more susceptible the transfer is to radio noise interference and possible aborting of the process. The smaller the segment, the slower the transfer, but the less prone to radio noise interference. This setting is only required at the transmitting station and, therefore, can be modified as it is determined to be required.

- 4 Click the **File Transfer** button. The **Telemetry Transfer** dialog box opens.



- 5 Designate a file either by typing the path and file name in the **File Transfer** entry field or by clicking the **Browse** button and navigating to the file.
- 6 From the **Dest Id** dropdown menu, select the Ship ID of the destination WinFrog station.

This menu displays all Ship ID numbers that are currently visible on the network.

- 7 Select the message priority from the **Priority** dropdown menu.

Priority values range from 2 to 4, with 2 being the highest priority and 4 being the lowest. This priority setting is ranked the same way as those discussed in **To Configure the Telemetry Device**, item 4, and as such sets the priority of the **File Transfer** messages with respect to other broadcast messages.

Generally, the message priority should be set to 4 (lowest) as the network speed is sufficient to transfer files in a timely manner. Only exceptional conditions will warrant increasing the priority of a vehicle's message, as this will obviously be to the detriment of other vehicles messaging. An example of this is the transfer of critical working files.

- 8 Click the **Start** button, in the **Control** area of the **Telemetry Transfer** dialog box, to begin the file transfer.

File transfer is accomplished using the **Link** message type. A new **Link** message is sent after receiving a **Link Ack** from the destination station. If a **Link Ack** is not received in the allowed time, the same **Link** message is re-transmitted.

The following information is displayed in the first line of the **Status** area of the **Telemetry Transfer** dialog box:

- Total size of file being transferred
- Segment number being transferred
- Percentage of file already sent

The following additional messages appear in the second line of the **Status** area when sending a file (these messages are also displayed in the **I/O Devices** window for the telemetry device):

Link Message Complete	Indicates the link message has successfully been transferred.
Segment n Sent to IDs p% Done	Indicates that segment number n was sent to Ship ID number s and that the file transfer is p percent complete.
Segment n Re-sent to IDs p% Done	Indicates that segment number n was re-sent to Ship ID number s and that the file transfer is p percent complete. This message may indicate a communication problem.
Final Segment Sent to IDs	Indicates that the final segment of the file being transferred is being sent to Ship ID number s .
Final Segment Re-sent to IDs	Indicates that the final segment of the file being transferred is being re-sent to Ship ID number s . This message may indicate a communication problem.
File Cannot Be Sent	Indicates that there is a communication problem and that the file could not be transferred.
No response after n times retryLink Aborted	Indicates that WinFrog unsuccessfully attempted to connect n times with the receiving computer and the link was aborted.

Note: the file transfer can be stopped at any time by clicking the **Abort** button in the **Control** area. Also, this dialog can be exited and re-accessed later to examine the file transfer status without affecting the file transfer.

Receiving a File

WinFrog automatically starts receiving a file sent via telemetry when the station's Ship ID number matches that entered in the **Telemetry Transfer** dialog box in the WinFrog transmitting station. The file is stored in the telemetry directory.

To Change the WinFrog Telemetry Directory

- 1 Select **File > Select Working Directories** to open the **Working Directories** dialog box.
- 2 Select the **Filing Directory** radio button by clicking the radio button next to the **Telemetry** entry field or enter a user-defined directory.

For a detailed description of this dialog box, see the **Working Directories** chapter.

- 3 Click **OK**.

When WinFrog is receiving a file via telemetry, several different messages may be displayed in the **I/O Devices** window for the appropriate telemetry device:

Last Link Aborted. New link Rx'ed	Indicates that the last link was aborted due to a communication problem and that a new link has been received.
New Link Rx'ed	Indicates that a new link has been received for file transfer.
Filename Link Msg n Rx'ed	Segment number n for the file Filename has been received.
Filename Final Seg Rx'ed	Final segment for the file Filename has been received. The file transfer is complete.
Invalid Link Received s	Indicates that an invalid link message status s was received.

Chapter 16: Controlled Remote Tug Telemetry

Overview

The WinFrog **Controlled Remote Tug Telemetry** module (also called **Remote Control**) and the **WinFrog Remote** package enable one central WinFrog system to track other vehicles in the work area, with WinFrog systems installed on them, and to control the configuration and operation of the WinFrog systems on them. The central WinFrog, or controller, then provides the appropriate vehicle information to selected remotes to enable them to monitor and track the vehicles it is deemed necessary for them to see. This vehicle information includes fairlead information and anchor location and status, thus the remote WinFrog systems are able to display anchor patterns, live anchors, and the associated anchor cables. This provides an operational area safety factor in addition to the convenience of operating all WinFrog systems from one controller. **Note:** there is only one controller in a given network.

Both the **Controlled Remote Tug Telemetry** module and the **WinFrog Remote** system require a communications medium to operate. However, the **Remote Control** module is able to operate over a TCP/IP network using socket connections and the WinFrog Multi-Vehicle Positioning and Telemetry (MVP&T) system (see the **MVP&T** chapter). The **WinFrog Remote** can only operate using the **WinFrog Telemetry**.

The **Remote Control** capability has a number of possible uses but has been developed primarily to support work vessels in construction, such as anchor handling tugs for pipe lay projects or structure float outs and placements. A typical configuration has a pipe lay barge/vessel operating as the controller and the anchor handling tugs as the remote sites. The surveyor at the controller is able to control the basic system configurations and operations of the remote sites, thus providing the tug's crews with operational information such as that required for the deployment and recovery of anchors without the requirement of having survey personnel onboard the tug.

Note: In order to use socket connections, the computers must have the TCP/IP protocol installed and correctly configured. Refer to the Windows™ documentation for necessary installation and configuration instructions.

The following summarizes the capabilities of the Controller with the Remote Control option:

Configurations

Vehicle Positioning Parameters

Configuration of the vehicle positioning parameters as accessed via the **Configure Vehicle-Devices** dialog with the exception of the addition and removal of data types using the **Add** and **Delete** buttons and setting the **Data Source**. It does include the filter selection and associated settings, dead reckoning, gating, etc.

Device (Data Type) Configuration

Configuration of the data types attached to the vehicles including the antenna offsets, Primary/Secondary settings, graphics on, and accuracy. **Note:** this data type configuration is the same as that performed from the **Configure Vehicle-Devices** dialog with the **Edit** button, not from the **I/O Devices** window.

Vehicle Presentation Configuration

Configuration of all aspects of the vehicle presentation as accessed with the **Vehicle Presentation** dialog.

Vehicle Shape

Configuration of the graphic representation of the vehicle as accessed via **Configure Vehicle Outline** dialog.

Vehicle Offsets

Configuration of the vehicle offsets and selection of the offset to use with the **Configure Offsets** dialog.

Waypoint Selection

Configuration of the waypoint selection for the remote vehicle. **Note:** any files directly accessed for the selection of this point are those in use at the control site, not the remote site. Once selected, the actual waypoint data are transferred.

Line Selection

Configuration of line selection for the remote vehicle. **Note:** any files directly accessed for the selection of this point are those in use at the control site, not the remote site. Once selected, the actual line data are transferred.

Graphics Configuration

Configuration of the **Graphics** window 1 at the remote site. It is expected that this is the only open window. If more are open, it is assumed that the operator at the remote site is knowledgeable enough to manipulate them. The control extends to all components of the standard graphics configuration (with the exception of chart control) including zoom in, zoom out, and pan. It is possible to select an option to display the remote graphics configuration at the control site using **Graphics** window 1 to ensure the remote site graphics are providing the necessary information. It should be noted that any change in the graphics configuration, scale, or centering made at the remote is automatically sent back to the control system to keep the two systems synchronized.

Event Configuration

Configuration of the eventing at the remote site. It should be noted that even though the event data can be configured to be sent to the control site for monitoring, all data logging is accomplished at the remote site.

Data Transmissions

Remote Position Transfer

Configuration of the transmission interval of the Remote station's positional information to the Controller. These data are used to track the **Remote** at the **Controller**.

Remote Data Transfer

Configuration of the transmission interval of the Remote station's raw device data to the Controller. This permits troubleshooting capabilities of the Remote's system from the Controller.

Remote Event Data Transfer

Configuration of the transmission interval of the Remote's **Event** data to the Controller. This enables monitoring of the eventing process configured for the Remote.

General Position Transfer

Selection of the vehicles whose positional information will be transmitted to a Remote to enable it to track vehicles other than itself.

File Transmissions

Working Waypoint File	The Controller's current Working Waypoint file can be transmitted to a selected Remote which will then automatically use it as its Working Waypoint file.
Working Line File	The Controller's current Working Line file can be transmitted to a selected Remote which will then automatically use it as its Working Line file.
Working Picture File	The Controller's current Working Picture file can be transmitted to a selected Remote which will then automatically use it as its Working Picture file.

Security

It is important to note that the standard WinFrog license has full Controller capability. The **Remote Control** feature is controlled by the license or modules available on the **remote** WinFrog vessels. That is, the WinFrog on the remote vehicles must either be licensed to use the Controlled Remote Tug Telemetry module or actually be the WinFrog Remote package.

Remote Sites

WinFrog with the Controlled Remote Tug Telemetry Module versus the WinFrog Remote Package

WinFrog with the **Controlled Remote Tug Telemetry** module (also known as Remote Control) operates the same way as the **WinFrog Remote** package with respect to the remote control application itself. Therefore, with the exception of the first steps followed in the case of starting the Controlled Remote Tug Telemetry module, the use of both is the same from an operator's perspective. The exception to this is that the **WinFrog Remote** package can not be accessed over a TCP/IP network.

The **Controlled Remote Tug Telemetry** module is activated with a flag setting in the winfrog_3.ini file. The **WinFrog Remote** package sets this flag automatically without actually checking the winfrog_3.ini file.

WinFrog with the Remote Control module has all WinFrog functionality. However, the WinFrog Remote package has restricted functionality in keeping with its purpose of providing basic navigational and positional functionality on a remote vessel without a trained operator (at a reduced license price).

Remote Control with Telemetry versus TCP/IP Network

The differences between the operation of the **Remote Control** module at the remote site with a TCP/IP network and telemetry are as follows:

- For operation with the telemetry, a telemetry device must be added to the **Remote WinFrog** and configured accordingly. This is not required for TCP/IP network.
- For operation with a TCP/IP network, the computers on the network must be configured to use the TCP/IP protocol and the IP address of the **Remote WinFrog** systems must be determined. This is not required for the telemetry.
- When operating with the TCP/IP network, a listener window is opened automatically. Closing this will disconnect the network connection (irrecoverably, except by exiting and re-running WinFrog). However, closing the device window will not affect the telemetry application.
- The TCP/IP network transfers data at a much higher rate than the telemetry units.

Configuring a Remote Site

It is important to note that for the purpose of setting up the **Remote WinFrog**, you proceed as if setting up a normal WinFrog for a single vehicle operation, that vehicle being the one on which the system is installed. It is only after the WinFrog is up and running that the affect of operating as a **Remote WinFrog** becomes relevant.

The following provides an overview for setting up the **Remote WinFrog** with references to the chapters of this manual that cover the topics in steps.

To Configure a Remote Site

- 1 Start the WinFrog as installed on the **Remote** vehicle.

Note: a remote requires a security key in order to operate, whether it is a standard WinFrog with the **Controlled Remote Tug Telemetry** module or the **WinFrog Remote** package.

- 2 **Configure** the geodetics and units.

This is very important because the geodetics and units cannot be configured via the **Remote Control** option from the **Controller**.

See the **Configuring Geodetics and Units** chapter for details.

- 3 Setup the working directories.

See the **Working Directories** chapter for details.

- 4 Assign working files.

See the **Working Files** chapter for details.

Note: the transfer of picture files, line files, and waypoint files by telemetry can be a time consuming process, so it is best to load the initial files at this stage.

- 5 Create a single vehicle representing the vessel on which the system is installed.

See the **Vehicles** chapter for details.

- 6 From the **Configure Vehicle-Devices** dialog, select **Real-Time** as the **Data Source**. While there is no need to configure the other parameters as this can be done later from the control site (the exception to this is detailed in Step 8 below) it is recommended that the configuration be performed in its entirety.

Note: the vehicle name, in conjunction with Ship ID or TCP/IP address, is used to identify the remote from the controller. This comparison is exact, including being case sensitive. Therefore, it is critical to note the name exactly as it is entered at the **Remote** in order that it can be entered for the appropriate vehicle on the **Controller** exactly the same.

- 7 Add devices.

See the **Peripheral Devices** chapter for details.

The adding of devices and the associated configuring of them, including the communication parameters and any device specific configuration, must be executed at the **Remote** as these tasks cannot be performed remotely from the **Controller**.

Note: in order to access the **Configure Device** window, place your cursor in the device tree portion of the **I/O Devices** window, click the right mouse button, and choose the **Configure Device** option.

If the remote is to be controlled via telemetry, the WinFrog telemetry device must be added at this stage (see the **Multi-Vehicle Positioning & Telemetry** chapter). There is no device associated with the TCP/IP connection.

- 8 Attach the data types (**GPS, Position, Gyro, Heading**, etc.) to the vehicle.

This must be performed at the **Remote** because it cannot be done from the **Controller**. Available telemetry data types are not to be attached. For the **Remote Control** feature, the telemetry is associated with the system, not a specific vehicle.

Note: the exception to this is if the telemetry is providing RTCM corrections that are then to be used in a WinFrog pseudorange solution for **GPS Positioning** at the Remote. In this case, the telemetry data type **DGPS-CORs** is attached to the vehicle. However, it is recommended that at the Remote, the RTCM corrections be output directly to the GPS receiver and the DGPS

position from this receiver be used for the Remote positioning. This is due to two reasons. The first is that the configuration of the **PSEUDORANGE** data type is not currently supported by the Controller/Remote interface. Secondly, the DGPS positioning at the Remote using a single DGPS Reference Station solution directly from a GPS receiver is less complicated to setup and monitor, and thus better suited for **Remote WinFrog** operation. It will meet the accuracy requirements for the majority of remote vessel operations.

See the **Vehicles** chapter for details.

- 9 The system should now be running as a “typical” WinFrog. Exit the system using **File > Exit**.
- 10 In the **Exit WINFROG** dialog box, click **Yes**.
- 11 If the Remote is running a **WinFrog Remote** package, at this point proceed to **Step 15**. Otherwise, use a text editor to open the winfrog_3.ini file stored in the system directory, e.g. c:\winnt\.
- 12 Search the file for the IsMonitor keyword, the only member of the [System] section.

This parameter controls the operation of WinFrog based on the value entered next to the equal sign:

0	Standard WinFrog operation. In the standard mode, WinFrog can operate as a controller site.
-1	WinFrog operates as a remote site, accessed via a TCP/IP network connection.
-2	WinFrog operation as a remote site, accessed via the telemetry device.

- 13 Change this parameter to the appropriate setting.

For example, IsMonitor = -2.

- 14 Save and close the winfrog_3.ini file. Exit the text editor.
- 15 Launch WinFrog.

WinFrog now starts in the remote mode.

- 16 It is recommended that a configuration file be created at this point. (Use the **File > System Config File... Save** option.) This can be accessed at a later time to reset the **Remote WinFrog** to the correct remote settings and state, if required.

Remote Site Operation

When the **Remote WinFrog** system boots up, regardless of how the system was exited with respect to open windows, only the **Graphics1** and **Vehicle1** windows open and fill the screen. It is expected that these will meet the requirements of the navigation and vehicle tracking at most **Remote WinFrog** systems.

If the remote is running in TCP/IP network mode, there is also a small window at the top left of the screen behind the **Graphics** window. Do not close this window because the socket connection is associated with it and will be disconnected if the window is closed. If this occurs, you must exit WinFrog and restart it.

It is intended that operator action is not required nor, other than the manipulation of **Graphics1** window, is it expected. However, on some vessels the ship's personnel will be knowledgeable about computers and may wish to take advantage of having a navigation and positioning package onboard. This will not impact the operation of the **Remote WinFrog** as a remote unless changes are made to those components critical to the operation as a remote or operation in general. These critical areas are as follows:

- Adding, removing, and editing of devices, especially the **Telemetry** device if the communications between the Controller and the Remote is via telemetry.
- Attaching and removing of data types to and from a vehicle. If the configuration of the data types is changed, this can be addressed from the Controller.
- Modifying the geodetics.
- Closing the Listen Sockets window if the communications between the Controller and the Remote is via the TCP/IP network.

Note: changes to the **Remote WinFrog** are **not** sent back to the **Controller**, with the exception of changes to the **Graphics1** window. Any changes made to the configuration of this window, including the actions initiated from the toolbar buttons, such as **Zoom In**, and any changes made from the configuration dialog are transmitted to the **Controller** to maintain synchronization of the graphics configuration.

If the **Configure Vehicle-Devices** dialog for any vehicle other than the actual Remote's local vehicle is accessed, the data source will be seen to be set to **Ctrl'd Remote**. This must not be changed.

Note: As mentioned in the setup procedure, it is recommended that after the **Remote** is originally setup and then re-started, a configuration file be created using **File > System Config File... > Save**. Thus, should the **Remote WinFrog** become corrupted from operator interference, the operator can be instructed to load this configuration file using the **File > System Config File... > Load** option. This will reset the **Remote WinFrog** to the correct state for **Remote Control** operation.

Control Sites

Operation Overview

The **Controller** is a standard WinFrog system and is configured as such. It is also secured in the usual manner.

If the **Remotes** are to be accessed via telemetry, the **Telemetry** device must be added to WinFrog and configured (see the **Multi-Vehicle Positioning & Telemetry** chapter). No telemetry data types are attached to any vehicles.

If the **Remotes** are to be accessed using a TCP/IP network, there is no device associated with the Controller/Remote communications to be added. However, the **Controller** computer must have the TCP/IP protocol installed and correctly configured.

The operation of WinFrog as a **Controller** is enabled when you open up one of up to ten **Controlled Remote** windows. It is from this window that the connection to a **Remote** is configured and established. The subsequent control of the **Remote** and the data flow between the **Controller** and the **Remote** is also handled via this window. One window is required for each **Remote** and must be kept open (though it can be minimized) in order to maintain the connection. Thus, up to ten **Controlled Remote WinFrogs** can communicate with the **Controller** simultaneously.

Once connected, control of the remotes can also be executed from the other display windows (see the **Operator Display Windows** chapter). For example, a waypoint can be selected from the **Setup Waypoint Tracking** dialog box accessed via the **Vehicle Text** window when the desired **Remote** vehicle is displayed in the window (click the right mouse button and click the **Setup Waypoint Tracking** option).

Note: the changes made to a **Remote** from the **Controller** are not reflected at the **Controller** until confirmation is received from the **Remote** that the configuration change was received and applied. It is important to note that you can manually initiate all processes, even those performed automatically during the connection process, such as querying the **Remote** for its vehicle data type list and the associated configurations (**Sys Config** button).

The Controlled Remote Window

The **Controlled Remote** window provides the connection to the Remote. As soon as it is opened or loaded from either an ini or cfg file, it attempts to make a connection to its Remote. If it is unsuccessful, it repeats the attempt every minute indefinitely.

For a set of **Controlled Remote** windows configured to use the same telemetry device (cell), only one **Controlled Remote** window can attempt to connect at one time. All the other **Controlled Remote** windows associated with this telemetry device must wait their turn.

Once the connection is made, a complete configuration exchange takes place. The Controller transmits a vehicle list and the complete configurations for each of these vehicles to enable the Remote to configure its vehicle list and all associated vehicles. The Remote, in turn, transmits its local vehicle configuration to the Controller.

On subsequent re-connections, the vehicle list is transmitted, but the transmission of the associated configurations and the transmission by the Remote of its local vehicle configuration are skipped. This makes subsequent re-connections more efficient by eliminating the transfer of data that is considered to have already been exchanged. Exceptions to this occur in two instances. The first is if the **Controlled Remote** window's **Address** button is clicked and the resulting dialog is exited using the **OK** button. In this case, the next re-connection process will involve the complete configuration exchange sequence. The second case is when the list of vehicles the Remote is tracking is changed. At that time, the new vehicle list is sent and the complete configuration for each is sent.

During the connection and subsequent exchange of configuration data, there are messages that are considered to be critical and those that are considered to be non-critical. If the appropriate acknowledgment or response is not received from the Remote after three attempts to send data or query for data considered to be critical, the connection process is aborted. If this occurs while working with messages considered to be non-critical, the process simply moves on to the next step.

While connected, the Controller checks the communications once a minute by transmitting a "heartbeat" to the Remote, which returns the message to indicate the communications are okay. If unsuccessful, this attempt is tried three times each minute before aborting the attempt. If the Controller's attempts to initiate a heartbeat response from the Remote fail for 5 consecutive minutes, it disconnects from the Remote. It will try and reconnect every minute after this.

At the Controller, any changes to the configuration of any vehicle that is being tracked by any Remote are automatically transmitted to the Remotes to maintain synchronization.

Note: when not connected, not all options in the **Controlled Remote** window are accessible.

The name of the Remote vehicle associated with a **Controlled Remote** window is included in that window's title bar.

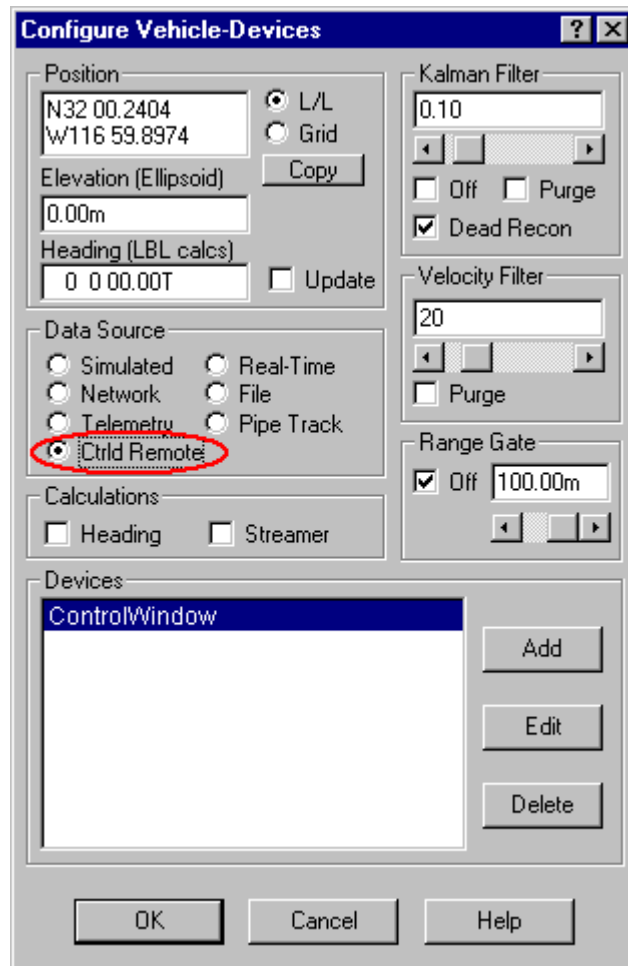
To Add and Configure a Controlled Remote in the Controller's Vehicle List

All remote vehicles that are to be tracked at the Controller using the information from **Controlled Remote** windows must be added to WinFrog (see the **Vehicles** chapter).

There are a few points specific to a Controlled Remote .

- 1 In the **Configure Vehicle-Devices** dialog, set the **Data Source** to **CtrlId Remote**.

No further configuration is required in this dialog, with the exception of devices, if required. The only devices that can be added to a controlled remote vehicle at the controller are output devices.

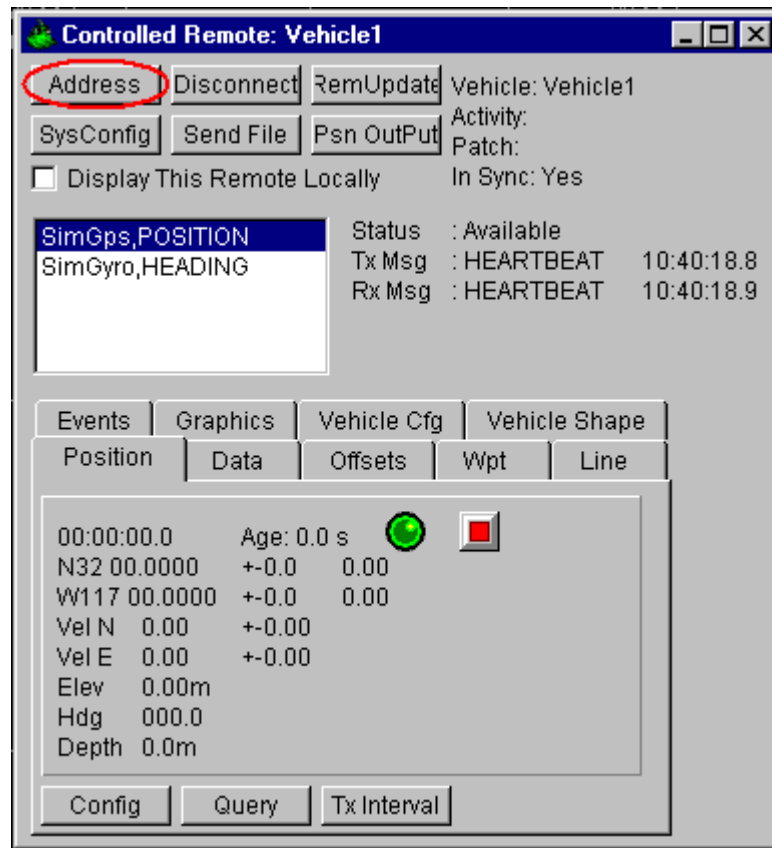


2 Vehicle Presentation dialog

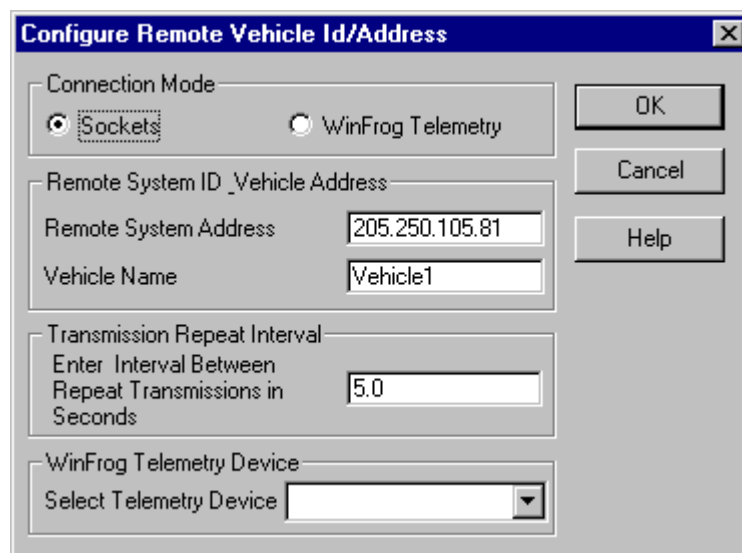
The name of the Controlled Remote must be entered here exactly as it is entered at the Remote. If this is not done, the data from the associated **Controlled Remote** window will not be associated with this vehicle.

To Connect to a Remote

- 1 From the **View** menu, choose the **Controlled Remote** option.



- 2 Click the **Address** button and configure the communications protocol and Remote name and ID/address.



Connection Mode

Sockets	Select this option to use the TCP/IP sockets as the communications medium.
WinFrog Telemetry	Select this option to use the WinFrog Telemetry device as the communications medium.

3 Select the appropriate **Connection Mode**.

If using **Sockets**, enter the IP address of the WinFrog Remote computer, e.g. 10.0.0.10. To determine the IP address of the Remote, open a DOS window on that computer and type **ipconfig** and press Enter. If the computer is correctly setup for TCP/IP protocol, the IP address displays.

If using the WinFrog Telemetry device, enter the Ship ID as entered for the **Remote WinFrog's Telemetry** device configuration (see the **Multi-Vehicle Positioning & Telemetry** chapter). The parameter entered here is the address used to identify the WinFrog system that is communicated with using this window.

4 Enter the Remote's local **Vehicle Name**.

The local vehicle at the Remote is the vehicle on which the Remote system is installed. **Note:** the name must be entered exactly as entered at the Remote. The Controller uses this name and the name entered for the respective vehicle added to the Controller (see the **To Add and Configure a Controlled Remote in the Controller's Vehicle List** section) to associate the data from the Remote with the vehicle tracked at the Controller.

Note: If the ID/address is correct but there is an error in the vehicle name, the **Controlled Remote** window will connect to the Remote WinFrog system but will be unable to refine the connection to the correct vehicle. As a result, the connection will appear to be okay, but there will be no communication from the Remote's local vehicle itself. The name must be entered exactly as it is entered at the Remote.

Note: if the name entered for the respective vehicle added to the Controller does not exactly match the name entered here for the Remote's local vehicle (but the name is entered correctly here), the data will appear in the **Remote** window correctly and the communications with the Remote will operate correctly. However, the Controller will not be able to correctly associate the data from the Remote with the vehicle it has added for tracking and the position in the **Vehicle Text** window will be yellow and won't update.

5 Enter a **Transmission Repeat Interval**.

When the Controller transmits a query, configuration data, or a file segment, it waits for the appropriate response. If it does not get a response within the

time interval entered here, it repeats the transmission. The process is repeated three times. If the appropriate response is not received, the transmission is aborted. The default of five seconds is a reasonable initial setting if using the **WinFrog Telemetry**, though this can usually be reduced to three in reasonable conditions. If using sockets, an interval of one second is reasonable.

- 6 If using the **WinFrog Telemetry** for communications, select the **WinFrog Telemetry Device** from the dropdown list. WinFrog supports the use of multiple telemetry devices in cells. All telemetry devices added to the Controller are listed here.

Note: the positions received from a Remote in one cell can be transmitted to a Remote on another cell. This permits the use of multiple cells with only a few Remotes in each. The fewer the Remotes in a cell, the faster the attainable update rates within that cell.

- 7 Click **OK** to exit.

Note: if an attempt to connect to a **Remote** is already in progress after exiting the **Address** dialog box, perform the following corrective steps.

- Return to the **Address** dialog.
- Change the **Connection Mode** from the desired mode.
- Click **OK** to exit.
- Return to the **Address** dialog.
- Re-select the correct **Connection Mode**
- Click **OK** to exit.

This will reset the connection to the Idle state regardless of what stage it had previously been in.

- 8 The vehicle list for the Remote should be configured now, before attempting to connect to the Remote or later after the connection is complete. An advantage of doing it at this stage is that if all the vehicle configurations are already known (i.e. all the other Remotes have already been connected to and interrogated for their configurations), the time consuming process of transmitting the configurations is executed at connection time. A disadvantage is that if the vehicle list for the Controller is incomplete or the configurations for all the vehicles (including any other Remotes) is incomplete, the current configurations will be sent now and then have to be re-transmitted as each vehicle configuration is completed.

If it is desired to edit the Remote vehicle list at this point, refer to the **To Edit The Remote's Vehicle List** section.

- 9 The **Status** line, in the **Controlled Remote** window, should indicate **Idle**. Click the **Connect** button to initiate the connection process. The progress can be monitored by viewing the Status, Tx Msg and Rx Msg lines. The appropriate Status line message is given here for each stage. For more information concerning the messages given in the Tx Msg and Rx Msg lines, refer to the **Monitoring the Controller/Remote Communications** section.

The process is as follows:

- Controller looks for the Remote. Status is **Connecting**
- After detecting the Remote, the Controller synchronizes with the Remote. Status is **Syncing**.
- If the Controller cannot detect the Remote it returns to the **Idle** state. If this occurs, click the **Connect** button again. If the Remote still cannot be detected, the communication settings for the Controller and the Remote must be checked to ensure they are correct. An incorrect address and/or Ship ID is often the cause of the problem. If using the WinFrog Telemetry, check the **I/O Devices** window for this device to ensure that the telemetry network is operating correctly.
- The Controller sends the communication parameters to the Remote, including the **Vehicle List** that the Remote is to use. Status is **Initializing**.
- The Controller then waits 30 seconds for the Remote to configure its vehicle list. Status is **Waiting n seconds**, where n is the count down from 30 seconds.
- If the connection is a re-connect after a successful connection has previously been made, and no changes to the **Address** or **Vehicle List** have been made, the next two steps are skipped.
- The Controller updates the Remote with the configurations of the vehicles in the **Vehicle List**, sent during the initialization stage above. If the list is empty, this step is skipped. Status is **Updating**.
- The Controller queries the Remote for its complete configuration. Status is **RqstCnfg**.
- When the Remote's configuration download is complete, the Controller transmits a **StartPulse** to the Remote and looks for a reply. This message informs both systems that the configuration exchange is complete. Status is **Starting**.
- When the Controller receives the Remote's **StartPulse** reply, the connection process is completed. Status is **Available**.

Note: When using sockets, many of the stages occur so quickly that the

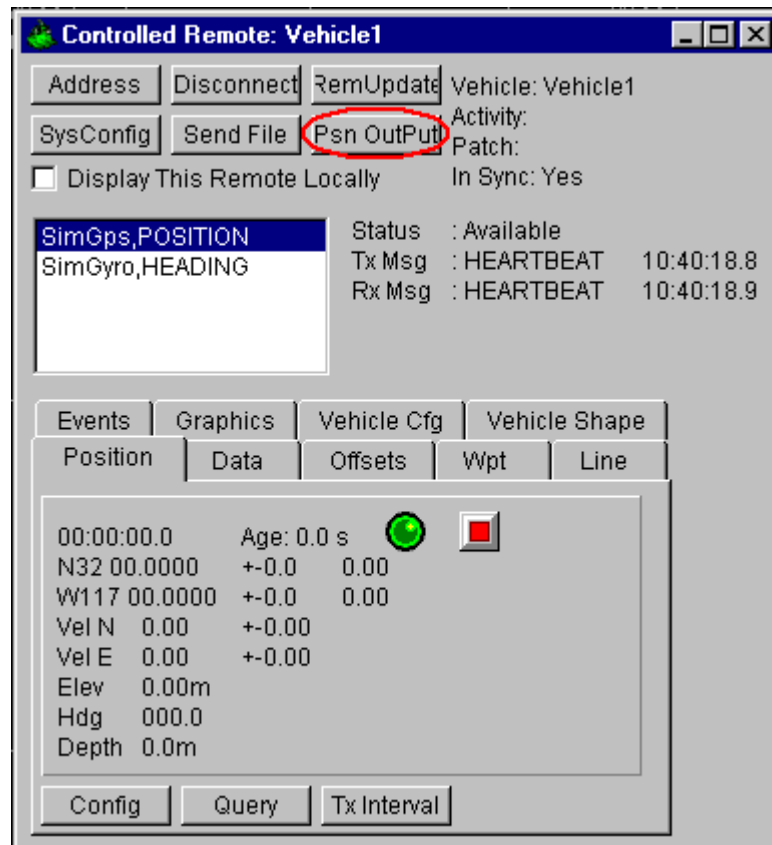
associated status is displayed and then replaced by the next stage status in such a fashion that it is not even detectable by the operator.

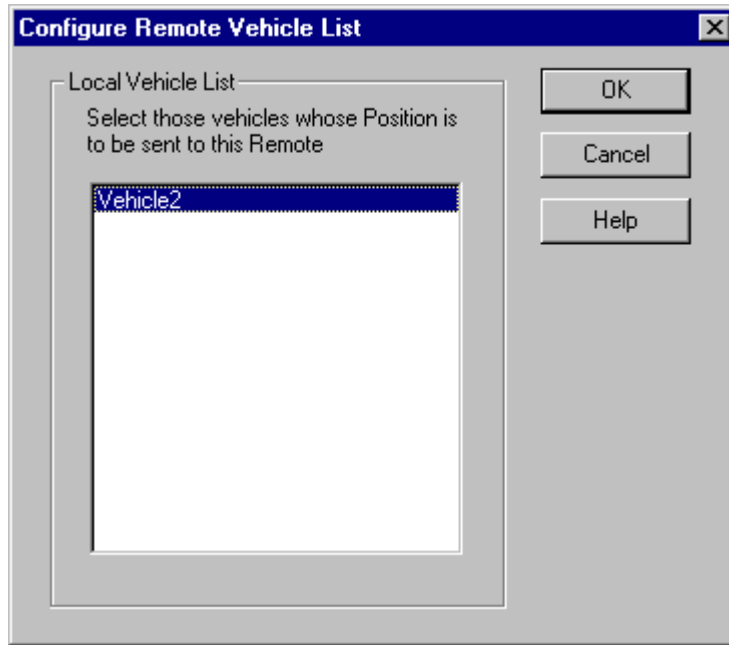
To Disconnect from a Remote

- 1 Click the **Disconnect** button.
- 2 The Controller transmits a disconnect message to the Remote and awaits a reply. Status is **Disconnecting**.
- 3 When the reply to the disconnect message is received from the Remote, the Controller changes to the **Idle** state. Status is **Idle**.
- 4 If after three transmissions of the disconnect message, the Controller has not detected the appropriate reply from the Remote, the Controller resets its connection state and changes to the **Idle** state. Status is **Idle**.

To Configure the Vehicle List for the Remote

- 1 Click the **Psn OutPut** button.





- 2 In the **Configure Remote Vehicle List** dialog, select those vehicles that are to be tracked at the Remote.

Any vehicle already on the list will be highlighted. To select an unselected vehicle, click on it in the list and it will become highlighted. To de-select a selected vehicle, click on it in the list, and will become un-highlighted.

- 3 Click the **OK** button.
- 4 The Controller transmits the vehicle list to the Remote. Status is **Initializing**.
- 5 The Controller waits 30 seconds while the Remote re-configures it's vehicle list. Status is **Waiting n seconds**, where n is the count down from 30.
- 6 The Controller sends the complete configuration for each vehicle on the list. Status is **Updating**.
- 7 The Controller resumes normal communications. Status is **Available**.

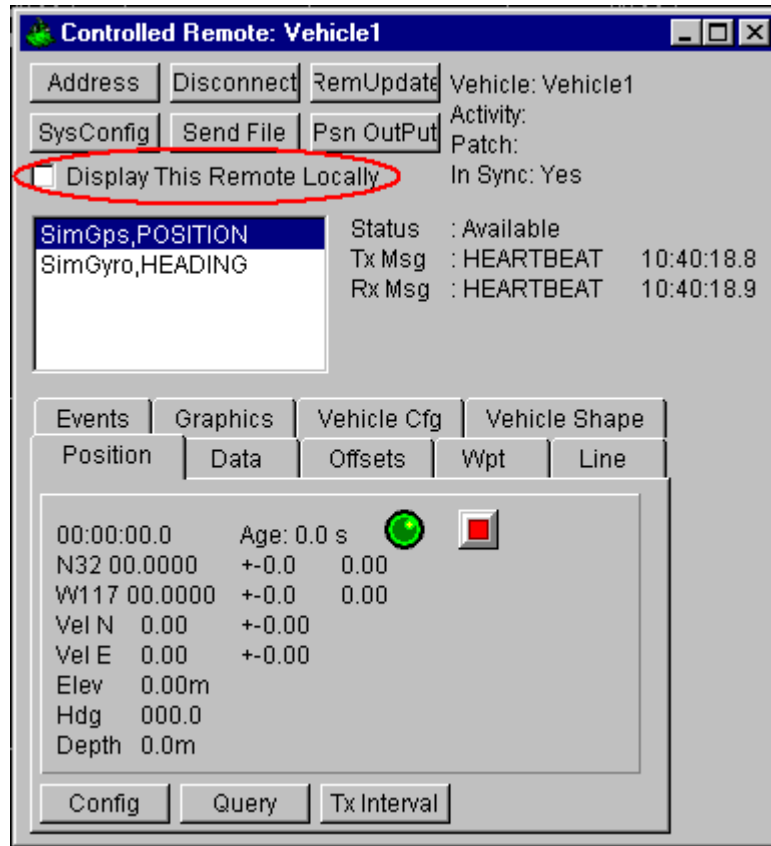
The position data for four vehicles is sent in any one position transmission by the controller. If there are more than four vehicles on the list to be transmitted, they will be cycled through. The actual position output rate is determined by the fastest selected Tx Interval for a Remote position update rate in any of the **Controlled Remote** windows sharing the same telemetry device.

If more than one Remote is in a given telemetry cell, the **Tx Msg** line will indicate the transmission of the position output message in only one of the **Controlled Remote** windows.

To Display the Remote Graphics at the Controller

- 1 Check the **Display This Remote Locally** box.

Any other **Controlled Remote** window that has this checked is automatically set to unchecked.



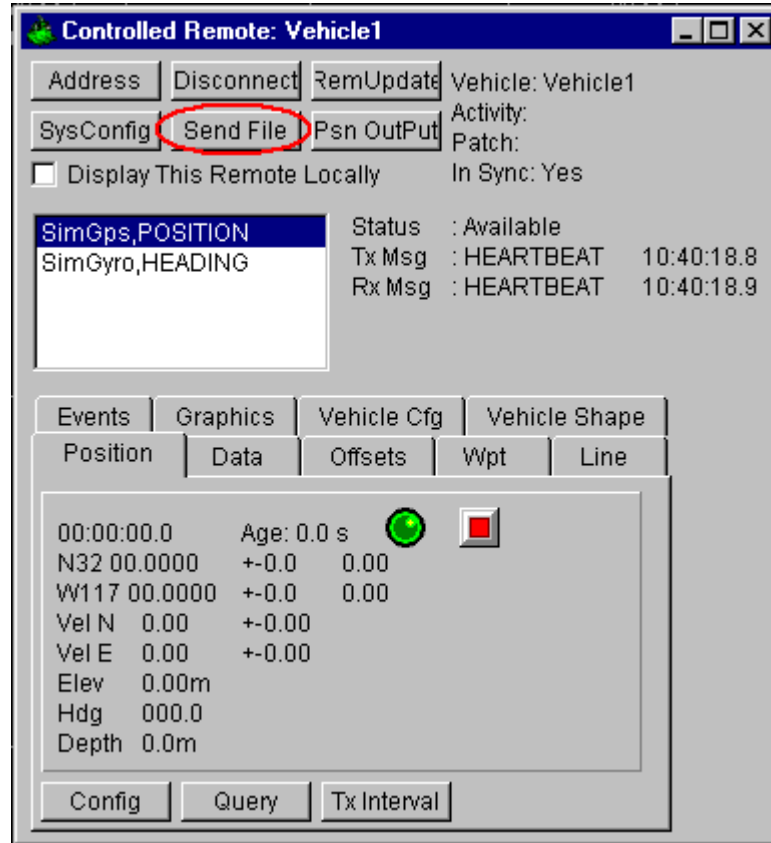
Checking this box automatically sets the configuration for the Controller's **Graphics1** window to match the configuration for the same window on the Remote. This enables the Controller to monitor what the Remote is seeing.

Note: this forces the Controller to use the same **Graphics1** window configuration, but it does **not** mimic all factors affecting the display of data in the this window, due to the limitations of the synchronization of the Controller and the Remotes. For example, the Controller's **Graphics1** window displays all vehicles set to be displayed at the Controller, whereas the Remote may not even be configured to track all vehicles. As a result, the Controller's **Graphics1** window will not be exactly as the Remotes. While in this mode, if the **Graphics1** window on the Controller has the focus, any toolbar graphic functions, such as Zoom In, and any change in the configuration for this window will be transmitted to the Remote as if they were accessed directly from the **Controlled Remote** window via the **Graphics** tab. They will not be applied at the Controller until an acknowledgment of

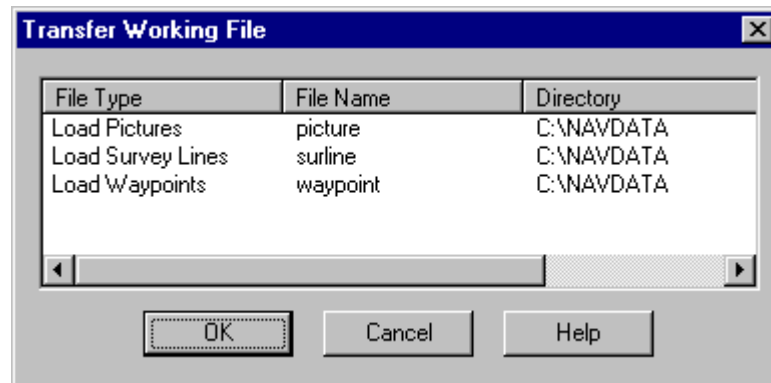
the changes transmission has been received from the Remote.

To Send a Working File to the Remote

- 1 Click the **Send File** button in the **Controlled Remote Window**.



- 2 In the **Transfer Working File** dialog, select the **Working File** to transfer to the Remote, either pictures, survey lines, or waypoints.



- 3 Click the **OK** button. The transfer starts immediately.

The Controller transmits the file in segments. After transmitting each segment, it waits for confirmation that the Remote has received that segment without

errors. If necessary, the Controller makes three attempts to transmit each segment. If unsuccessful after three attempts to send the same segment at any stage in the file transfer, the transfer is aborted.

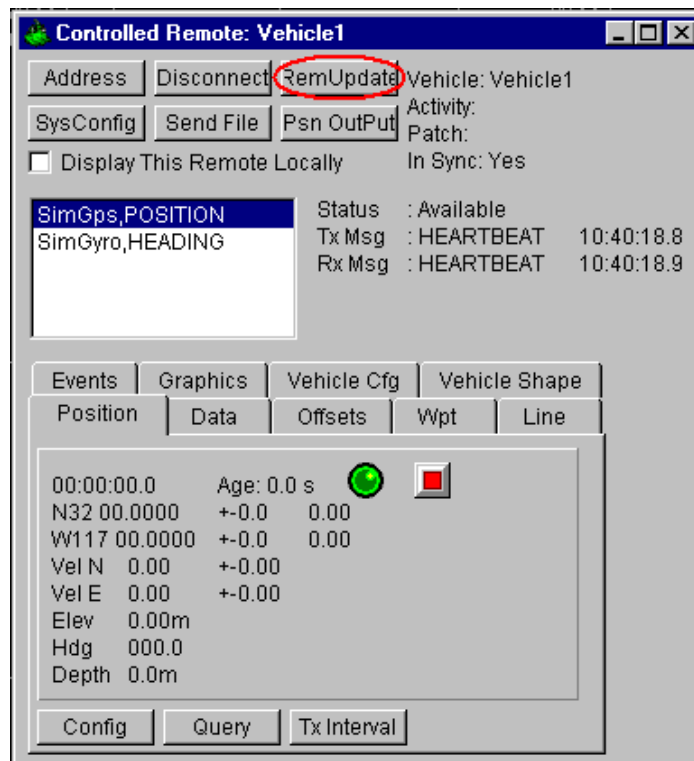
The **Status** of the process can be monitored with the **Tx Msg** and **Rx Msg** lines in the **Controlled Remote** window. The following messages may be found in the status lines:

Tx Msg :FILE REC n	Controller has sent file segment n
Tx Msg :FILE ABORT	Controller has aborted the file transfer
Rx Msg: FILE Rn CFM	Remote has received segment n OK
Rx Msg: FILE Rn ERR	Remote has received segment n with an error, Controller will re-transmit this segment.
Rx Msg :FILE ABORT	Remote has confirmed aborted file transfer.

- 4 At the Remote, when the file transfer is completed, the new file automatically replaces the current relevant Working File and is written to the disk.

To Force an Update of the Configuration of the Vehicles on the Remote's Vehicle List

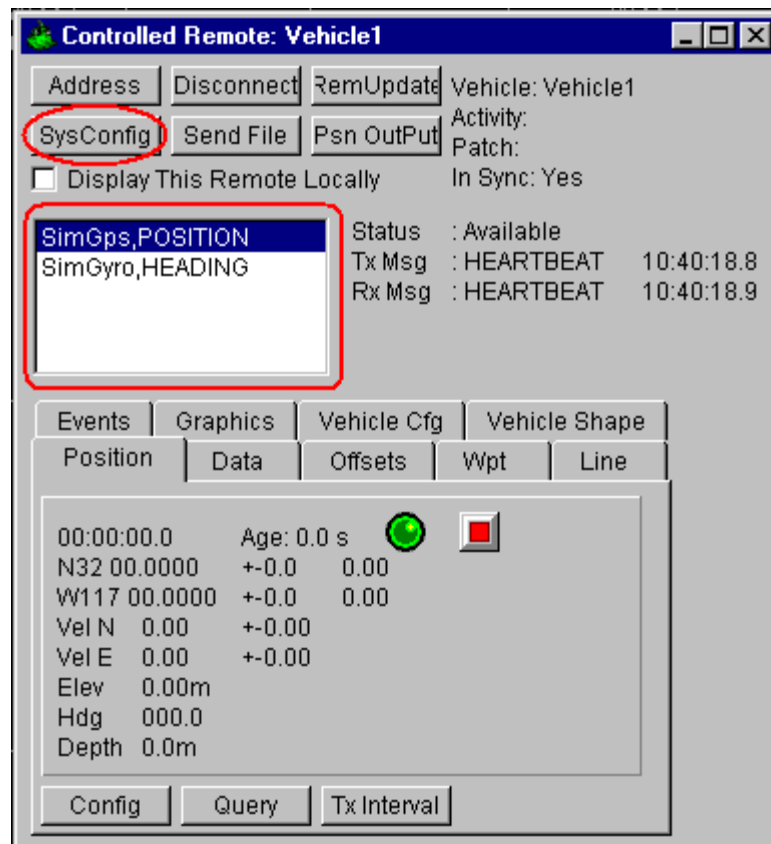
- 1 Click the **RemUpdate** button.



- 2 The Controller sends the complete configuration for each vehicle on the list. Status is **Updating**.
- 3 The Controller resumes normal communications. Status is **Available**.

To Interrogate the Remote Vehicle Data Type List and Configuration

- 1 Click the **Sys Config** button.



- 2 The Controller queries the Remote for the list of device data types that are attached to the Remote's local vehicle and their associated configurations. The **Tx Msg** line will show **SYS CFG QRY**. When the Remote responds, the **Rx Msg** line will show **ITM TYPE**.
- 3 The data types attached to the vehicle are listed in the list window to the left of the status lines.

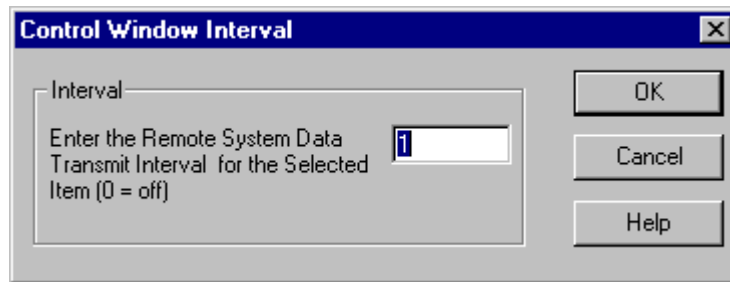
To Query the Remote Vehicle and System for Configurations

- 1 Select the tab associated with the data of interest.
- 2 Click the **Query** button.
- 3 The Controller sends the associated query message to the Remote. This is indicated in the **Tx Msg** line.

- 4 The Remote responds by sending the configuration data to the Controller. This is indicated in the **Rx Msg** line.
- 5 The information in the tab is updated accordingly. Further review of the configuration is possible by clicking the **Config** button (see the **To Configure the Remote Vehicle and System** section).

To Set the Remote's Data Transmission Rate

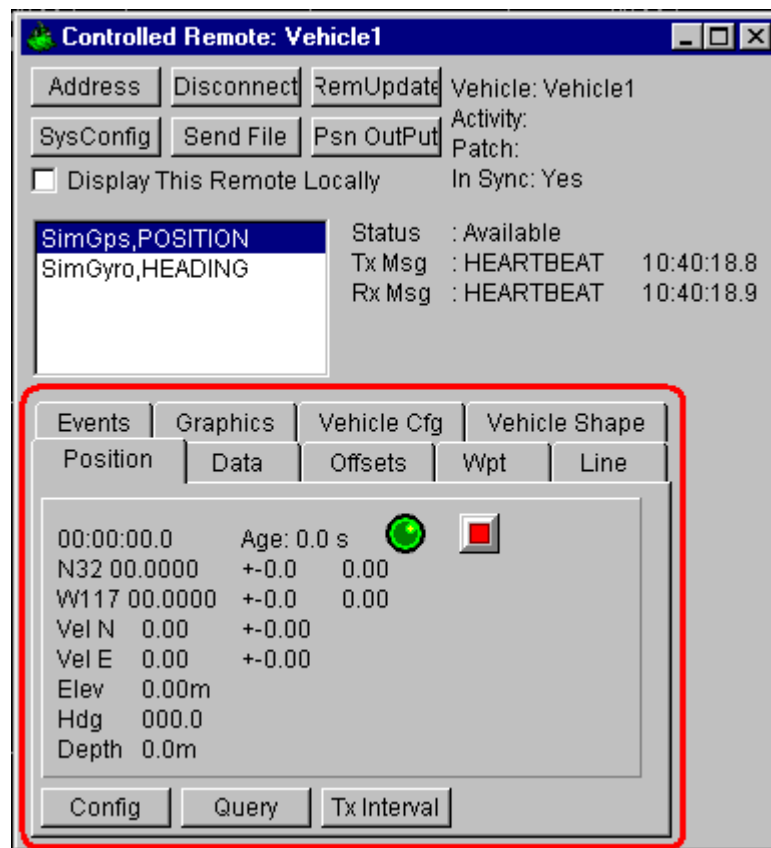
- 1 Select the tab associated with the data of interest.
- 2 Click the **Tx Interval** button.



- 3 Enter the desired update rate in seconds.
Note: it is important that the update rate is not set at a rate that exceeds the communications mode. To enhance the performance of the Controlled Remote feature, only that data that are required should be transmitted by the Remote back to the Controller.
- 4 Click **OK**.
- 5 The Controller sends a communication configuration message to the Remote. This is indicated in the **Tx Msg** line with **COM CFG UPD**.
- 6 The Remote sends a confirmation message back to the Controller. This is indicated in the **Rx Msg** line with **COM CFG UPD**.

Monitoring and Configuring the Remote Vehicle and Graphics

The tabs in the **Controlled Remote** window and their associated buttons below them enable you to view specific information about the Remote vehicle and graphics and query and configure the Remote with respect to the data type tab selected.



To Configure the Remote from the Controlled Remote Window

- 1 Click the tab for the appropriate data, then click the **Config** button.

The associated configuration dialog will appear. This reflects the associated configuration at the Remote. This is an important point as there are several areas where this may result in confusion if this is not considered.

If you click the **OK** button to exit the **Configuration** dialog, the appropriate configuration message is transmitted to the Remote. The change is not reflected at the Controller until it has received a confirmation from the Remote that the configuration message was received and implemented. At this time, the changes are made at the Controller as well. The changes are then transmitted to all Remotes.

If a configuration message is not acknowledged by the Remote after three attempts, the configuration is aborted. No message is currently presented to you with this information. Therefore, any attempt at re-configuring a Remote must be monitored during the communications process to ensure it was successful. The status of the communications can be monitored in the Tx Msg and Rx Msg lines. It can also be checked by re-accessing the associated configuration dialog. If the Remote acknowledged the configuration, the changes will be present in the configuration dialog. If not, the configuration settings will have reverted to their original state.

Note: the configuration for the Remotes can also be manipulated from the standard WinFrog locations when the Remote vehicle is selected. For example, from the **Vehicle Text** window displaying a Remote vehicle, use the right mouse button to access the pop-up menu and select **Configure Offsets**. Changes made here are transmitted to the Remote. They will then be reflected at the Controller once confirmation has been received from the Remote that the configuration change was received and implemented. There are exceptions to this. These will be discussed later in this section.

The individual configuration dialogs will not be discussed here unless there are specific points that require comment. Refer to the appropriate chapters for information on the associated configurations.

To Interrogate the Remote from the Controlled Remote Window

- 1 Click the tab for the appropriate data, then click the **Query** button.

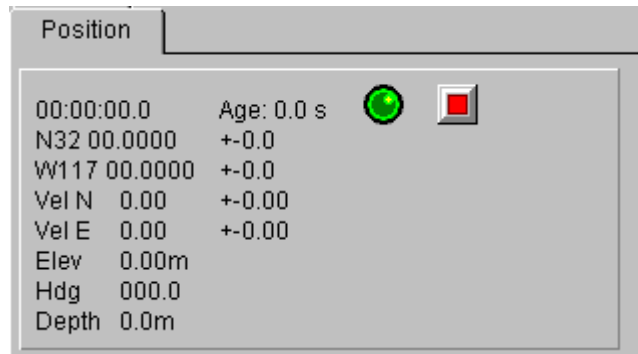
The Controller sends an interrogation to the Remote, which, in turn, will reply with the appropriate configuration data. The query will be repeated three times if an appropriate reply is not received from the Remote. If still unsuccessful, the query is aborted. **Note:** there is not a message to advise you that the query is aborted, so you should monitor the query process to ensure it is successful.

Note: to set the data transmission rate for the Remote from the **Controlled Remote** window, see the **To Set the Remote's Data Transmission Rate** section. Only the **Position**, **Data**, and **Event** tabs have an associated **Tx Interval** button.

The following details the available tab displays and the associated configuration, query, and transmission if comments are required.

Position Tab

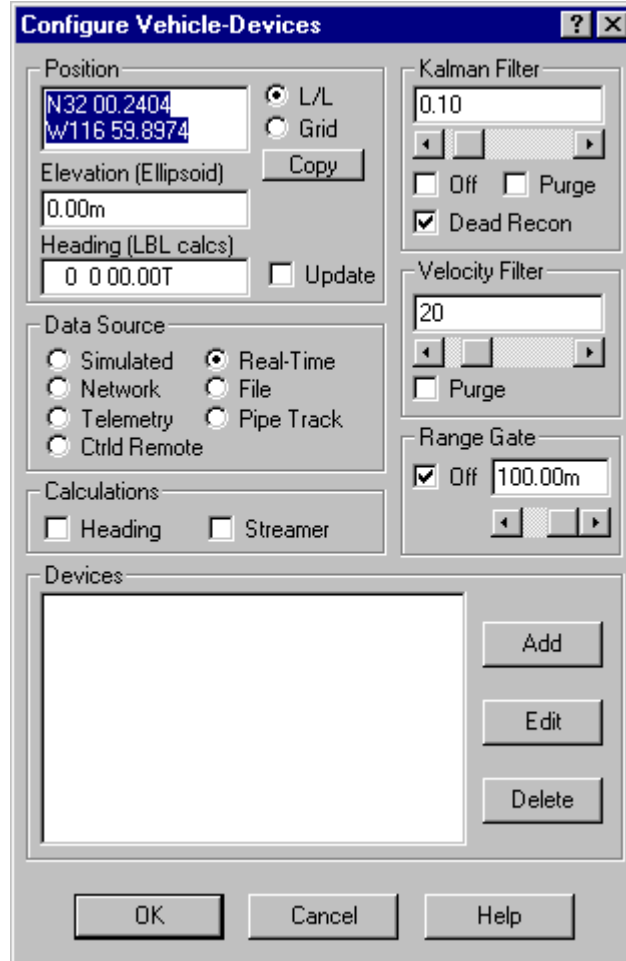
Displays the position information for the Remote if the associated Tx Interval has been set such that the Remote is transmitting the position data back to the Controller.



The display includes:

- The time of the position and the age of the data used for the position at the Remote.
- Latitude and longitude in the Remote's local ellipsoid complete with the standard deviation (from the Kalman Filter).
- Velocity North and East vectors with the standard deviations (from the Kalman Filter).
- Elevation
- Heading
- Water Depth
- Position status LED indicating the status at the Remote. If the age of the data exceeds 15 seconds the LED is yellow; if the age exceeds 30 seconds, the LED is red. In addition, if the age exceeds 30 seconds an audible alarm sounds. This is acknowledged by clicking the red button in this tab.

If you click the **Config** button while this tab is displayed, the **Configure Vehicle-Devices** dialog opens. This operator interface is susceptible to incorrect configuration. There are several important aspects to this configuration.



Notice that although the **Data Source** is set to **Real-Time**, there are no devices displayed. It is important that you do not try to add devices (click the **Add** button) from this dialog. If data types are added, the information is not transmitted to the Remote because this capability is not supported by the **Remote Control** feature. However, they will remain in the list adding confusion to the operation that is really occurring.

Changing the **Data Source** results in the change being implemented at the Remote and causes the Remote vehicle to stop positioning correctly. Do **not** change this setting.

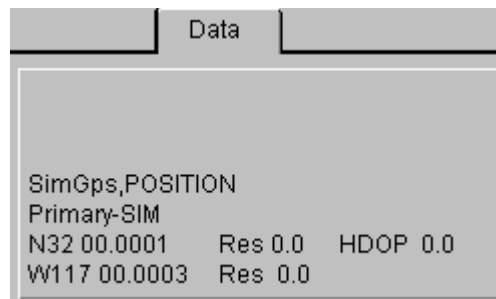
The configuration information in the **Position**, **Kalman Filter**, **Velocity Filter**, and **Range Gate** panels are the configuration items intended to be manipulated from the Controller.

It is also important to note that when the **Configure Vehicle-Devices** dialog is accessed from any other part of the Controller, such as via the right-click in the **Vehicle Text** window (when the Remote vehicle is displayed), it does not send a configuration message to the Remote when exited with the **OK** button. It does display the current settings of the **Position**, **Kalman Filter**, **Velocity Filter**, and **Range Gate** panels at the Remote. If these settings are changed here, the Remote is not changed, but the same dialog accessed via the associated **Controlled Remote** window will show these new settings. Therefore, do **not** change the settings of the **Position**, **Kalman Filter**, **Velocity Filter**, and **Range Gate** panels from here for a Remote. The **Configure Vehicle-Devices** dialog accessed from anywhere but the **Controlled Remote** window is only for the designating the vehicle as a **CtrlId Remote** and adding output devices as required (see the **To Add and Configure a Controlled Remote in the Controller's Vehicle List** section).

Data Tab

Displays the raw data for the Remote if the **Tx Interval** associated with this tab has been set such that the Remote is transmitting the raw data back to the Controller. The specific data displayed are controlled by selecting a data type in the **Data Type List** in this window. The display is the same format used in the **Calculations Window** for **Data Item Text**.

Note: the transmission of raw data is given a lower priority by the Remote than any other data being transmitted. As a result, the update rate for the raw data may not be as high as set using the **Tx Interval** button. The viewing of the raw data is intended for troubleshooting the Remote system. If required, the position transmission interval for the Remote should be set to 0 seconds (off) and only the data set to transmit.



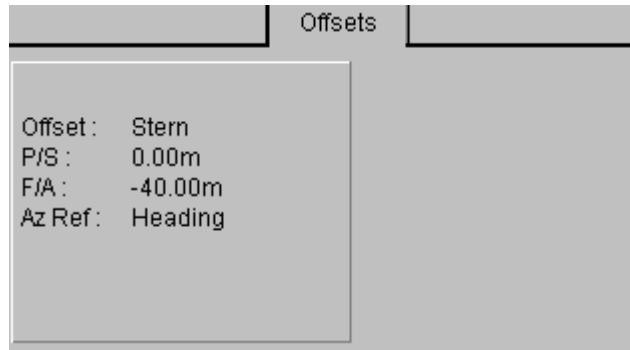
The configuration for the data type is accessed by clicking the **Config** button when the data tab is displayed. The configuration (and **Query** if clicked) is for the data type displayed at the time the button is clicked. The configuration for the data types at the Remote are only accessible from here. The configuration dialogs accessed are the same as those accessed for the data types via the **Configure Vehicle-Devices** dialog when a data type is highlighted and the **Edit** button is clicked.

The data transmission rate set by clicking the **Tx Interval** button controls the

transmission of the raw data for all data types, not just the one displayed at the time.

Offsets Tab

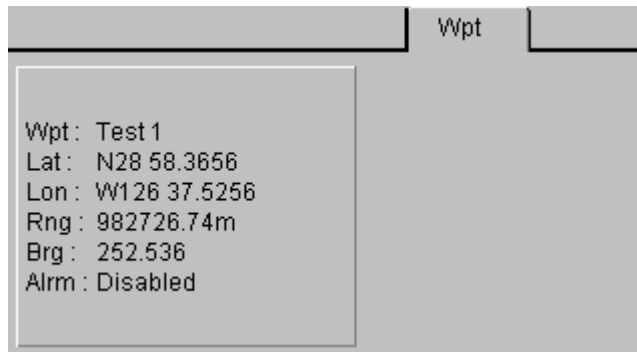
Displays the current vehicle offset selected for the Remote.



The configuration of the offsets for the Remote can be accessed from here or anywhere else offsets are configured at the Controller (i.e. from the **Vehicle Text** window when the Remote vehicle is displayed, use the right mouse button to access the pop-up menu and select the **Configure Offsets** option) with the same results.

Wpt Tab

Displays the active waypoint and waypoint tracking information for the Remote.



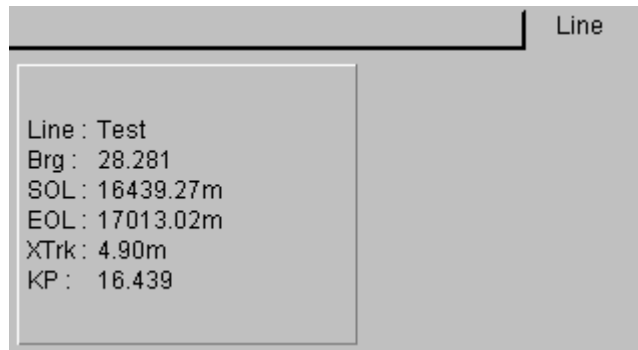
The configuration of the active waypoint for the Remote can be accessed from here or anywhere else a waypoint can be selected at the Controller (i.e. from the **Vehicle Text** window when the Remote vehicle is displayed, use the right mouse button to access the pop-up menu and select the **Setup Waypoint Tracking** option) with the same results.

When a waypoint is selected, the waypoint tracking configuration and the associated waypoint data are transmitted to the Remote. Therefore, the **Remote's Working Waypoint** file does not need to be synchronized with the

Controller in order to configure the waypoint tracking for the Remote. The waypoint file accessed when selecting a waypoint at the Controller for the Remote is, in fact, the Controller's **Working Waypoint** file.

Line Tab

Displays the active line name and line tracking information for the Remote.

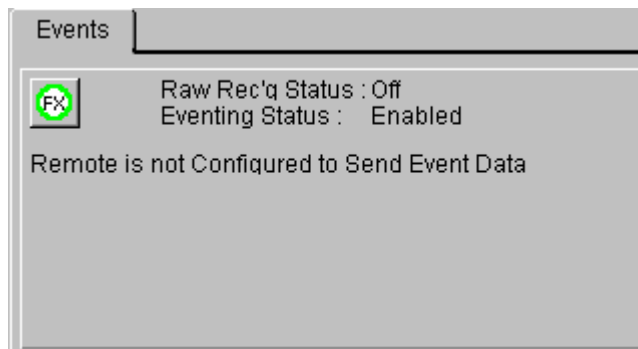


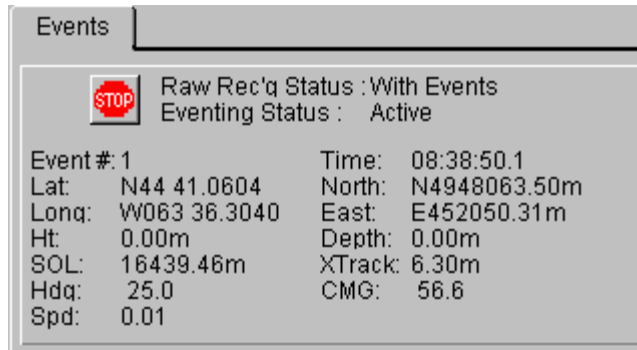
The configuration of the active line for the Remote can be accessed from here or anywhere else a track line can be selected at the Controller (i.e. from the **Vehicle Text** window when the Remote vehicle is displayed, use the right mouse button to access the pop-up menu and select the **Setup Line Tracking** option) with the same results.

When a line is selected, the line tracking configuration and the associated line data are transmitted to the Remote. Therefore, the Remote's **Working Survey Line** file does not need to be synchronized with the Controller in order to configure the line tracking for the Remote. The line file accessed when selecting a line at the Controller for the Remote is, in fact, the Controller's **Working Survey Line** file.

Events Tab

Displays the event status and data for the Remote. The **Start Events** and **Stop Events** buttons are located directly within this tab if the **Events** are enabled or active, respectively.





The configuration of the Eventing at a Remote requires two stages of configuration communications, the first to setup the eventing parameters and the second to define and create the appropriate files. If either fails, the event configuration aborts.

The actual configuration is the same as if being executed for a local vehicle. Refer to the **Eventing** chapter. The starting and stopping of the events is controlled via the buttons that are shown in this tab at the appropriate stages of event setup and execution. These mimic those in the standard WinFrog toolbar.

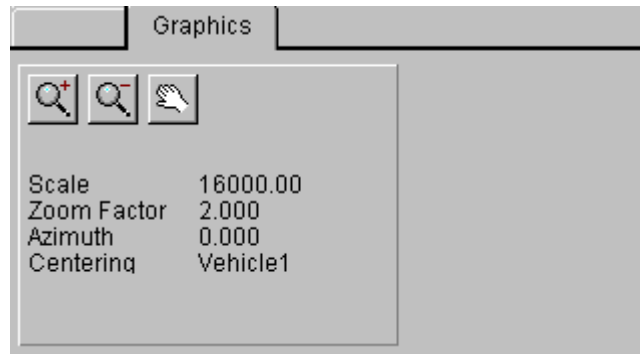
It is important to note that even though the event data can be sent by the Remote back to the Controller, it is only logged at the Remote.

Note: the eventing configuration accessed here is for the Remote only. Eventing configuration accessed anywhere else at the Controller is for the Controller system. The two are independent, including the setting of the **Event** states of **Off**, **Primary**, and **Secondary** in the **Vehicle Presentation** dialog.

Note: if the Remote is a WinFrog Remote package instead of WinFrog with the Remote module, it does not support Eventing. In this case, when the **Events Tab** is selected, the statement *This Remote Vehicle does not support Eventing.* is displayed in the tab and the **Config**, **Query** and **Tx Interval** buttons are not visible.

Graphics Tab

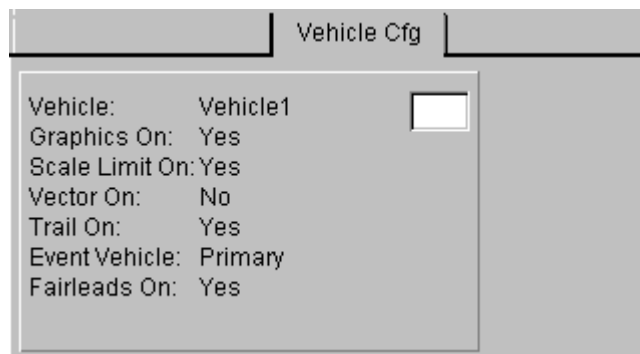
Displays the **Graphics1** window configuration basics for the Remote. There are also **Zoom In**, **Zoom Out**, and **Pan** buttons located directly in this tab to directly control the Remote.



Note: The configuration and manipulation of the Remote's **Graphics1** are only possible from here (unless the **Display This Remote Locally** checkbox is checked). In this case, any action and configuration executed on the **Graphics1** window at the Controller acts directly on the Remote **Graphics1** window.

Vehicle Cfg Tab

Displays the basic vehicle presentation configuration for the Remote, including a rectangle displaying the current vehicle color. The associated configuration dialog is **Vehicle Presentation**.



The configuration of the Vehicle Presentation for the Remote can be accessed from here or anywhere else a track line can be selected at the Controller (i.e. from the **Vehicle Text** window when the Remote vehicle is displayed, use the right mouse button to access the pop-up menu and select the **Vehicle Presentation** option) with the same results.

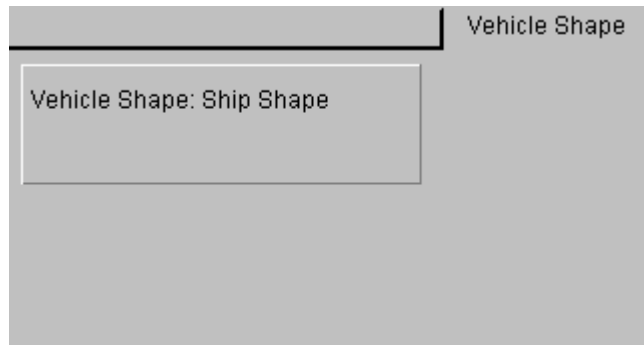
The exception to this is as follows:

The manipulation of the **Event Generation** settings is associated with where this dialog is opened. If opened from the **Controlled Remote** window, these settings affect the Remote vehicle at the Remote. If opened from anywhere else at the Controller (i.e. from the **Vehicle Text** window when the Remote vehicle is displayed, use the right mouse button to access the pop-up menu and select the **Vehicle Presentation** option) these settings affect the Remote vehicle at the Controller. Therefore, the **Event Generation** settings at the Controller and the Remote are independent.

It is important to note that the name of the Remote can be changed from this dialog. If this is done, the name entered for the **Remote Vehicle Name** for the associated **Controlled Remote** window (see the **To Connect to a Remote** section) must be changed to reflect this. Otherwise, though the connection to the Remote WinFrog will remain operational, communications with the Remote vehicle will cease.

Vehicle Shape Tab

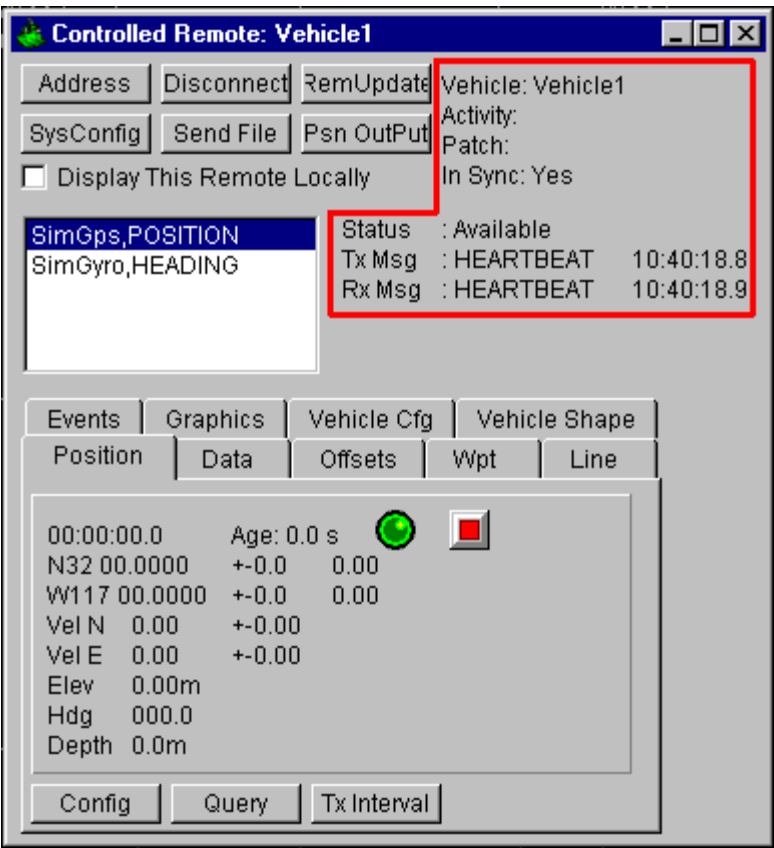
Displays the vehicle shape type for the Remote. The configuration associated with this tab is the **Configure Vehicle Outline** dialog.



The configuration of the **Configure Vehicle Outline** for the Remote can be accessed from here or anywhere else a track line can be selected at the Controller (i.e. from the **Configure Vehicles** dialog when the Remote vehicle is highlighted, click the **Configure Vehicle Outline** button) with the same results.

Monitoring the Controller/Remote Communications

The **Connection Status** lines display the status of the Controller/Remote connection plus current activity. The second to fourth lines in the top right hand corner pertain to OBC Seismic operations. The remaining status lines are general.



Vehicle	The name of the Vehicle to which the Controlled Remote window is configured to connect.
Activity	The current seismic-related operation in which the Remote vehicle is currently involved.
Patch	The name of the patch in which the Remote vehicle is working.
In Sync	The status of the synchronization of the Controller and the Remote with respect to the seismic line set.

Status	The connection state in which the system is currently. The possible states are listed here. The first 5 states listed are associated with the unconnected and connecting stages. The remaining items are associated with the connected stage.
Idle	The connection is idle, no communications are being attempted.
Waiting For Address	There was an error in the sockets connection, the socket is waiting for an address.
Connecting	The connection with the Remote WinFrog system is underway.
Connected	The connection with the Remote WinFrog system has been made.
DisConnecting	The Controller is disconnecting from the Remote.
Idling	The controller is waiting to connect.
Syncing	The controller has connected and is now synchronizing with the Remote.
Initializing	The controller is sending the connection configuration to the Remote to initialize the communications. It also sends the list of vehicles to be tracked by the Remote at this point.
Waiting n seconds	The controller waits for 30 seconds while the Remote sets up its vehicle list and initializes each vehicle.
Updating	The controller sends the configuration for all the vehicles that the Remote is to track.
RqstCnfg	The controller requests the Remote vehicle's configuration.
Starting	The controller sends a start pulse to the Remote to tell it that the controller is ready to proceed after the connection process and exchange of configurations is completed. The Remote responds in like.
Available	Indicates the connection has been successfully made including the exchange of the start pulses and communications are operating normally.
Confirming	Periodically the Controller confirms the connection by sending a Heartbeat to the Remote and the Remote responds in like.

Tx Msg	Displays the last message type transmitted via this window and the time it was sent to the transmit queue. The message can be any of the following:
Waiting to Connect	Another window is trying to connect, this window is waiting its turn.
DISCONNECT	Disconnect message.
CONNECTING	Connect message.
COM CFG UPD	Communication configuration message.
SYS CFG QRY	Querying the Remote vehicle data types.
VEH CFG QRY	Querying the Remote vehicle configuration.
VEH SHP QRY	Querying the Remote vehicle shape.
VEH O/S QRY	Querying the Remote vehicle offset configuration.
PSN CFG QRY	Querying the Remote vehicle position calculation configuration.
ITM CFG QRY	Querying the Remote vehicle data types configuration.
LIN CFG QRY	Querying the Remote vehicle line tracking configuration.
WPT CFG QRY	Querying the Remote vehicle waypoint tracking configuration.
GRF CFG QRY	Querying the Remote WinFrog Graphics1 window configuration.
EVT CFG QRY	Querying the Remote vehicle eventing configuration.
STARTPULSE	Startpulse message to instruct the Remote WinFrog to start normal communications.
HEARTBEAT	Heartbeat sent by the Controller to confirm communications with the Remote WinFrog are still okay.
FILE ABORT	The Working File transfer has been aborted due to no response from the Remote WinFrog confirming receipt of file segments.
VEH SHP UPD	New Remote vehicle shape configuration sent to the Remote WinFrog.
OTH VEH UPD	New configuration affecting one of the vehicles tracked by the Remote sent to the Remote.
ANC STE UPD	New anchor status for any vehicle sent to the Remote.

PSN CFG UPD	New Remote position calculation configuration sent to the Remote.
LIN CFG UPD	New Remote vehicle line tracking configuration sent to the Remote.
WPT CFG UPD	New Remote vehicle waypoint tracking configuration sent to the Remote.
VEH O/S UPD	New Remote vehicle offset configuration sent to the Remote.
VEH CFG UPD	New Remote vehicle presentation configuration sent to the Remote.
GRF CFG UPD	New graphics configuration sent to the Remote.
EVTs UPD	New Remote vehicle event configuration sent to the Remote, where s is one of the following:
DSB	Disabling eventing.
CFG	Configuring eventing
ENB	Enabling eventing
STR	Starting eventing
ACT	Activating eventing
STP	Stopping eventing
ITM CFG UPD	Remote vehicle data type configuration sent to the Remote.
FIL REC n	Working File segment sent to the Remote, where n is the segment number.
GRF UPD CFD	Confirmation of new Remote graphics configuration confirmation sent by the Remote to the Controller, sent to the Remote.
PSN DATA	Vehicle position data message sent to the Remote.
VCF n UPD	Vehicle presentation configuration (other than the Remote) sent to the Remote, where n is the vehicle number.
VSH n UPD	Vehicle shape configuration (other than the Remote) sent to the Remote, where n is the vehicle number.
VFL n UPD	Vehicle fairlead configuration (other than the Remote) sent to the Remote, where n is

	the vehicle number.
VAN n UPD	Vehicle anchor state and configuration (other than the Remote) sent to the Remote, where n is the vehicle number.
Rx Msg	Displays the last received message type received from the Remote associated with this window and the time it was taken from the receive queue.

These can be any of the following:

CONNECTING	Confirms connecting process started.
HEARTBEAT	Heartbeat received, response to one sent by the Controller, confirms communications are okay.
STARTPULSE	Startpulse message, response to one sent by the Controller to indicate Remote is ready for normal communications.
ENDWAITING	Confirms Controller can stop waiting for the Remote to configure its vehicle list.
DISCONNECT	Confirms the disconnect message sent by the Controller was received.
FILE ABORT	Confirms the aborting of the file transfer as initiated by the Controller.
FIL Rn CFM	Confirms the file segment n was received.
FIL Rn ERR	Error in the file segment n was detected. This segment is re-sent by the Controller.
ALARM DATA	Alarm data.
GRF DATA	Graphics1 configuration.
EVT SP# DATA	Specific Event data, i.e. the data for the last event generated by the Remote.
EVT DATA	General Event configuration data.
EVT START	Eventing started.
EVT s CFD	Eventing configuration stage confirmed, where the stage is indicated by s, which can be one of the following:
DSB	Disabling eventing.
RCT	Initial configuration, actual eventing parameters.
CFG	Secondary configuration, event file parameters.

ENB	Enabling
STR	Starting
STP	Stopping
DSB	Disabling
COM CFG CFD	Confirms communications configuration was received.
GRF CFG CFD	Confirms Graphics1 configuration was received.
VCF CFD	Confirms other vehicle presentation configuration was received.
VFL CFD	Confirms other vehicle fairlead configuration was received.
VSH CFD	Confirms other vehicle shape configuration was received.
AST CFD	Confirms other vehicle anchor status configuration was received.
PSN DATA	Remote vehicle's Position data.
ITEM DATA	Remote vehicle's data type raw data.
VEH O/S CFG	Remote vehicle's offset configuration.
PSN CFG	Remote vehicle's position calculation configuration.
VEH CFG	Remote vehicle's presentation configuration.
VEH SHP	Remote vehicle's shape configuration.
WPT DATA	Remote vehicle's waypoint tracking configuration.
LIN TRK DATA	Remote vehicle's line tracking configuration.
LIN DATA	The line data for the Remote vehicle's track line.
ITM TYPE	Remote vehicle's data type list.
ITM CFG DATA	Remote vehicle's data type configuration.
PSN CFG CFD	Confirms Remote vehicle's position calculation configuration received.
WPT CFG CFD	Confirms Remote vehicle's waypoint tracking configuration received.
LIN TRK CFD	Confirms Remote vehicle's line tracking configuration received.
LIN DAT CFD	Confirms line data for Remote vehicle's line tracking received.

ITM CFG CFD	Confirms Remote vehicle's data type configuration received.
VEH CFG CFD	Confirms Remote vehicle's presentation configuration received.
VEH O/S CFD	Confirms Remote vehicle's offset configuration received.
VAN STE CFD	Confirms Remote vehicle's anchor status configuration received.
VEH SHP CFD	Confirms Remote vehicle's shape configuration received.

Remote Control and Anchor Handling Operations

The **Remote Control** feature is closely linked with the **Anchor Handling** window.

All changes in the fairlead and anchor status caused by a **Pick**, **Drop**, **Edit**, or **Reset** function executed from this window at the Controller is immediately transmitted to all Remote vehicles. Thus, all Remotes are able to display the fairleads and anchors graphically in real-time, including the designation of live anchors. In addition to improving the coordination of operations, it also provides a safety benefit.

This window also enables target data to be sent to the Remotes. When the **Tx** function is executed from the **Anchor Handling** window, the target information is sent to all Remotes where it is automatically set as the respective vehicle's **Active Waypoint** and displayed graphically as a bull's eye with 3-meter rings.

Operating Restrictions

There are some restrictions to the use of the Remote Control feature:

- Remote control of the graphics does not extend to the charting capabilities.
- When configuring the position information of a remote, only the position and height, Kalman Filter and median filter controls, dead reckoning and gating are to be controlled. Enforced restrictions for these items is not yet implemented.
- **Vehicle Offset** names are not displayed at the remote.
- Anchor names are not transmitted or displayed at the remote
- Vehicle shape transfer to the remote is limited to 27 points. Any extra points will be ignored.

Chapter 17: LBL Acoustics

Overview

Long Baseline (LBL) acoustics provides the means to position surface and subsurface vehicles using ranges determined by acoustic signals.

The basic principle of LBL acoustic positioning starts with the observation of the two-way travel time (**TWTT**) of an acoustic signal between two points. This TWTT is reduced to a range by first subtracting any delays in the signal's travel time, i.e. the time between the second point receiving the signal and then re-transmitting a return signal (known as turn-around-time or **TAT**). The result is then divided by two to produce the one-way travel time and multiplied by the velocity of sound in water to derive a distance.

Note: a valid **Working Velocity** file must be created and loaded before any LBL operations can take place. This must be updated as required throughout the operation. See the **Working File** chapter for details.

The standard application of LBL acoustics involves observations of this type between a single transceiver or smart transponder mounted on a moving vehicle or structure and a network or array of transponders located at known fixed positions in the work area, generally on the floor of the body of water. The resulting range data is used in a rigorous Least Squares range/range adjustment to solve for the position of the single transceiver or smart transponder. This solution can be three-dimensional (**3D solution**) or two-dimensional (**2D solution**). In the case of a 3D solution, the known points must be located to provide strong horizontal and vertical geometry. The 2D solution is often used because the height component for the unknown point can be obtained either directly or from other sensors thus eliminating the need to solve for it.

The LBL system can also be used to monitor structures once they are in place for subsidence.

Note: a valid **Working Xponder** file must be created and loaded before any LBL operations can take place. See the **Working File** chapter for details.

An alternative application is Inverted LBL. This application differs from the aforementioned in that the transponder array is mounted on the moving vessel or structure that is to be positioned and multiple transceivers and smart transponders are located at the known fixed locations. The spatial relationships between the transponder array are accurately known and are applied as constraints in the least squares adjustment solving for the transponder array positions.

This section discusses how WinFrog uses LBL systems.

The reader is referred to the documentation for the respective LBL systems to determine how they are operated and what options they provide that WinFrog will use.

Components

Transponders are self-contained units with their own electronics and transducer. These units listen for an interrogation signal and, upon detecting one, respond with a reply signal. They provide ranging capabilities.

The **transceiver** is a transducer connected directly to the LBL system's control unit, the electronics that control the LBL system. The control unit is in turn interfaced directly to WinFrog. This transceiver is used to interrogate the transponders. It should be noted that the transceiver is not necessarily attached to the same vehicle on which the control unit resides. The transceiver is also required for communications with **smart transponders**.

Smart transponders are transponders that are capable of more than simply responding to an interrogation signal. Upon receiving special pulses or specific instruction telegrams transmitted by the control unit, a smart transponder can execute an interrogation of a specific transponder or array of transponders, an internal sensor observation or a preprogrammed series of interrogations and/or observations. If required by the instruction type, the results are telemetered back to the transceiver. A special case of a smart transponder is a **responder**, a transmit-only unit that is connected to the deck unit via a cable and controlled directly via the deck unit.

The actual configuration and capabilities are dependent upon the LBL system type. The reader should refer to the relevant LBL system documentation for a complete description of how that system can be used.

The Data

The basic observable of an LBL system is travel time, the time it takes for an acoustic signal to travel between transducers, plus any delays introduced by the units involved. This is reduced to a distance observation by removing the known delays (relevant transponder turn-around-time or TATs), dividing by two if the observation is a TWT'T (exceptions to this are the signal received by the transceiver from a responder, and the sing-around signal initiated by a responder or relay transponder, see Operational Modes) and multiplying by the velocity of sound to derive a distance measurement.

In addition, smart transponders are capable of providing the following types of data depending upon their configurations:

- Depth from strain gauge and digiquartz sensors
- Attitude from inclinometers
- Temperature
- Salinity

Fixed Transponder Arrays and the Working Xponder File

Standard LBL acoustic operations require a minimum of three transponders located at known points. These form the LBL transponder network or array. Measurements to these transponders from transceivers or smart transponders provide the ranges required to perform a Least Squares adjustment and solve for the position of the interrogating transceiver or smart transponder. The design of this array is critical to the application of the LBL.

An entry for each station in the array must be made in the Working Xponder file as a Fixed LBL Transponder. Refer to the **Working Files** chapter for more information.

The intricacies of network design are beyond the scope of this manual. However, the following points must be considered in the design of the array and be provided by the array:

- Provide a strong geometrical solution for the work area. Strong geometry can usually be obtained by creating quadrilaterals with sides of nearly equal lengths. If 3D solutions are required, the vertical geometry must also be considered.
- Minimize the possibility of ranges of the same length during the positioning. (If unavoidable, these instances must be addressed by altering transponder TATs).
- Transponder mounting arrangements. For general operations, the transponders can be tethered to anchor weights with a short strop. If the work is in very deep water with long baselines, these strops may need to be longer to overcome the affects of ray bending. They may also need to be lengthened due to the seafloor topology to avoid physical blockage of the signals. If high accuracy is required combined with the requirement of redeployment/replacement of transponders throughout the project, tripods with buckets for placing the transponders in may be required.
- Evaluate structures in the area that may cause blockage or reflection of the acoustic signals.
- Ensure the safety of the transponders. Be aware of operations in the area that may result in damage to transponders, such as anchoring operations resulting in anchor chains being dragged through an array.
- Determine if there are other acoustic operations in the area and the impact they will have on the LBL acoustics, such as frequency interference.

For additional information, refer to Survey textbooks on the subject of network design.

The determination of the positions of the transponders in an array is accomplished with an LBL Calibration. This is covered in the **LBL & USBL Calibration** chapter.

Non-Fixed Transponders and the Working Xponder File

Not all the transponders used for LBL operations are fixed. These are generally smart transponders and can be Relay transponders, Responders, Simultaneous transponders, Cyclic transponders and Sequential transponders. It should also be noted that the transponders themselves are often the same type, but operated in different modes. It is the mode that is referred to here. These transponders are generally attached to the vehicle that is to be tracked.

Any transponders that are to be attached to vehicles or structures to enable these to be tracked and positioned must also be added to the **Working Xponder** file. In their case, the positions are not required. All other configuration settings must be entered.

Refer to the **Working Files** chapter for more information on Xponder files.

Inverted LBL and the Working Xponder File

Static Transceivers, Static Simultaneous transponders and Dynamic Array transponders are the terms used for the units involved in Inverted LBL operations. These must be entered in the **Working Xponder** file.

Refer to the **Working Files** chapter for more information on Xponder files.

Velocity Files

LBL acoustics require the application of a velocity of sound in water value to the observed travel time in order to reduce this observation to the distance required for the position adjustment. WinFrog uses a velocity file whose records contain a depth and velocity of sound at that depth. The depths of the acoustics units involved in an observation are used in conjunction with the velocity file to determine a velocity of sound through the relevant portion of the water column. This velocity value is then used to reduce the observed travel to a distance.

Velocity data is usually gathered by lowering and raising a velocity probe through the water column in the work area. This is referred to as a velocity cast. This is usually performed twice whenever it is done. Velocity casts are performed throughout the acoustic work as often as is deemed necessary given the conditions of the work area. Some areas are very stable with respect to water temperature, pressure and salinity, factors that affect the velocity, whereas others are not. To optimize the results of the acoustic calculations, velocity probes should be performed as required to ensure that WinFrog is using velocity data that represents the prevailing conditions.

The velocity file in use at any time by WinFrog is called the **Working Velocity** file. If a velocity file is not created/opened and set to be the **Working Velocity** file, the LBL will still function. However, the data will be reduced using a default velocity of 1485 m/s which, depending on the actual prevailing velocity of sound, can result in large errors.

It is recommended that the option to display the name of the **Working Velocity** file in the **Vehicle Text** window be used. In addition, flashing warnings are displayed in the following windows if a **Working Velocity** file is not loaded:

- I/O Device window, in the raw data panel if an LBL device is selected in the device panel.
- Calculation window, when the Data Item text option is selected for an LBL data item.
- Vehicle Text window, if the Velocity File name item is selected for display.

In addition, messages as to the validity of the **Working Velocity** file with respect to providing data for the full water depth required are also presented in the Calculation Window when the Data Item text option is selected for an LBL data item.

Please refer to the **Working Files** chapter for more information on velocity files.

Operational Modes

WinFrog supports the application of LBL in the following modes:

- Standard range/range positioning mode where the direct simultaneous interrogation of all fixed transponders is performed by the transceiver. The resulting observations are used to position the transceiver. This mode is generally used for positioning a surface vessel, an ROV using a specially built small transceiver connected to the LBL control unit via the ROV's umbilical and an ROV using a specially built LBL control unit that is mounted directly on the ROV and interfaced back to WinFrog via the ROV's umbilical.
- Responder positioning mode. A responder is a transmit-only unit that is connected directly to the control unit via a cable. The control unit and its transceiver are usually located on a surface vessel. The responder transmits a signal that is received by the transceiver connected to the same control unit. In addition, this signal is also received by the fixed transponders in the array which each then transmit their own signals that are received by the aforementioned transceiver. A subsequent direct interrogation of the fixed transponders by the transceiver completes the data collection cycle. By combining the observations, WinFrog derives the ranges from the fixed transponders to the responder in addition to the range from the transceiver to the responder. These are then used to solve

for the position of the responder. The responder is usually located on an ROV and is connected to the control unit via the ROV's umbilical.

- Relay positioning, or sing-around mode. A relay transponder is a smart transponder. This application is similar to that described for the responder positioning except that the relay transponder is not attached to the control unit. It receives its instruction to transmit via an acoustic signal from the transceiver. The rest of the process is the same as described above for the responder. The relay transponder is usually located on an ROV.
- Simultaneous positioning mode. This requires a smart transponder that is able to perform its own interrogation of the fixed transponders when instructed by the control unit via an acoustic signal. The observed TWTs are then acoustically telemetered to the control unit. The observations are reduced to ranges enabling the solution of the smart transponder's position.
- Monitoring mode. This requires one or more transponders equipped with either a digiquartz depth sensor or inclinometer. These are interrogated for attitude and depth only. This information can then be used to monitor the subsidence of structures after placement.

The fact that these LBL positioning modes are available within a package already providing multiple surface and subsurface positioning, monitoring and viewing capabilities results in a powerful LBL application.

Data Items

The LBL devices provide the following data items:

- **LBL TRANSCIVER**

This is added to a vehicle that has a transceiver that is connected to either the standard or special underwater control unit mounted on it that is to use the acoustic data for positioning.

If not specifically being used for positioning itself, this need not be added to a reference vehicle in order to be able to use the other data items associated with the LBL device.

- **XPONDER**

The XPONDER data item is associated with those non-fixed transponders entered in the transponder file: **Relay, Responder, Simultaneous and Cyclic**. If there are no such transponders available in the transponder file, though this data item can be attached to a vehicle, it will not be configurable.

The XPONDER is added to a remote vehicle that is to be tracked and positioned. The Xponder data item associated with any one LBL device can be added multiple times to the same or different vehicles.

- **FIXED XPONDER**

The FIXED XPONDER data item is associated with fixed transponders as entered in the transponder file. If there are no such transponders available in the transponder file, though this data item can be attached to a vehicle, it will not be configurable.

The FIXED XPONDER need only be added to one vehicle regardless of how many vehicles may be configured to use the associated data. The selected transponder is then interrogated for depth that can then be used in a Differential Depth application for a more precise monitoring of the relative depth of other transponders.

- **ATTITUDE**

The ATTITUDE data item is associated with those transponders equipped with an inclinometer. These transponders are capable of being interrogated for pitch and roll data which is then available for adding to a vehicle, or more usually a structure, being positioned.

- **ELEVATION**

The ELEVATION data item is associated with those transponders or LBL Transceivers that can determine their depth. For those transponders that send the depth as part of the range message (e.g., SI) this data item does not need to be added to the vehicle. If the depth is obtained by its own command then it does need to be added to the vehicle.

- **INVERTED TRANSCEIVER**

The INVERTED TRANSCEIVER data item is associated with the Static Transceivers entered in the transponder file. Though the units themselves are not physically attached to the structure being positioned, the associated data item is. This data item is attached to the sub-surface vehicle that is to be tracked with the INVERTED LBL option.

- **INVERTED XPONDER**

The INVERTED XPONDER data item is associated with the Static Simultaneous units entered in the transponder file. Though the units themselves are not physically attached to the structure being positioned, the associated data item is. This data item is attached to a sub-surface vehicle that is to be tracked with the INVERTED LBL option.

- **STATIC VEHICLE**

The STATIC VEHICLE data item is associated with the Inverted LBL device. This option allows you to use the Static Transceiver and Static Simultaneous units in the Working Xponder file to configure and set the position of a static vehicle or structure.

Standard LBL Setup

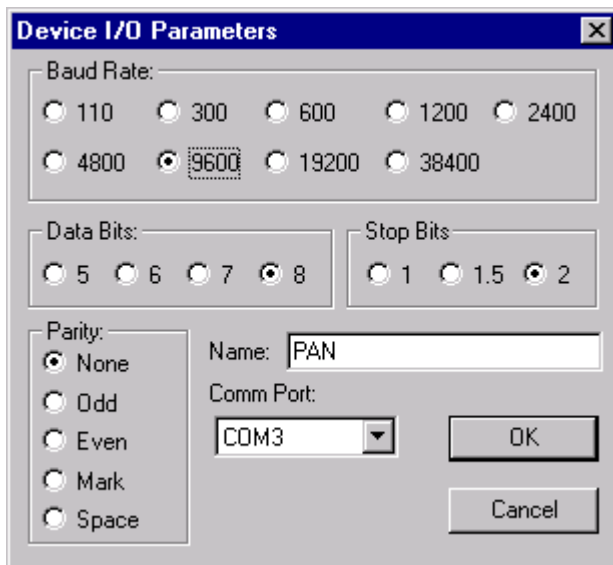
To Add the LBL Device to WinFrog

- 1 Connect the LBL system to a WinFrog com or Digiboard™ port.
- 2 From the Main Menu, select **Configure > I/O Devices... > Add**

Or

from within the **I/O Devices** window, click the right mouse button and click **Add Device** in the pop-up menu.

- 3 From the **Devices** tree, expand the LBL node (click the + next to LBL or double-click LBL) to display the list of available LBL devices.



- 4 Select the appropriate device.
- 5 Click **OK**.
- 6 Enter an appropriate name for the device in the **Name** field.
- 7 Set all of the communication parameters to match those of the LBL device.
- 8 Click **OK**.

At this point the LBL device has been added to WinFrog. Depending upon the LBL device added, WinFrog may start transmitting the initialization telegrams to the device based upon default parameters. These can be monitored in the **I/O Devices** window.

The data received from the LBL system will be displayed in the **I/O Devices** window. The display format depends upon the LBL device added.

To Configure the LBL Device

LBL Device configuration is system dependent and requires configuration at this point. Use the dialog boxes to appropriately configure your specific device.

For additional information on the configuration of specific devices, see the Appendix C documents, in PDF file format, on the software CD.

To Attach and Configure the LBL TRANSCIEVER Data Item

The LBL TRANSCIEVER data item does not need to be added to a vehicle if it is not required to be positioned.

The LBL TRANSCIEVER data item for a given Sonardyne device may be added to more than one vehicle, or multiple times to the same vehicle. This supports the use of multiple transducers connected to a single control unit. The subsequent configuration of each instance of the data item determines which transducer is used.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **LBL, *, LBL TRANSCIEVER** data item from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the **LBL TRANSCIEVER** data item.
- 6 Click **Edit**.
- 7 Configure the LBL TRANSCIEVER data item as required:

Basic Configuration Tab

The configuration of how the transceiver is to operate as attached to this vehicle is edited using this tab.

Configure LBL Transceiver

Basic Configuration | Select Fixed Transponders

Calculation Mode
☒ Primary ☐ Secondary

Solution Control
 Accuracy Convergence Tolerance

Depth Calculation Mode
☐ Calculated
☐ Use Depth for CRP from other source
 Depth interrogation interval in cycles
☐ DigiQuartz
☒ Use entered Depth for CRP (0 for ship)
 CRP Depth (+ve below water surface)

Tow Fish Depth interrogation
☒ Off ☐ FD3 ☐ FD1 Interval in cycles

Interrogating Transducer Control
☒ 1 ☐ 2 ☐ 3

Transmit Control
☒ On ☐ Off Transmit Code

Interrogation Cycle Control
☒ Cycle ☐ Time Interval

Receive
☒ On ☐ Off

Graphics
☐ On ☒ Off

Offsets
 Fore/Aft Port/Stbd Depth (+down)

OK Cancel Help

Calculation

Primary

If available, the range data observed directly by the transceiver are used to determine the position of the transceiver. This is then corrected to the CRP and used in the vehicle's primary position determination.

Secondary

If available, the range data observed directly by the transceiver are used to determine the position of the transceiver. This is then corrected to the CRP and used as one of the vehicle's secondary positions.

Solution Control

Accuracy

The standard deviation of the ranges observed directly by the transceiver. This will depend upon frequency of the acoustics.

Note: the accuracy is entered in the default distance units, not milliseconds.

Convergence Tolerance

The position calculation is a least squares solution. The process is an iterative one where the least squares actually determines and applies a correction to a position estimate to arrive at the final position solution. Given reasonable data, this correction will become smaller every iteration, i.e. the solution will converge. The process is considered complete when the correction is less than a specified convergence tolerance. You can edit this tolerance to match the accuracy of the acoustics being used, i.e. the tolerance for EHF can be set to a small value, such as 1 cm., to optimize the data. The tolerance is entered in the default distance units.

Depth Calculation Mode

This refers to the method of determining the depth of the transceiver, specifically those transceivers mounted on subsurface vehicles such as ROVs. In the case of the transceiver being mounted on a surface vehicle, the Use entered Depth for CRP option must be selected.

Calculated

The depth will be calculated using the observed ranges.

Use Depth for CRP from other source

To use this there must be another device attached to this vehicle that can determine the vehicle's depth, i.e., some ROV sensors/devices provide a depth of the vehicle. When this option is selected, the respective device's ELEVATION data item must be added to the vehicle and configured.

Alternatively, several of the LBL systems are able to provide the depths for their transceivers.

PAN: In the case of a PAN, whose transducer

is interfaced to a tow fish, select this option and then configure the interrogation as per the **Tow Fish Depth Interrogation** section below.

RovNav MK3: In the case of a ROVNAV MK 3, enter the depth interrogation interval in the **Depth interrogation interval in cycles** in this group.

RovNav MK4: In the case of a ROVNAV MK 4, enter the depth interrogation interval the **Depth interrogation interval in cycles** in this group. If the ROVNAV MK 4 is fitted with a Digiquartz, select the checkbox and click the Digiquartz Setup button to enter the parameters, observation time, water density and atmospheric pressure. Note that the sensor depth rating is not required because the data is automatically scaled to reflect the shallower type. If the MK4 is fitted with a strain gauge, leave the Digiquartz checkbox unchecked and click the MK4 Depth Setup button to enter the water density (because the MK4 strain gauge returns gauge pressure, the atmospheric pressure is not required).

RovNav MK5: In the case of a MK 5, enter the depth interrogation interval in the **Depth interrogation interval in cycles** in this group. The MK5 can be equipped with either a digiquartz or a strain gauge sensor. If it has a digiquartz, the respective coefficients are already uploaded to the MK 5 unit and it can provide the resulting pressure directly. Therefore WinFrog treats both sensors as the same and simply interrogates for the pressure. Note that the pressure provided regardless of sensor type is absolute pressure. Leave the Digiquartz checkbox unchecked and click the MK5 Depth Setup button to allow entry of the water density and atmospheric pressure.

RovNav Mini: This unit does not currently support a depth query.

For details on the digiquartz parameters, refer to the section **Editing Standard**

Xponders, Supporting Configuration
Options: Sensor Setup Button in Chapter 5.

For details on the configuration and application of the option, including the associated ELEVATION data item, refer to the respective device documents in **Appendix C: Device Documentation-LBL**.

Use entered Depth for CRP

This is a manually entered depth for the vehicle's CRP (not the transceiver). This will be used as the vehicle's CRP elevation. The offsets between the transceiver and the CRP (see below) will be applied to derive the sensor depth for the position calculation.

Tow Fish Depth Interrogation

If a PAN's transducer is interfaced with a tow fish and the **Use Depth for CRP from other source** option is selected, use this group box to set the command and depth interrogation frequency. FD3 is used for the production model of the tow fish while FD1 is used for the pre-production model. These two commands request scaled data, i.e. depth in meters.

Interrogating transducer Control

1/2/3

Some LBL equipment have more than one transducer port; this controls which transducer is to be used for this transceiver.

Transmit

On

This must be selected when the transceiver is used for any operations.

Off

The transceiver is disabled for all uses.

Code

This is the command or code required by the device to initiate range observations. Different manufacturer's equipment requires a different command or code to be entered here. For some LBL systems, this entry is designed to present only the available choices. For others, you will need to know the specific code, frequency and/or command to enter. If the transceiver is not to be used for positioning the vehicle leave this blank (or select **None**).

Interrogation Cycle Control

You can control the primary interrogation cycle interval for this data item to provide improved control when multiple LBL operations are being performed, each with a different update requirement. Note that the depth interrogation intervals are based upon the primary interrogations, that is, they monitor the number of primary interrogations to determine when to interrogate for depth.

Cycle	Selecting this option dictates that the primary interrogation control interval will be based upon complete cycles through all LBL interrogations, including all synchronized devices.
Time	Selecting this option dictates that the primary interrogation control interval will be based upon elapsed time between interrogations. Note that the interrogations will not necessarily occur precisely at the entered interval, but at the first opportunity after the interval has elapsed.
Interval	This is the desired interval for the primary interrogations in either cycles or seconds, depending upon the above selection.
Receive On/Off	Reserved for future development.
Graphics On/Off	Controls the display in the Graphics window of the transceiver position on the vehicle. In the case of using the transceiver to position the vehicle (primary or secondary), the position displayed is the actual computed position. Due to the relatively slow update rate of acoustics, this position may appear to lag behind the vehicle because it is only updated when new acoustic data are received and a position calculation is performed.

Offsets

Fore/Aft

Port/Starboard

Depth

These values are from the CRP to the transceiver. The depth (draft) of the transceiver is entered as positive if the transceiver is below the CRP and negative if it is above.

Note: if the transceiver is attached to a surface vehicle, the CRP must be at the water line.

Special Cases

Positioning or Monitoring of a Smart Transponder

If using the LBL to position a smart transponder (Relay, Responder, Simultaneous or Cyclic) unless also being used to position this transceiver, the Transmit Code is set to None or left blank. All required configuration is associated with the XPONDER data item attached to the appropriate vehicle (see To Attach and Configure the XPONDER Data Item).

Positioning using the Sequential Option - Transceiver

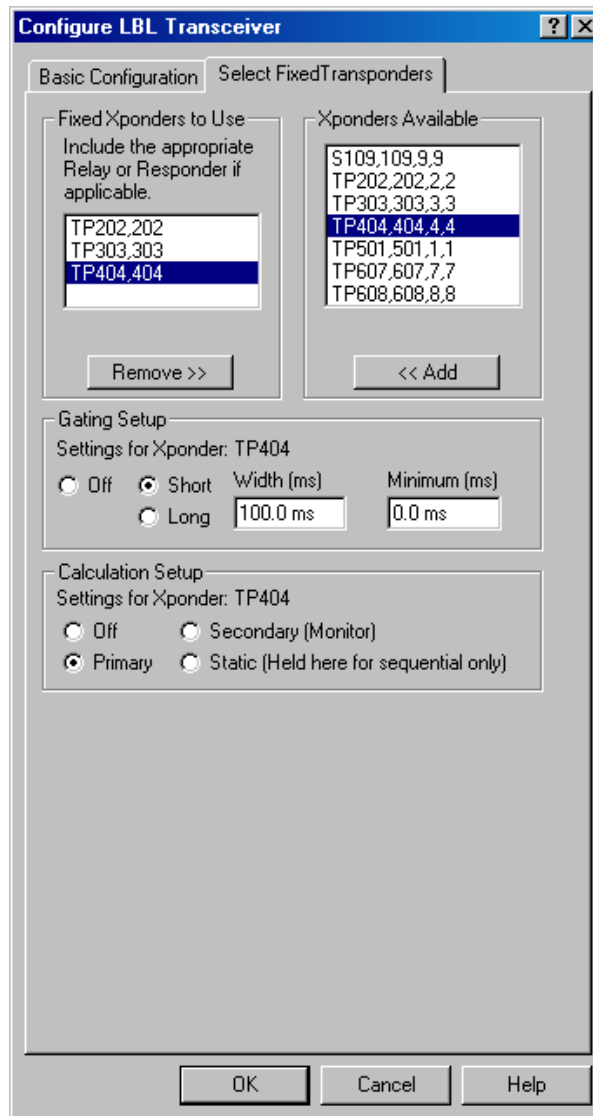
If the sequential option for collecting data to position the transceiver is required, select the II command from the Transmit Code drop down list. This is only available for Sonardyne PAN, ROVNAV MK 4 and MK 5 systems.

Select Fixed Transponders Tab

The transponders to be used for the associated positioning and calibration data collection are configured from this tab. The transponders are selected from the transponders in the **Working Xponder** file set to **Fixed**. In addition, the transponder gating and application in the position solution settings are configured here.

Note: the association of transponders for a given instance of the LBL TRANSCEIVER data item and their gating and application configuration are independent of the association of the same transponder for any other instance of a LBL TRANSCEIVER data item. For example, a given transponder can be used in one solution (complete with gating on) and monitored in another with no gating applied.

Note: the gating and calculation setup for a transponder can also be accessed from the **Calculations** window.



Fixed Xponders to Use

This is a list of those fixed transponders, selected by the operator from the Available list, to be used in conjunction with this transceiver.

To remove a transponder from the list, highlight it and click the **Remove>>** button.

To Add a transponder to the list, highlight it in the **Xponders Available** list and click the **<<Add** button or double-click the entry in the list.

Xponders Available

This is a list of all the fixed transponders in the **Working Xponder** file. Each one is identified by station name, address, reply code, and individual interrogation frequency (IIF). Those fixed transponders that do not have an

address or IIF (i.e. the first one listed here) will not have anything between the first and second comma and will not have an IIF after the last comma.

To select a transponder required for use in conjunction with this vehicle. (i.e. for positioning or collecting ranges for calibration or for use with a relay/responder transponder) double-click the transponder in the list or highlight it and click the **<<Add** button. This will copy the transponder name to the **Fixed Xponders to Use** list. **Note:** the selected transponder still appears in the available list.

Gating Setup

These settings control the application of range Gating for the data for the transponder highlighted in the Fixed Xponders to Use list. Gating refers to comparing the new range against the expected range based upon a history for that range. If the new range lies within the gate (the expected range +/- the gate width) it is accepted, otherwise it is gated from the solution that is not used but still monitored.

Off	Gating is not applied to the range data for the transponder, all data will be used in the solution.
Short	Gating is applied using a short history, specifically the last 4 ranges, to determine the trend against which the new range is evaluated to determine if it is to be gated from the solution.
Long	Gating is applied using a long history, specifically the last 10 ranges, to determine the trend against which the new range is evaluated to determine if it is to be gated from the solution.
Width	If gating is on, this value is used as the criteria to accept or reject a range. If the range lies within the window created by this value and the trend determined by the Long or Short selection, it will be accepted. This value is in milliseconds.
Minimum	This is the minimum acceptable TWTT in milliseconds. If the associated TWTT is less than this entry, the range is not used in the solution. This test is independent of the gating and applied whether gating is on or off. It is grouped with the gating due to the similar nature of its use.

Note: if gating is on it requires two to four ranges before a trend can be established thus the first few sets of ranges will not result in a fix computation. This will be indicated in the **Calculations** window (see Monitoring the Standard LBL Operation).

Calculation Setup

These settings control how the range data for the transponder highlighted in the **Fixed Xponders to Use** list is used in the position calculations.

Off	The transponder's data are not used in the solution, nor is a residual calculated and displayed, i.e. the range is not monitored.
Primary	The transponder is used in the solution.
Secondary	The transponder is not used in the solution, but a residual is computed for the range, i.e. it is monitored.
Static	This mode applies to LBL systems that support WinFrog's sequential transponder interrogation. If selected, the last observed range will be used in subsequent position calculations and this transponder will not be interrogated again until the Static setting is changed.

- 8 Click **OK** to accept the settings and return to the **Configure Vehicle-Devices** dialog. At this point, the changes will take affect and any interrogations and calculations configured will commence.
- 9 Complete the configuration of the **Vehicle Position Calculations**, i.e. Kalman Filter control.
- 10 Click **OK** to exit the **Configure Vehicle-Devices** dialog.

To Attach and Configure the XPONDER Data Item

The XPONDER data item associated with a given LBL device may be added more than once to the same vehicle or different vehicles. The subsequent configuration of each instance of the data item will differentiate the transponder to which it is associated from others. In this way, for example, multiple transponders that are attached to a single structure for the monitoring of its deployment and subsequent final positioning are associated with that vehicle in WinFrog.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.

- 2 Click the **Add** button.
- 3 Select the **LBL, *, XPONDER** data item from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the XPONDER data item.
- 6 Click **Edit**.
- 7 Configure the XPONDER data item as required.

Tracking Transponder Tab

This tab is used to select a non-fixed transponder from the **Working Xponder** file to be associated with this instance of the XPONDER data item and to configure the depth control.

The screenshot shows the 'Configure XPONDER data type' dialog box with the 'Tracking Transponder' tab selected. The 'Tracking Transponder Selection' dropdown is set to 'TP607,607,SI,7,Simultaneous,Digiquartz,Internal Incl'. Under 'Transponder Depth Determination Method', 'Interrogate Depth/Attitude Only' is selected. The 'Associated Options...' section includes a button for 'SI/FS Error Handling', an unchecked checkbox for 'Apply Tide (Subtracted from Depth)', and a checked checkbox for 'Use in differential depth mode with the selected FIXED XPONDER'. The 'Digiquartz Temperature Count' section has 'Interrogate Xponder' selected with a value of 3. The 'Depth Interrogation' section has an interval of 1 cycle and 'Use CQ for Depth' checked. The 'Inclinometer Interrogation' section has an interval of 2 cycles. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

Tracking Transponder Selection

This dropdown list box displays the transponders set to **Relay**, **Responder**, **Simultaneous**, **Sequential** or **Cyclic** in the **Working Xponder** file. If there are no transponders of these types in the transponder file then a vehicle cannot be positioned by this data item. Each transponder is described by its **Name**, **Address**, **Receive code**, **Transmit code**, **LBL transponder type** and **depth sensor type**. If the transponder does not use addresses then there will just be two commas between name and receive code.

Select the appropriate transponder or **None** to cancel a previous selection and stop interrogation.

The following are the available operating modes associated with the respective transponder type:

Responder Positioning Mode	Responder, the Responder must also be added to the Fixed Xponders to Use list.
Relay Positioning Mode	Relay transponder, the Relay transponder must also be added to the Fixed Xponders to Use list.
Simultaneous Positioning Mode	Simultaneous transponder
Cyclic Positioning Mode	Cyclic transponder
Sequential Positioning Mode – transponder	Sequential transponder

The selection of the transponder controls the available configuration options and must be done first.

Note that any option that refers to cycles, refers to the measurement cycle appropriate to the type of transponder selected. For example, a cycle for a Simultaneous transponder is a single measurement command and response cycle.

Transponder Depth Determination Method

This controls how the depth of the transponder will be determined.

Calculate Xponder Depth	The depth will be calculated using the observed ranges (i.e. 3D solution).

**Use Xponder Observed
Depth**

The depth observed directly from the transponder will be used as the depth in the solution (i.e. 2D solution, fixed depth). In some cases this is included with the data, in others it will require a specific interrogation to obtain it. If this method is selected and a specific interrogation is required for the transponder type, the **Depth Interrogation** edit box below becomes active and must be configured.

In the case of a simultaneous transponder fitted with a Digiquartz, and you do not want to use the depth from the reply to the SI command, do not select this option. Instead select the **Use Depth from other Source** option. You may want to do this if a 9 second interrogation time is desired instead of the 1 second as part of the SI command.

**Use Depth of CRP from
other Source**

The depth of the vehicle's CRP is determined using another sensor (device). This depth will be used in the solution (i.e. 2D solution, fixed depth). If the depth is to be determined by a simultaneous transponder using the CQ command, choose this option. Then select the Use CQ for Depth. You must also attach the ELEVATION data item for this device to this vehicle.

Use Entered Depth

The depth as entered here for the vehicle's CRP is used in the solution (i.e. 2D solution, fixed depth).

**Interrogate Depth/Attitude
only**

If the transponder is to be used only for monitoring a structure and ranges are not required for a position determination, select this option. Then configure the Depth and Inclinator interrogations appropriately. If the transponder is to be interrogated for depth, it must be equipped with a Digiquartz depth sensor. In addition, the associated ELEVATION data item must be attached to this vehicle. If the transponder is to be interrogated for inclination, the associated ATTITUDE data item must be

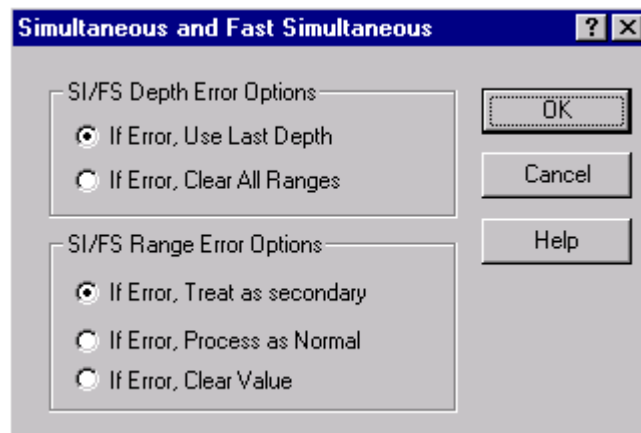
attached to this vehicle and configured to use this transponder (select this transponder in the dropdown list in the configuration dialog).

Associated Options...

These are configuration options that enhance the application of the transponder data.

SI/FS Error Handling

If the selected transponder is a simultaneous transponder, this option is enabled. It accesses the following dialog allowing the configuration of action to take when errors are detected and reported by the LBL system.



SI/FS Depth Error Options

This controls how the detection of an error in the depth observation is handled.

If Error, Use Last Depth

If an error is reported for the depth observation, the last good depth observation is used in the solution.

If Error, Clear All Ranges

If an error is reported for the depth observation, all range data is cleared and no position is solved for.

SI/FS Range Error Options

This controls how the detection of an error in the range observation is handled.

If Error, Treat as Secondary	If an error is reported for a range observation, the respective range is not used in the solution but a residual is computed and displayed.
If Error, Process as Normal	If an error is reported for a range observation, it is ignored and the respective range is used in the solution.
If Error, Clear Value	If an error is reported for a range observation, the respective range is zeroed and treated as if it didn't exist.

Apply Tide This option remains disabled unless the depth is observed from this transponder. In order to use this option, tide must be available to the vehicle, i.e. the TIDE data item must be attached to the vehicle. The tide is **subtracted** from the observed depth to obtain the depth below datum. When using this option, the fixed transponder's depths must be relative to this same datum.

Use in differential depth mode... This option is available for the modes that utilize an observed depth value. The concept of a differential depth determination involves the monitoring of a static transponder's depth against the defined depth for that transponder. The difference observed between these values becomes a correction that can be applied to other depth observations to ensure they are relative to the static transponder's vertical datum, regardless of changes in tide and atmospheric pressures. If this option is checked, the **FIXED TRANSPONDER** that is to be used must be selected from the drop down list. Note that in order to use this option, a **FIXED XPONDER** data item must be attached to a vehicle, though not necessarily this vehicle, and configured (see To Attach and Configure the FIXED XPONDER Data Item).

Digiquartz Temperature Count

If the selected transponder is equipped with a digiquartz depth sensor, this controls how the associated temperature count data is obtained.

Use Manual Value	If this option is selected, WinFrog will use the value entered in the associated data entry window labeled Count .
Interrogate Xponder	If this option is selected, WinFrog will interrogate the transponder at the interval entered in the associated data entry window labeled Cycle .

Depth Interrogation

Case: Not a Simultaneous Transponder

If the **Use Xponder Observed** depth option is selected above and the selected transponder is not a Simultaneous transponder, this option is enabled. The interval between depth interrogations, if appropriate for the transponder type, is entered. This interval is in cycles and must be greater than 1.

Case: Simultaneous Transponder with a Digiquartz

If the Use Depth of CRP from other Source is selected, the Use CQ for Depth checkbox will become active. If checked, the Interval and the Digiquartz Temperature Count group box will become active. This allows you to use the long observation period of the CQ command (9 seconds) to obtain a more accurate reading than provided by the SI command (1 Second). If this box is checked, the ELEVATION data item of this device must be attached to this vehicle and configured.

Case: Interrogate Depth/Attitude Only

If this option is selected, the Use CQ for Depth checkbox will become active. If checked, the Interval and the Digiquartz Temperature Count group box will become active. If this box is checked, the ELEVATION data item of this device must be attached to this vehicle and configured.

Inclinometer Interrogation

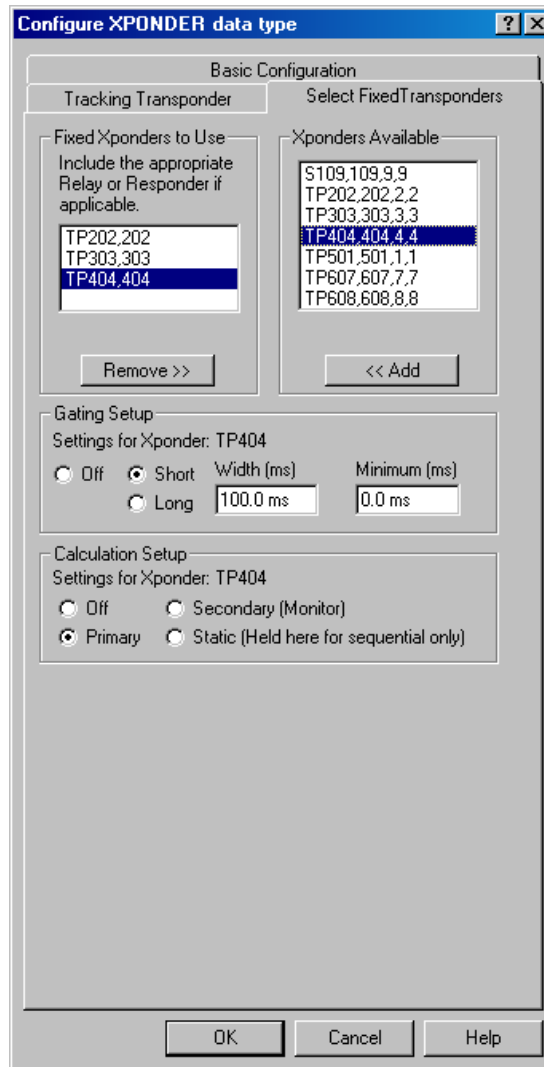
If the selected transponder is configured for an inclinometer, this option is enabled. The interval between inclinometer interrogations is entered. This interval is in cycles and must be greater than 1. The associated ATTITUDE data item must be attached to this vehicle and configured.

Select Fixed Transponders Tab

Use this tab to select the fixed transponders for use in the position solution

or calibration data collection. The transponders are selected from the transponders in the **Working Xponder** file set to **Fixed**, **Relay**, and/or **Responder**. In addition, the transponder gating and application in the position solution settings are configured here.

Note: the association of transponders for a given instance of the XPONDER data item and their gating and application configuration are independent of the association of the same transponder for any other instance of the XPONDER data items. For example, a given transponder can be used in one solution (complete with gating on) and monitored in another with no gating applied. This is important when multiple non-fixed transponders are attached to a structure and are interrogating the same fixed array. In this situation, a fixed transponder may provide a steady return to one non-fixed transponder while due to blockage or reflections of the signals, provide unreliable returns to one of the other non-fixed transponders, but yet can still be monitored.



Note: the gating and calculation setup for a transponder can also be accessed from the Calculations window.

Xponders Available

This is a list of all the fixed transponders and the non-fixed Relay and Responder transponders in the **Working Xponder** file. Each one is identified by station name, address, reply code, and individual interrogation frequency (IIF). Those fixed transponders that do not have an address or IIF (i.e. the first one listed here) will not have anything between the first and second comma and will not have an IIF after the last comma.

To select a transponder required for use in conjunction with this vehicle. (i.e. for positioning or for use as a relay/responder transponder) double click the transponder in the list or highlight it and click the **<<Add** button. This will copy the transponder name to the **Fixed Xponders to Use** list. Note that the selected transponder still appears in the available list.

Note: it is important that if operating in Relay or Responder positioning mode that the relay transponder or responder selected as the **Tracking Transponder** be added to the **Fixed Xponders to Use** list. Although this is not a fixed transponder, it is necessary to select it here.

Fixed Xponders to Use

This is a list of those fixed transponders, selected by the operator from the available list, to be used in conjunction with this transceiver.

Note: it is important that if operating in Relay or Responder positioning mode that the relay transponder or responder selected as the **Tracking Transponder** be added to the **Fixed Xponders to Use** list. Although this is not a fixed transponder, it is necessary to select it here. To remove a transponder from the list, highlight it and click the **Remove>>** button.

To add a transponder to the list, highlight it in the **Xponders Available** list and click the **<<Add** button or double-click the entry in the list.

Gating Setup

These settings control the application of range gating for the data for the transponder highlighted in the **Fixed Xponders to Use** list. Gating refers to comparing the new range against the expected range based upon a history for that range. If the new range lies within the gate (the expected range +/- the gate width) it is accepted, otherwise it is gated from the solution that is not used but still monitored.

Off

Gating is not applied to the range data for the transponder, all data will be used in the solution.

Short	Gating is applied using a short history, specifically the last 4 ranges, to determine the trend against which the new range is evaluated to determine if it is to be gated from the solution.
Long	Gating is applied using a long history, specifically the last 10 ranges, to determine the trend against which the new range is evaluated to determine if it is to be gated from the solution.
Width	If gating is on, this value is used as the criteria to accept or reject a range. If the range lies within the window created by this value and the trend determined by the Long or Short selection it will be accepted. This value is in milliseconds.
Minimum	This is the minimum acceptable TWTT in milliseconds. If the associated TWTT is less than this entry, the data is not used in the solution. This test is independent of the gating and applied whether gating is on or off. It is grouped with the gating due to the similar nature of its use. Note: if gating is on it requires two to four ranges before a trend can be established thus the first few sets of ranges will not result in a fix computation. This will be indicated in the Calculations window (see Monitoring the Standard LBL Operation).

Calculation Setup

These settings control how the range data for the transponder highlighted in the **Fixed Xponders to Use** list will be used in the position calculations.

Off	The transponder's data are not used in the solution, nor is a residual calculated and displayed, i.e. the range is not monitored.
Primary	The transponder is used in the solution.
Secondary	The transponder is not used in the solution, but a residual is computed for the range, i.e. it is monitored.
Static	This mode applies to LBL systems that support WinFrog's sequential transponder interrogation. If selected, the last observed

range will be used in subsequent position calculations and this transponder will not be interrogated again until this setting is changed.

Basic Configuration Tab

The basic transponder configuration is implemented from this tab.

The screenshot shows a Windows-style dialog box titled "Configure XPONDER data type". It has two tabs: "Tracking Transponder" (selected) and "Select Fixed Transponders". The "Basic Configuration" section contains the following settings:

- Calculation Mode:** Radio buttons for "Primary" (selected) and "Secondary".
- Solution Control:** Text boxes for "Accuracy" (1.00m) and "Convergence Tolerance" (0.20m). A checkbox for "Test for outliers" is unchecked.
- Kalman Filter Input:** Radio buttons for "Ranges" and "Least Squares Position" (selected).
- Transponder Control:** Radio buttons for "On" (selected) and "Off".
- Interrogating Transducer Control:** Radio buttons for "1" (selected), "2", and "3".
- Interrogation Cycle Control:** Radio buttons for "Cycle" (selected) and "Time". A text box for "Interval" contains the value "1".
- Graphics:** Radio buttons for "On" and "Off" (selected).
- Offset, from the CRP:** Three text boxes for "Fore/Aft", "Port/Stbd", and "Up/Down", all containing "0.00m".

At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

Calculation

Primary

The position determined for the transponder associated with the data item will be used in the Primary position calculation for this vehicle. Note that if the transponder is to be used for monitoring depth and inclination only, this setting is not applicable. In this case control of the use of the resultant data

Secondary	as primary or secondary is configured with the associated ELEVATION and ATTITUDE configurations. The position determined for the transponder associated with the data item will be used as a Secondary position for monitoring this vehicle's primary position.
Solution Control	
Accuracy	The standard deviation to be used for each range used in the position solution for this transponder. This will depend upon frequency of the acoustics. The accuracy is entered in the default Distance units.
Convergence Tolerance	The position calculation is a least squares solution. The process is an iterative one where the least squares actually determines and applies a correction to a position estimate to arrive at the final position solution. Given reasonable data, this correction will become smaller every iteration, i.e. the solution will converge. The process is considered complete when the correction is less than a specified convergence tolerance. You can edit this tolerance to match the accuracy of the acoustics being used, e.g. the tolerance for EHF can be set to a small value to optimize the data, such as 1 cm. The tolerance is entered in the default Distance units.
Test for Outliers	This option pertains only to use with the Inverted LBL application and the Static Simultaneous transponder and is disabled here.
Kalman Filter Input	
Ranges	Ranges are passed into the Kalman filter.
Least Squares Position	Computed positions (from the ranges) are passed into the Kalman filter.
Transponder Control	
On	The transponder is active.
Off	The transponder is disabled within WinFrog, i.e. WinFrog will not communicate with it automatically as configured here.

Interrogation Transducer Control

1/2/3

This controls which transceiver connected to the control unit will be used to communicate with/interrogate the transponder.

Interrogation Cycle Control

You can control the primary interrogation cycle interval for this data item to provide improved control when multiple LBL operations are being performed, each with a different update requirement. Note that the depth and inclination interrogation intervals are based upon the primary interrogations, that is, they monitor the number of primary interrogations to determine when to interrogate for depth.

Cycle

Selecting this option dictates that the primary interrogation control interval will be based on complete cycles through all LBL interrogations, including all synchronized devices.

Time

Selecting this option dictates that the primary interrogation control interval will be based on elapsed time between interrogations. Note that the interrogations will not necessarily occur precisely at the entered interval but at the first opportunity after the interval has elapsed.

Interval

This is the desired interval for the primary interrogations in either cycles or seconds, depending upon the above selection.

Graphics

On/Off

Turns the display of the raw transponder position **On** and **Off** in the **Graphics** window. Due to the relatively slow update rate of acoustics, this position may appear to lag behind the vehicle because it is only updated when new acoustic data are received and a position calculation is performed.

Offsets, from the CRP

Fore/Aft
Port/Starboard
Height

Enter the offsets from the CRP to the transponder. The vertical offset, Z, is

positive up. Note that if the transponder is also being used as an ELEVATION data item, the actual depth sensor offsets must be entered in the configuration of that data item.

- 8 Click **OK** to accept the settings and return to the **Configure Vehicle-Devices** dialog. At this point, the changes will take affect and any interrogations and calculations configured will commence.
- 9 Complete the configuration of the **Vehicle Position Calculations**, i.e. Kalman Filter control.
- 10 Click **OK** to exit the **Configure Vehicle-Devices** dialog.

To Attach and Configure the FIXED XPONDER Data Item

The FIXED XPONDER data item provides the capability for monitoring the real time depth observations of a static transponder (usually one of the fixed transponder array network) with respect to the depth assigned in the Working Xponder File. As a result of the monitoring, the entire fixed transponder array is continually updated with respect to their defined depths, or a correction accounting for variations in tide and atmospheric pressure is made available for application to the depth observations of dynamic transponders. This is referred to as differential depth determinations. Note that if a TRANSCIEVER data item requires the application of differential depth determination, the FIXED XPONDER would have to be configured to update the Working Xponder File.

The FIXED XPONDER data item associated with a given LBL device can be added only once to any vehicle though it can be added once to multiple vehicles. However, if multiple vehicles are to use the same transponder as a FIXED XPONDER, it is not necessary to add the data item to all the vehicles, but only one. Attaching it to more than one vehicle will result in unnecessary redundant interrogations that will slow the LBL interrogation cycle.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **LBL, *, FIXED XPONDER** data item from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the **FIXED XPONDER** data item.
- 6 Click **Edit**.

- 7 Configure the **FIXED XPONDER** data item as required.

Configure Fixed Transponder

Select Transponder: TP501,501,1,DIGIQUARTZ

Interrogation Parameters

Transponder is equipped with a Digiquartz.

Interrogation... ☒ On ☐ Off

Interrogate on transducer... ☒ 1 ☐ 2

Interrogate based on... ☒ Time ☐ Cycle

Enter depth/digiquartz interrogate interval: 30

Enter temperature count interrogation interval, based on depth interrogation interval: 2

Enter minimum depth tolerance: 0.000 m

Enter maximum depth tolerance: 99999.000

☒ Apply tide

Working Transponder File Control

☐ Adjust depths of all FIXED LBL transponders in Working Transponder file based on results.

OK Cancel Help

Select Transponder

Select the transponder from the drop down list that is to be used as the **FIXED XPONDER**. Only those transponders in the **Working XPONDER File** set to **Fixed** are listed.

Interrogation Parameters

Transponder is equipped...	This line states the depth sensor type of the selected transponder.
Interrogation	Select On or Off to enable or disable the interrogation of this transponder for depth.
Interrogate on transducer	Select the transceiver to be used for transmitting the interrogation.

Interrogate based on	Select whether the interrogation interval is to be controlled by cycles or time. In the case of cycles, this refers to the complete LBL interrogation cycle, including all synchronized LBL devices. In the case of time, this refers to the elapsed time between interrogations. Note that in the case of a time interval, the interrogations are not necessarily executed as soon as the interval has elapsed but rather at the first opportunity, based on the cycle and transmission of other devices/commands, after the time interval has elapsed.
Enter depth/digiquartz interrogate interval	Enter the interrogation interval. If the Time was selected above, this interval is in seconds.
Enter temperature count interrogation interval	If the depth sensor is a digiquartz, enter the interval between temperature count interrogations. This interval is based upon the depth interrogation cycle, i.e. every n depth interrogations.
Enter the minimum depth tolerance	This provides a basic filter of bad observations. Enter the minimum (shallowest) depth considered acceptable.
Enter the maximum depth tolerance	This provides a basic filter of bad observations. Enter the maximum (deepest) depth considered acceptable.
Apply tide	If tide is to be applied to the observations to relate the depths to a specific datum, select this checkbox. In order to use this option, tide must be available to the vehicle, i.e. the TIDE data item must be attached to the vehicle.

Working Transponder File Control

Select this checkbox if the depth observations are to be used to determine a correction to be applied to the depths of all **Fixed** transponders in the **Working Xponder File** in realtime.

To Attach and Configure the ELEVATION Data Item

The ELEVATION data item is required if, in the case of the **LBL TRANSCIEVER** data item, the **Depth Calculation Mode option is selected**, or in the case of the **XPONDER** data item, the **Transponder Depth Determination Method** is set to **Use Depth of CRP from other source** or **Interrogate Depth/Attitude Only**.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **LBL, *, ELEVATION** data item from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the **ELEVATION** data item.
- 6 Click **Edit**.
- 7 Configure the **ELEVATION** data item as required.

Configure Elevation

Mode

☐ Primary

☒ Secondary

☒ Reference for Differential Heighting

Multiple Device Control

Xponder Source TP607 (607)

Calibration

Enter the calibration value to be ADDED to the raw elevation value. 0.00m

Offsets

Fore/Aft 0.00m Port/Stbd 0.00m Height -0.91m

OK Cancel

Mode

Primary

If the depth is to be used for the vehicle, select Primary.

Secondary

If the elevation is not to be used directly for the vehicle's depth, select Secondary.

NOTE: If the ELEVATION data item is associated with an XPONDER data item that has been configured to interrogate for depth and has been configured for Differential Depth mode, even though the depth is to be used for the vehicle, the mode is set to **Secondary**.

Reference for Differential Heighting

If the ELEVATION data item is associated with an XPONDER data item that has been configured to interrogate for depth and has been configured for Differential Depth mode this checkbox **must** be selected.

Multiple Device Control

Xponder Source

If the ELEVATION data item is associated with a TRANSCEIVER data item that has been configured to interrogate for depth, select **Transceiver** from the dropdown list.

If the ELEVATION data item is associated with an XPONDER data item that has been configured to interrogate for depth, select the transponder that is being interrogated for the depth (selected as the Tracking Transponder in the associated XPONDER data item configuration) from the dropdown list.

Calibration

If there is a known calibration value for the respective sensor, it is to be entered in the *Calibration* panel. Care must be taken with the sign convention. If the sensor is reading deeper than the actual depth, the entry is positive. If the sensor is reading shallower than the actual depth, the entry is negative. There are two important points to be aware of with respect to the calibration entry:

- When a transponder is selected, the depth sensor calibration value that was entered for the same transponder in the Xponder File is not automatically retrieved and used here. However, the same value and sign convention as used for that calibration value is used here even though it is stated here that the calibration is *added* and in the Xponder File dialog it is stated that the value is *subtracted*. This is because in the Xponder File dialog it is referring to a depth but in the ELEVATION data item dialog it is referring to a height.
- The calibration value is a depth term, not a pressure.

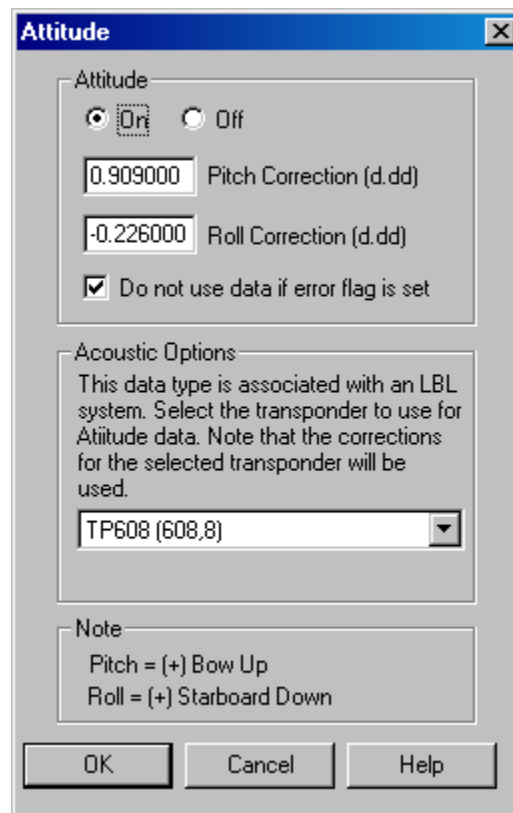
Offsets

Enter the offsets to relate the depth (pressure) sensor to the CRP of the vehicle. It is important to note that the offsets apply to the sensor, not the transducer. If an attitude sensor is available and set to on, the data from it will be used to reduce the offsets.

To Attach and Configure the ATTITUDE Data Item

The ATTITUDE data item is required if the attitude data from a transponder is to be used to orient the vehicle.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **LBL, *, ATTITUDE** data item from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the **ATTITUDE** data item.
- 6 Click **Edit**.
- 7 Configure the **ATTITUDE** data item as required.



The screenshot shows the 'Attitude' configuration dialog box. It has a title bar with the text 'Attitude' and a close button. The dialog is divided into three main sections. The top section, titled 'Attitude', contains two radio buttons: 'On' (selected) and 'Off'. Below these are two text input fields: 'Pitch Correction (d.dd)' with the value '0.909000' and 'Roll Correction (d.dd)' with the value '-0.226000'. A checkbox labeled 'Do not use data if error flag is set' is checked. The middle section, titled 'Acoustic Options', contains a text box with the instruction: 'This data type is associated with an LBL system. Select the transponder to use for Attitude data. Note that the corrections for the selected transponder will be used.' Below this is a dropdown menu showing 'TP608 (608,8)'. The bottom section, titled 'Note', contains the text: 'Pitch = (+) Bow Up' and 'Roll = (+) Starboard Down'. At the bottom of the dialog are three buttons: 'OK', 'Cancel', and 'Help'.

Attitude

On

If the attitude data is to be applied to orient the vehicle, select **On**.

Off

If the attitude data is not to be applied to orient the vehicle, select **Off**.

Pitch Correction

Enter the pitch correction value to be added to the raw pitch value before applying to orient the vehicle.

Roll Correction

Enter the roll correction value to be added to the raw roll value before applying to orient the vehicle.

Do not use data if error flag is set

Select this checkbox if the data is not to be used if the inclinometer reply error flag is anything but 0 (no errors).

Acoustic Options

Select transponder that is to be used to provide the attitude data from the dropdown list. This ensures that the data for correct transponder is used when the acoustic device is being used to interrogate multiple transponders. In this case, the correction values are retrieved from the **Working Xponder File** for the selected transponder when it is selected (see **Inclinometer Calibration** in the **Working Files** chapter). These values can be overridden by clicking in the respective boxes and typing in a new value.

Differential Depth Operation

The Differential Depth option provides the means to use precise digiquartz depth sensors located in a fixed transponder (part of the network array) and a dynamic transponder(s) to monitor the depth of the dynamic transponder(s) and the associated vehicle(s) relative to the fixed transponders vertical datum regardless of changes in water levels (tides) and atmospheric pressures.

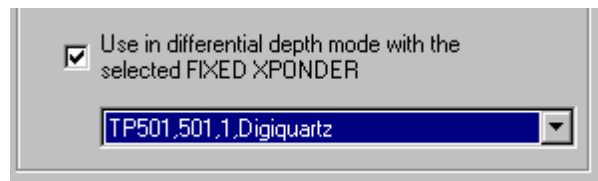
There are three basic methods of applying Differential Depth to address its application to standard positioning using simultaneous COMPATTs, positioning using another depth source, and monitoring depth/attitude only. It is important to note that these can be combined. For example, two transponders

can be associated with the same vehicle. One transponder can be configured for **Interrogate Depth/Attitude Only** as per the steps below and the second for **Use Depth of CRP from other source** and then use the depth data from the former by configuring the **ELEVATION** data item for the former.

To Implement the Differential Depth for Standard Simultaneous Positioning Operations

The following details the configuration for standard Simultaneous transponder positioning using the differential depth feature.

- 1 Associate a **FIXED XPONDER** to a vehicle and configure it.
- 2 Associate an **XPONDER** data item to the respective vehicle.
- 3 Open the associated configuration dialog.
- 4 Select the Simultaneous transponder to use for positioning from the drop down list.
- 5 Select the **Use Xponder Observed Depth** option.
- 6 Select the **Use in differential...** checkbox and select the **FIXED XPONDER** to use as the reference from the dropdown list.



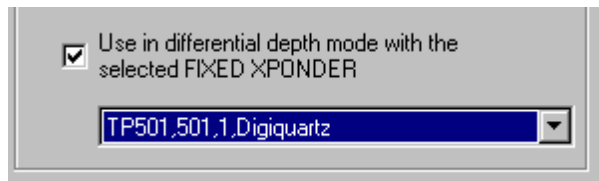
- 7 Enter the offsets to relate the transponder's transducer to the vehicle's CRP.
- 8 Complete the standard configuration of the **SI/FS Error Handling**, and the **Basic Configuration and Select Fixed Transponders** tabs.
- 9 Click **OK**.

To Implement the Differential Depth for CRP Depth from Other Source Positioning Operations

The following details the configuration for Simultaneous transponder positioning, interrogating the Simultaneous transponder's digiquartz directly to obtain a more accurate reading than that provided as part of the simultaneous interrogation.

- 1 Associate a **FIXED XPONDER** to a vehicle and configure it.
- 2 Associate an **XPONDER** data item to the vehicle to be positioned.
- 3 Open the associated configuration dialog.

- 4 Select the Simultaneous transponder to use for positioning from the drop down list.
- 5 Select the **Use Depth of CRP from other source** option.
- 6 Check the **Use CQ for Depth** box and enter the interrogation interval cycle.
- 7 If interrogating the transponder for TQ, enter the respective interrogation interval cycle. If not, select the **Use manual value** option and enter the TQ value.
- 8 Select the **Use in differential...** checkbox and select the **FIXED XPONDER** to use as the reference from the dropdown list.

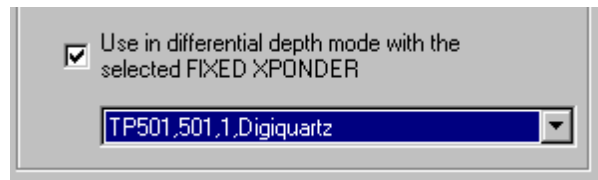


- 9 Enter the offsets to relate the transponder's transducer to the vehicle's CRP.
- 10 Complete the standard configuration of the **SI/FS Error Handling**, and the **Basic Configuration and Select Fixed Transponders** tabs.
- 11 Click **OK**.
- 12 Add the associated LBL **ELEVATION** data item to the vehicle to be positioned.
- 13 Open the **ELEVATION** data item configuration dialog. (The configuration is detailed below. For more information concerning the configuration of this data item see **To Attach and Configure the ELEVATION Data Item**.)
- 14 Select **Secondary** and check the **Reference for Differential Heighting** checkbox.
- 15 Select the same transponder that was selected as the Tracking Transponder in the associated **XPONDER** data item configuration, from the dropdown list.
- 16 If applicable, enter the calibration value for the depth source. Note that WinFrog does not automatically retrieve the calibration value for a selected transponder from the Working Xponder File – it must be re-entered here. If the sensor is reading deeper than actual, the calibration value is positive. Conversely, if the sensor is reading shallower than actual, the calibration value is negative.
- 17 Enter offsets to associate the depth sensor to the vehicle's CRP. Note that if a transponder is used, the offsets are from the depth sensor itself, not from the transducer.
- 18 Click **OK**.

To Implement the Differential Depth for Monitoring Depth/Attitude Operations

The following details the configuration for Simultaneous transponder monitoring only, interrogating the Simultaneous transponder's digiquartz directly.

- 1 Associate a **FIXED XPONDER** to a vehicle and configure it.
- 2 Associate an **XPONDER** data item to the vehicle to be positioned.
- 3 Open the associated configuration dialog.
- 4 Select the Simultaneous transponder to monitor from the drop down list.
- 5 Select the **Interrogate Depth/Attitude Only** option.
- 6 Check the **Use CQ for Depth** box and enter the interrogation interval cycle.
- 7 If interrogating the transponder for TQ, enter the respective interrogation interval cycle. If not, select the **Use manual value** option and enter the TQ value.
- 8 Select the **Use in differential...** checkbox and select the **FIXED XPONDER** to use as the reference from the drop down list.



- 9 Enter the offsets to relate the transponder's transducer to the vehicle's CRP.
- 10 Click **OK**.
- 11 Add the associated LBL **ELEVATION** data item to the vehicle to be positioned.
- 12 Open the **ELEVATION** data item configuration dialog.
- 13 Select **Secondary** and check the **Reference for Differential Heighting** checkbox.
- 14 Select the same transponder that was selected as the Tracking Transponder in the associated **XPONDER** data item configuration, from the dropdown list.
- 15 If applicable, enter the calibration value for the depth source. Note that WinFrog does not automatically retrieve the calibration value for a selected transponder from the Working Xponder File. If the sensor is reading deeper than actual the calibration value is positive. Conversely, if the sensor is reading shallower than actual, the calibration value is negative.

- 16 Enter offsets to associate the depth sensor to the vehicle's CRP. Note that if a transponder is used, the offsets are from the depth sensor itself, not from the transducer.
- 17 Click **OK**.

Monitoring the Standard LBL and Differential Depth Operations

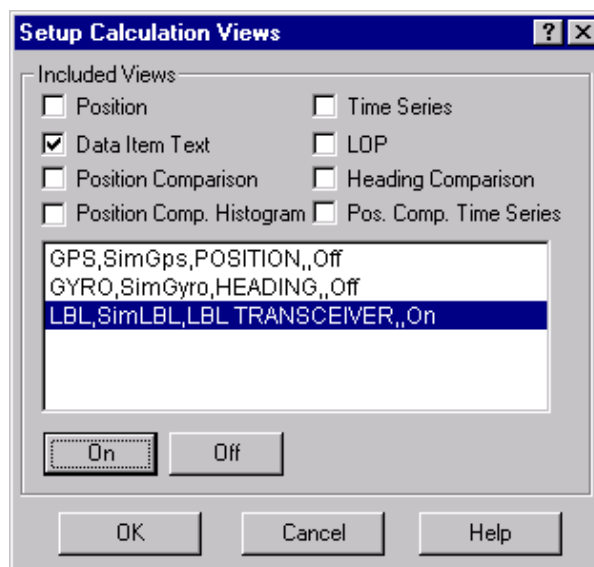
LBL operations can be monitored from the **I/O Devices** window, where the actual telegrams being sent to the LBL device and the data sent to WinFrog can be monitored, the **Calculations** window and the **Acoustics** window. The following details the use of the Calculations window.

Details for the Acoustic window are given in the chapter Operator Display Windows. The Acoustic window provides more comprehensive monitoring options and also includes the following.

To Monitor LBL Operations in the Calculation Window

The **Calculations** window is used in the same way for both the LBL TRANSCEIVER and XPONDER data items. The data presentation is almost identical and is discussed as one here.

- 1 Open a **Calculations** window. (**View > Calculations**)
- 2 From the dropdown list, select the appropriate vehicle.
- 3 Click the **Setup** button.

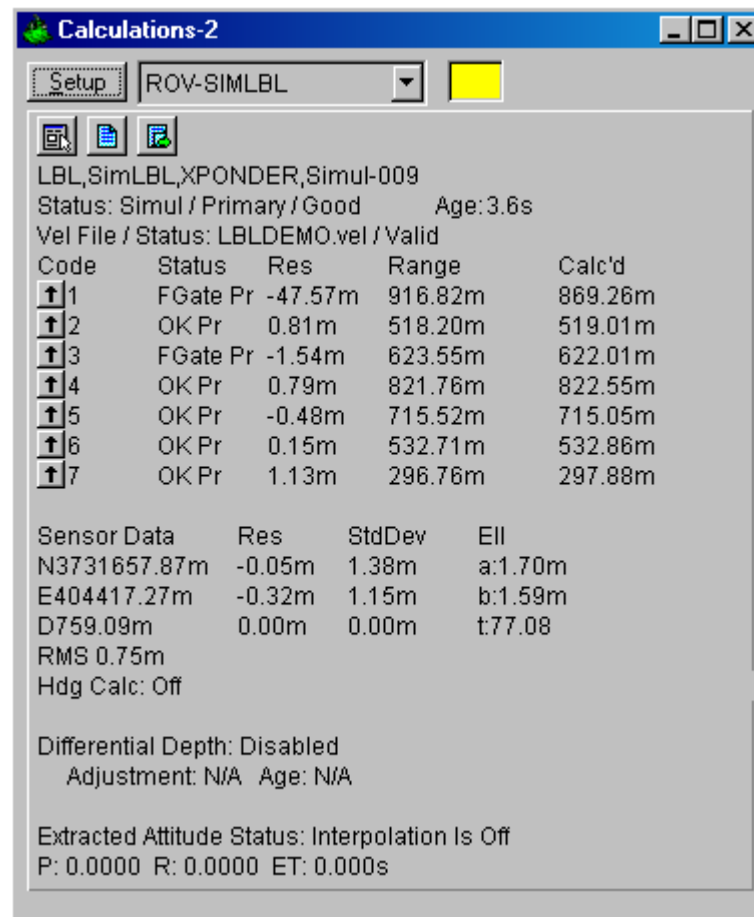


- 4 In the **Setup Calculation Views** dialog, check **Data Item Text**.
- 5 Highlight the LBL data item associated with this vehicle and click **On** (or double click the desired item).

Using the LBL Data Items Calculation Window for XPONDER and LBL TRANSCEIVER

The information in the **Calculations** window (Data Items option) for an LBL data item provides you with the means to monitor the performance of the acoustics in detail.

The window essentially presents the information in four sections if the data item is XPONDER, three if it is LBL TRANSCEIVER. Section one contains three lines of general status information. Section two contains a header line followed by a data/status line for each transponder assigned to the data item solution. The third section (only displayed for the XPONDER data item) displays the Differential Depth status and data. The third or fourth section, depending upon the data type, contains the solution results. In addition, there are four buttons used to access configuration dialogs or alter the data presented.



The Top Buttons



Accesses the configuration for the data item, either the LBL TRANSCEIVER or XPONDER.



N/A



Toggles the display of the last two columns for the transponder data. The data can be displayed as the following:

- Observed and calculated range in the default distance units
- Observed and calculated TWTT in milliseconds
- Sound velocity value used to reduce the raw data to distance and the transponder address (if applicable).

Section 1

Line 1

Device name and data item. If the data item is LBL TRANSCEIVER, the transducer number is also displayed. If the data item is an XPONDER, the respective transponder name is displayed.

Line 2

Status

Either Primary or Secondary as set by the operator for positioning with this device. This is followed by a slash then by either **Good** or **Bad**. Good displays if the fix was calculated with no errors and Bad if it was not. The Bad state may be caused by insufficient ranges or too many ranges that are invalid and gating is off.

Note: if the data item is an XPONDER, the status starts with the type of transponder associated with it.

Age

The time, in seconds, since the last fix was computed.

Line 3

The name of the current **Working Velocity** file and the status of the file's data with respect to the solution. If there is no **Working Velocity** file, this line is red and flashes "No VEL File".

The status messages are as follows:

Insufficient	The solution's depth or that of one of the fixed transponders lies outside of the scope of the data contained within the Velocity file, i.e. above the shallowest velocity entry or below the deepest velocity entry.
Valid	The velocity file data covers the depths of the transponders and transceivers involved in the solution and a velocity was successfully determined for all ranges.

Section 2

Header	The header Code Status Res Range Calc'd , Code Status Res TWTT Calc'd , or Code Status Res Vel Add is displayed depending upon the state of the toggle button (third from right in the top button area).
Column 1 - Code	The transponder transmit frequency/channel. If this is a relay transponder, the command or frequency used to interrogate it is displayed. In addition, there is an up arrow button that accesses a configuration dialog specifically associated with the transponder for which the line corresponds.
Column 2 - Status	The Status is a combination of two abbreviations. The first abbreviation possibilities are as follows:
OK	The transponder was used in the position calculation.
No	The transponder was not used in the position calculation, possibly due to a zero range.
FGate	The transponder was not used in the position calculation. Its range lay outside the gating parameters set by the operator.
MGate	The transponder was not used in the position calculation. Its range was less than the minimum set by the operator.
HLD	The transponder range is currently being Held Fixed as configured via the up arrow button in Column 1.
MAN	The transponder range is currently being

Held Fixed to the manually entered range as configured via the **up arrow** button in Column 1.

The second abbreviation possibilities are as follows:

Pr	This transponder is set to Primary and was used in the calculation.
Sd	This transponder is set to Secondary and was not used in the calculation. The residual is displayed for monitoring. Alternatively, the status may be one of the following terms:
Off	The operator has set this transponder to Off and the range was not used in the solution.
Static	The operator has set to this transponder to Static and the last range observed when the setting was made is being used for each position calculation.
Err Sd	There was a range error detected by the LBL system.
Err	There was a general error detected in the response from the LBL system.
Column 3 - Res	The range residual in milliseconds or distance units, depending upon the state of the toggle button (third from the right in the top button area).
Column 4 - Range	Depending upon the state of the toggle button (third from the right in the top button area):
Range	Reduced one-way range in the distance units
TWTT	Observed TWTT in milliseconds
Velocity	The calculated velocity of sound used to reduce the travel time to distance.
Column 5 - Calc'd	Depending upon the state of the toggle button (third from the right in the top button area):
Calc'd	The calculated reduced one-way range in distance units or calculated TWTT in milliseconds to correspond with the aforementioned Range or TWTT in Column 4
Add	The address of the transponder, if applicable.

Section 3

Header

The header **Sensor Data Res StdDev Ell** refers to the data found in columns 1 through 4 of this section.

Sensor Data

The unfiltered sensor (transceiver or transponder) position in map projection Northing and Easting coordinates, Depth, and the Root Mean Square (RMS) of the residuals of the used ranges.

Res

The difference between the unfiltered CRP position derived directly from the unfiltered sensor position and the vehicle's Primary CRP position for Northing, Easting, and Depth respectively. Note the sign convention is consistent with Primary CRP - unfiltered CRP.

StdDev

The standard deviations of the Northing and Easting coordinates (and Depth if a 3D solution) respectively, extracted from the Least squares solution covariance matrix.

Ell

The 2D error ellipse at 95% confidence for the solution, semi-major axis a, semi-minor axis b, and the orientation of the a axis, respectively.

Section 4

Differential Depth

When monitoring the XPONDER data item, this presents the status of the Differential Depth mode. If enabled, the selected transponder would be displayed with the associated adjustment and the time since the fixed transponder's last depth observation.

Section 5

Extracted Attitude Status

This presents the status of the attitude data extracted for use reducing the sensor position to the CRP. If enabled, and successful, the pitch and roll data used is displayed along with the age of the data.



Button

There is an “up arrow” button associated with each transponder displayed in section 2. Click any of these buttons to allow you access to the configuration for that specific

transponder. This configuration is displayed and edited in the **LBL Range** dialog. See Editing an LBL LOP at the end of this chapter.

Using the LBL Data Items Calculation Window for XPONDER, Depth and Attitude Only

The information in the **Calculations** window (Data Items option) for an LBL data item provides you with the means to monitor the performance of the acoustics in detail.

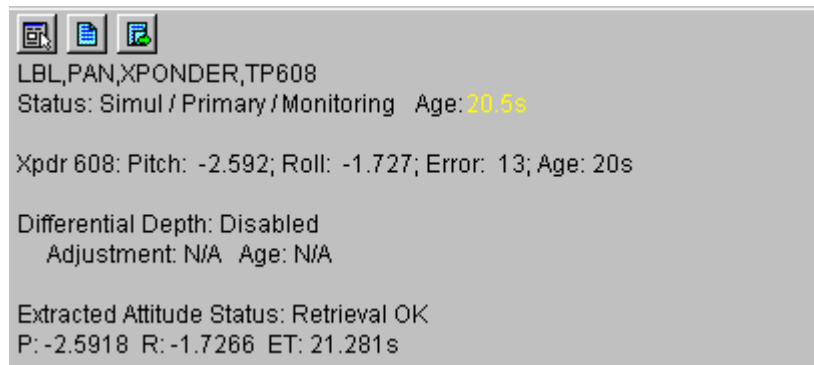
The window presents the information in four sections. Section one contains two lines of general status information. Section two contains the depth or attitude data depending upon the configuration for this transponder. The third section displays the Differential Depth status and data. If the respective transponder is set to interrogate for attitude data, this section indicates that this mode is disabled and the data is not available. Section four displays the attitude data extracted for use in reducing the depth data from the sensor to the CRP. In addition, there are four buttons used to access configuration dialogs or alter the data presented.

It is important to note that all the data for you to manually work through the Differential Depth process and confirm the results is provided in the respective view. Supporting information is provided in the Calculation Data Item view for the FIXED XPONDER (see below).

Monitoring Depth Interrogations



Monitoring Attitude Interrogations



The Top Buttons



Accesses the configuration for the data item.



N/A



N/A

Section 1

Line 1

Device name and data item, including the name of the associated transponder.

Line 2

Status

The status line starts with the type of transponder associated with this data item, then either Primary or Secondary as set by the operator for positioning with this device. This is followed by a slash and the term Monitoring.

Age

The time, in seconds, since the last respective data was received.

Section 2

Monitoring Depth Data

The transponder's transducer reduced depth and the age since the last interrogation. If the data has not yet been received, N/A is displayed. If the option to apply Differential Depth corrections was enabled, this depth is adjusted for the differential depth correction.

Monitoring Attitude Data

The attitude sensor observation, error flag and the age since the last interrogation. If the data has not yet been received, N/A is displayed. Note that the associated ATTITUDE data item must be also associated with this vehicle in order for the attitude data to be used (and displayed here).

Section 3

Differential Depth

This presents the status of the Differential Depth mode. If enabled, the selected transponder would be displayed with the associated adjustment, the time since the fixed transponder's last depth observation, the CRP depth for the fixed transponder and the vertical component of this transponder's (not the fixed transponder) offsets, corrected for attitude, applied to the CRP depth to derive the sensor depth.

Section 4

Extracted Attitude Status

This presents the status of the attitude data extracted for use reducing the fixed transponder's CRP to the sensor position. If enabled, and successful, the pitch and roll data used is displayed along with the age of the data.

To manually check the differential depth calculations, follow these steps:

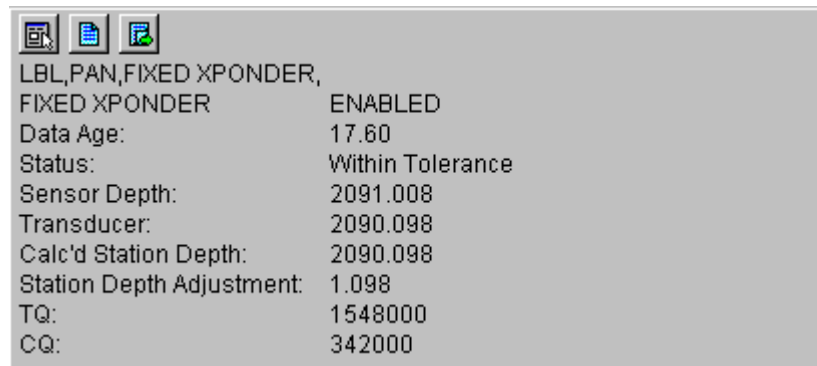
1. From the IO Device window, note the depth for the respective transponder's depth sensor. This will be given along with the raw CQ and TQ values.
2. In the Calculation window displaying the data item text for the respective ELEVATION data item, confirm that the reduced value is equal to the IO window depth value multiplied by -1 (to represent the depth as an elevation) plus the ELEVATION calibration value.
3. In the Calculation window displaying the data item text for the XPONDER data item:
 - a. The Other CRP Depth term is the CRP depth from the associated ELEVATION data item, i.e. the aforementioned

reduced value, corrected for the ELEVATION data item's offsets to the CRP.

- b. The Xponder Adjustment term is from the associated FIXED XPONDER data item and is the reverse sign of the Station Depth Adjustment value displayed for that data item in the Calculation window. The reverse sign is due to the fact that the adjustment to the array to correct the entire fixed transponder array for the change in water column depth is the opposite to the adjustment applied to a dynamic transponder to correct it to the fixed transponder array. This term is added to Other CRP Depth to produce the differential depth CRP depth. This is the depth that is passed to the vehicle and used as the CRP elevation/ROV depth.
- c. The Offset term is the vertical offset from the CRP to the transponder's transducer. Subtracting this from the adjusted CRP depth value gives the depth of the transponder's transducer. This depth is used in the Least Squares solution for the transponder's position if the XPONDER is configured for positioning.

Using the LBL Data Items Calculation Window for FIXED XPONDER

The information in the **Calculations** window (Data Items option) for an LBL data item provides you with the means to monitor the performance of the acoustics in detail.



LBL,PAN, FIXED XPONDER,	
FIXED XPONDER	ENABLED
Data Age:	17.60
Status:	Within Tolerance
Sensor Depth:	2091.008
Transducer:	2090.098
Calc'd Station Depth:	2090.098
Station Depth Adjustment:	1.098
TQ:	1548000
CQ:	342000

The Top Buttons



Accesses the configuration for the data item.



N/A



N/A

Line 1	Device name and data item.
FIXED XPONDER	Operation status, either ENABLED or DISABLED.
Line Data Age	Time in seconds since the last observation update.
Status	Observation status with respect to the minimum and maximum tolerances.
Sensor Depth	Calculated depth of the transponder's depth sensor.
Transducer Depth	Calculated depth of the transponder's transducer.
Calc'd Station Depth	Calculated depth of the respective transponder station.
Station Depth Adjustment	The calculated depth adjustment, the known station depth (from the Working Xponder File) minus the calculated station depth.
TQ	The raw temperature count.
CQ	The raw digiquartz sensor count.

Inverted LBL Application

Overview

The Inverted LBL application is specifically designed for Sonardyne hardware (PAN or ROVNAV MkIV). The application is for precisely positioning a moving structure relative to a target. In this application the transceivers and Simultaneous transponders are fixed at known locations and transponders are attached to a vehicle and are dynamic. The positions of the transducers of these transponders are to be precisely surveyed so that the offsets of each transponder's transducer with respect to the vehicle's CRP in a local reference coordinate frame are known. The device that supports the interface to the LBL unit for this application is actually the same as the PAN driver, but modifications have been made to make it appear as a new device to minimize possible confusion.

The associated data items are INVERTED TRANSCEIVER and INVERTED XPONDER. These are attached to the vehicle that is to be tracked. They are then associated with Static Transceiver and/or Static Simultaneous (xponders)

from the Working Xponder file. The subsequent configuration includes setting the Dynamic Array transponders that are to be tracked. These transponders will be those that are physically attached to the vehicle that is being tracked. In addition, you have the option to use the positions determined for the transponders to determine the heading and attitude of the tracked vehicle.

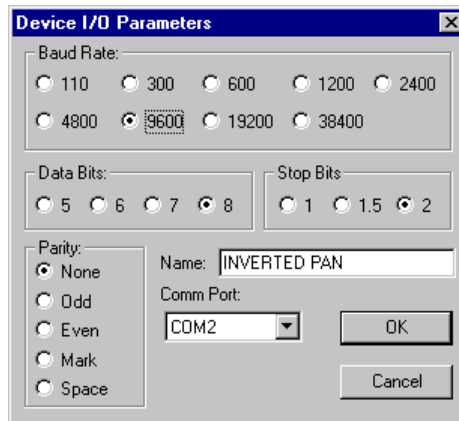
The positioning process involves sequentially commanding the transceivers and simultaneous transponders to range to the dynamic transponders. At each data update for a given INVERTED data item, the data for the other INVERTED data items attached to the same vehicle are accessed and combined in a 3 dimensional least squares adjustment. This least squares adjustment also makes use of the fact that the offsets of each dynamic transponder are precisely known and therefore baselines between each transponder pair are known and can be constrained in the adjustment.

Once the positions of each transponder's transducer are determined, these positions can be used to determine the CRP position, heading and attitude of the vehicle in another least squares adjustment.

In order to use these data items, there are minimum requirements with respect to the number of fixed and dynamic units. In order to solve for the positions of the dynamic transponders (those attached to the vehicle) the number of ranges observed from all the fixed transceivers and/or simultaneous transponders to all the dynamic transponders must be equal to or greater than the number of dynamic transponders multiplied by 3. Therefore, there must be a minimum of 3 fixed units. This will support the determination of any number of dynamic transponders. In order to solve for the CRP position, heading, pitch and roll there must be a minimum of 3 transponders on the vehicle.

Adding the INVERTED LBL Device

- 1 Connect the Sonardyne PAN or ROVNAV MkIV LBL system to a WinFrog com or Digiboard™ port.
- 2 From the Main Menu, select **Configure > I/O Devices... > Add**, or, from within the **I/O Devices** window, click the right mouse button and click **Add Device** in the pop-up menu.
- 3 From the **Devices** tree, expand the LBL node (click the + next to LBL or double click LBL) to display the list of available LBL devices.
- 4 Select the INVERTED PAN device.
- 5 Click **OK**.

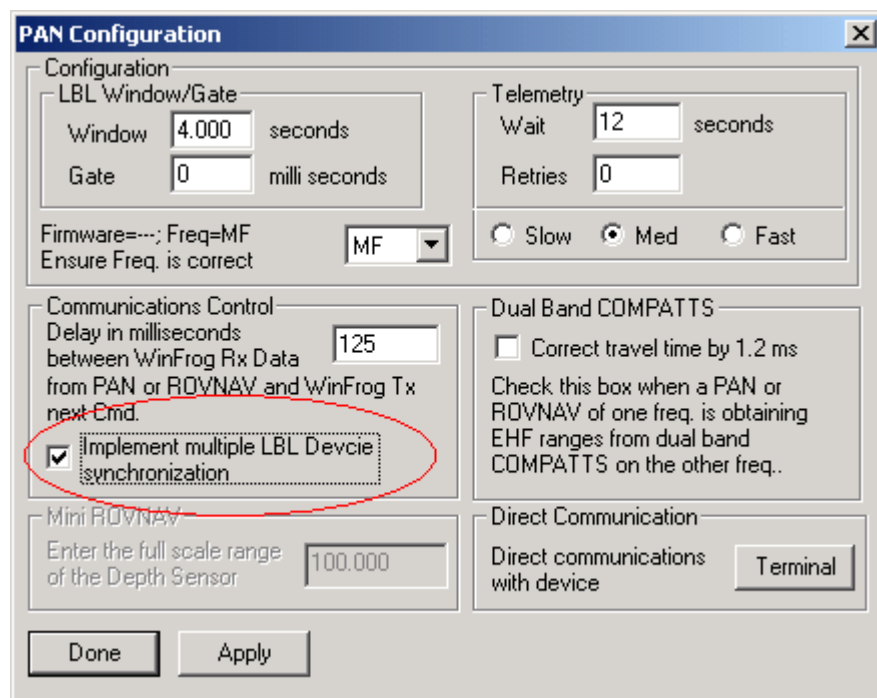


- 6 Enter an appropriate name for the device in the **Name** field.
- 7 Set all of the communication parameters to match those of the LBL device.
- 8 Click **OK**.

At this point the LBL device has been added to WinFrog. WinFrog will start transmitting the initialization telegrams to the device based upon default parameters. These can be monitored in the **I/O Devices** window.

The data received from the LBL system will be displayed in the **I/O Devices** window.

It is very important that if there are to be multiple INVERTED PAN devices added to WinFrog, the **Implement multiple LBL Device synchronization** option is checked.



Attaching Data items to the Vehicle

The **INVERTED TRANSCEIVER** and **INVERTED XPONDER** data items are attached to the vehicle being tracked.

When an **INVERTED** data item is attached to a vehicle, WinFrog tries to determine if another **INVERTED** data item has already been attached to this vehicle. If an existing one is found, the configuration settings pertaining to its application are copied to the newly attached data item. In addition, if these same configuration settings for any **INVERTED** data item attached to a given vehicle are changed, the respective settings for all other **INVERTED** data items attached to the same vehicle are also changed. This enables the adjustment control parameters to be kept synchronized between the **INVERTED** data items. The configurations settings that are kept in synchronization are indicated in the following sections with an * and are as follows:

Configure Inverted LBL Transceiver/Xponder Settings Tab

- Solution Control

Attitude Calculations Tab

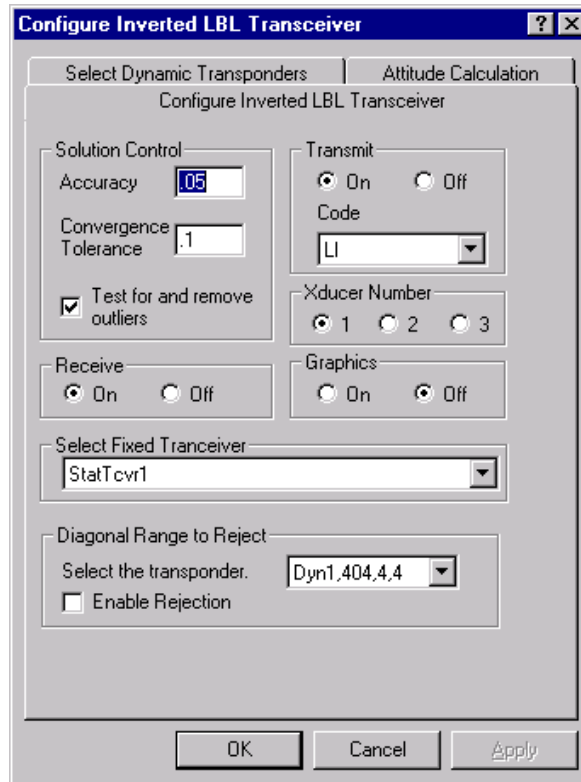
- Use
- Solution Criteria

The configuration for the **INVERTED TRANSCEIVER** and **INVERTED XPONDER** are very similar and dealt with together in the following. The specific data item the configuration is associated with is given in brackets.

- 1 Access the **Configure Vehicle - Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **LBL, *, INVERTED TRANSCEIVER** or **LBL, *, INVERTED XPONDER** data item from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle - Devices** dialog, highlight the **LBL, *, INVERTED TRANSCEIVER** or **LBL, *, INVERTED XPONDER** data item.
- 6 Click **Edit**.
- 7 Configure the data item as required. The configuration of the **INVERTED** data items are very similar and addressed together here.

Configure Inverted LBL Transceiver Tab (**INVERTED TRANSCEIVER** only)

The configuration of how the transceiver is to operate as attached to this vehicle is edited in this tab.



Solution Control*

Accuracy*

The standard deviation of the ranges observed directly by the transceiver. This will depend upon frequency of the acoustics. Note that the accuracy is entered in the default distance units, not milliseconds.

Convergence Tolerance*

The position calculation is a least squares solution. The process is an iterative one where the least squares actually determines and applies a correction to a position estimate to arrive at the final position solution. Given reasonable data, this correction will become smaller every iteration, i.e. the solution will converge. The process is considered complete when the correction is less than a specified **convergence tolerance**. You can edit this tolerance to match the accuracy of the acoustics being used, e.g. the tolerance for EHF can be set to a small value to optimize the data, such as 5 cm. The tolerance is entered in the default distance units.

Test for and remove outliers*

After the Dynamic Transponder position adjustment is performed, the residuals are tested to determine observation outliers. If found, the worst is removed from the solution and the solution is re-adjusted. This is repeated until removing anymore would result in a solution not being possible.

Receive

For future development.

Select Fixed Transceiver

This drop down list box accesses the Working Xponder file and lists all those xponders configured as Static Transceivers. Select the one associated with this instance of the data item.

Transmit

On

This must be selected when the transceiver is used for any operations.

Off

The transceiver is disabled for all uses.

Code

This is the command or code required by the device to initiate range observations. The drop down list lists all the possible selections for this option. It is recommended that the LI command be used.

Xducer Number

The Sonardyne PAN and ROVNAV support 2 transceivers. Select the one that is associated with this instance of the data item.

Graphics

Controls the display in the Graphics window of the solved for positions of the associated Dynamic Array transponders on the vehicle. Due to the relatively slow update rate of acoustics, this position may appear to lag behind the vehicle because it is only updated when new acoustic data is received and a position calculation is done.

Diagonal Ranges to Reject

Allows you to disable the use of a selected range associated with this data item, specifically the diagonal range that in applications of the INVERTED LBL operation could be heavily influenced by the signal path. This includes the possibility of the signal actually traveling through the structure. Note

that this rejection is specifically associated with only this INVERTED TRANSCEIVER data item and is not applied to any other INVERTED data items.

Select the transponder

From the dropdown list of all Dynamic Array transponders in the Working Xponder file, select the one whose range is to be disabled. Select None if all are to be used.

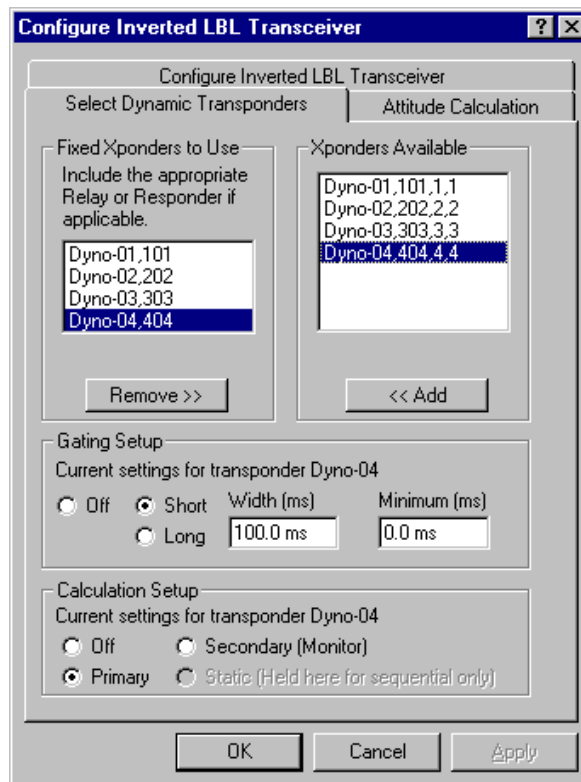
Enable Rejection

Check this box to implement the rejection of the selected Dynamic Array transponder from the solution.

**Select Dynamic Transponders Tab
(same for INVERTED TRANSCEIVER and INVERTED XPONDER)**

The selection of the dynamic transponders for use in the position solution is done from this tab. The transponders are selected from the transponders in the Working Xponder file set to Dynamic Array. In addition, the transponder gating and application in the position solution settings are configured here.

Note: The Gating and Calculation Setup for a transponder can also be accessed from the Calculations Window (see **Reading the INVERTED LBL Data Items Calculation Window**).



Xponders Available

This is a list of all the Dynamic Array transponders in the Working Xponder file. Each one is identified by station name, address, reply code and individual interrogation frequency (**IIF**). Those fixed transponders that do not have an address or IIF (i.e. the first one listed here) will not have anything between the first and second comma and will not have an IIF after the last comma.

To select a transponder required for use in conjunction with this vehicle double click the transponder in the list or highlight it and click the **<<Add** button. This will copy the transponder name to the **Fixed Xponders to Use** list. Note that the selected transponder still appears in the available list.

Fixed Xponders to Use

In this application, this is a list of those Dynamic Array transponders, selected by the operator from the **Available** list, to be used in conjunction with this transceiver.

To Remove a transponder from the list, highlight it and click the **Remove>>** button.

To Add a transponder to the list, highlight it in the Xponders Available list and click the **<<Add** button or double click the entry in the list.

Gating Setup

These settings control the application of range **Gating** for the data for the transponder highlighted in the **Fixed Xponders to Use** list.

Off	Gating is not applied to the range data for the transponder, all data will be used in the solution.
Short	Gating is applied using a short history, specifically the last 4 ranges, to determine the trend against which the new range is evaluated to determine if it is to be gated from the solution.
Long	Gating is applied using a long history, specifically the last 10 ranges, to determine the trend against which the new range is evaluated to determine if it is to be gated from the solution.
Width	If gating is on, this value is used as the criteria to accept or reject a range. If the range lies within the window created by this value and the trend determined by the Long

	or Short selection it will be accepted. This value is in milliseconds.
Minimum	This is the minimum acceptable TWT in milliseconds. If the associated TWT is less than this entry, the data is not used in the solution. This test is independent of the gating and applied whether gating is on or off. It is grouped with the gating due to the similar nature of its use.

Note: If gating is on it requires two to four ranges before a trend can be established thus the first few sets of ranges will not result in a fix computation. This will be indicated in the calculations window (see **Reading the INVERTED LBL Data Items Calculation Window**).

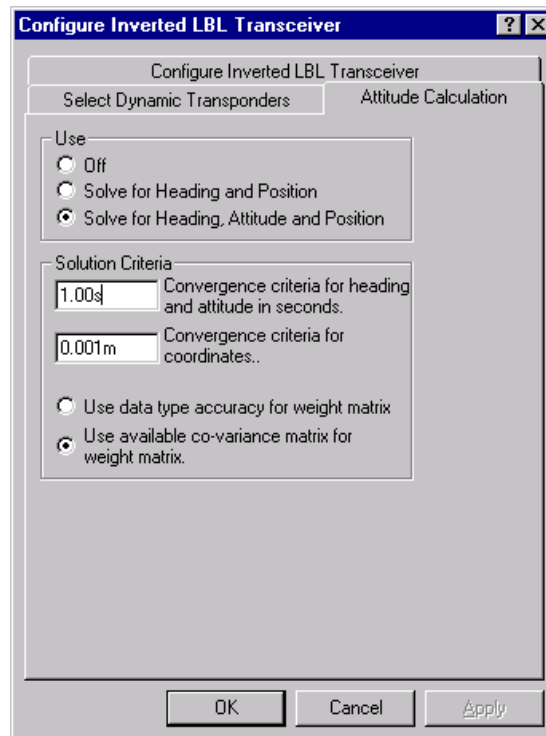
Calculation Setup

These settings control how the range data for the transponder highlighted in the **Fixed Xponders to Use** list will be used in the position calculations.

Off	The transponder's data is not used in the solution, nor is a residual calculated and displayed, i.e. the range is not monitored.
Primary	The transponder is used in the solution.
Secondary	The transponder is not used in the solution, but a residual is computed for the range, i.e. it is monitored.
Static	This option is not applicable for INVERTED LBL application.

Configure Attitude Calculation Tab

The configuration of how the positions of the Dynamic Array transponders attached to the vehicle are to be used to determine the vehicle heading and attitude is controlled from this tab.



Use*

Off*

The vehicle's heading and attitude are obtained from other sources/sensors. This data is used to compute a CRP position.

Solve for Heading and Position*

The Dynamic Array transponder position data is used to solve for the vehicle heading and CRP position. The positions for the transponders that form the longest horizontal baseline are used to determine a heading. This heading is then used with the transponder offsets to determine a mean CRP position. Attitude is not solved for nor obtained from another source but is assumed to be 0 pitch and 0 roll.

Solve for Heading, Attitude and Position*

The Dynamic Array transponder position data is used in a least squares adjustment to solve for the vehicle's heading, attitude and CRP position.

Solution Criteria*

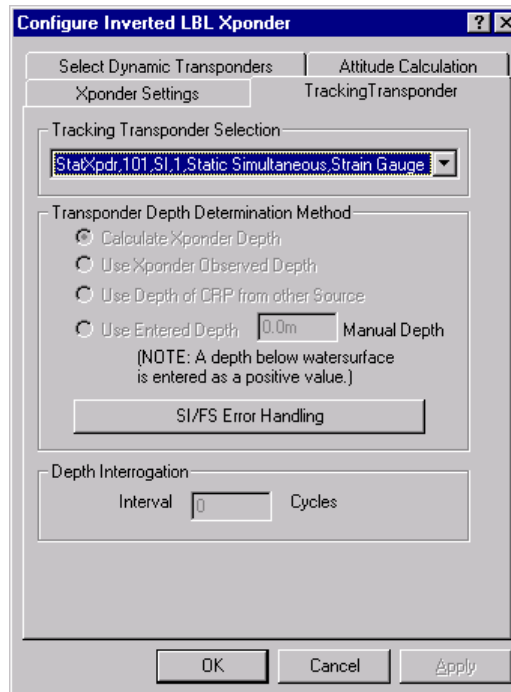
The unknowns in the least squares adjustment are heading, pitch, roll and CRP Northing, Easting and depth. You can enter the convergence criteria

for the angular and position components here. The default is 1" and 0.05m. The criteria for the position components are entered in the default distance units.

You can also select whether to use an arbitrary weight matrix where all observations used in the adjustment are equally weighted based on a standard deviation of 0.01m. Or the covariance matrix from the least squares adjustment for the Dynamic Array transponders (the observations for this adjustment) is used for the creation of the weight matrix. The latter provides a more realistic statistical analysis of the final CRP position results.

Configure Tracking Transponder Tab (INVERTED XPONDER data item only)

The selection of Static Simultaneous (transponder) from the Working Xponder file to be associated with this instance of the INVERTED XPONDER data item is done in this tab.



Tracking Transponder Selection

This drop down list box displays the transponders set to Static Simultaneous in the Working Xponder file. If there are no transponders of these types in the transponder file then a vehicle cannot be positioned with this data item. Each transponder is described by its Name, Address, Receive code, Transmit code, LBL transponder type and depth sensor type.

Select the appropriate transponder or **None** to cancel a previous selection and stop interrogation.

Transponder Depth Determination Method

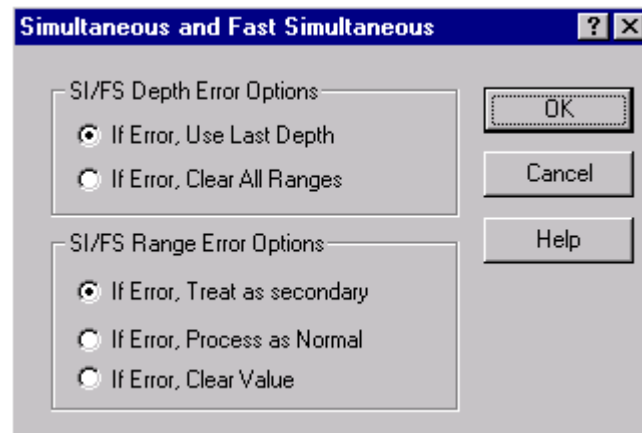
Not applicable for this data item.

Depth Interrogation

Not applicable for this data item.

SI/FS Error Handling

This accesses the following dialog allowing the configuration of action to take when errors are detected and reported by the LBL system.



SI/FS Depth Error Options

This controls how the detection of an error in the depth observation is handled.

If Error, Use Last Depth

If an error is reported for the depth observation, the last good depth observation is used in the solution.

If Error, Clear All Ranges

If an error is reported for the depth observation, all range data is cleared and no position is solved for.

SI/FS Range Error Options

This controls how the detection of an error in the range observation is handled.

If Error, Treat as Secondary

If an error is reported for a range observation, the respective range is not used in the solution but a residual is computed and displayed.

If Error, Process as Normal

If an error is reported for a range observation, it is ignored and the respective range is used in the solution.

If Error, Clear Value

If an error is reported for a range observation, the respective range is zeroed and treated as if it didn't exist.

Xponder Settings Tab (INVERTED XPONDER data item only)

Configure Inverted LBL Xponder

Select Dynamic Transponders | Attitude Calculation

Xponder Settings | Tracking Transponder

Calculation

☒ Primary
☐ Secondary

Solution Control

Accuracy
 Convergence Tolerance
☐ Test for outliers

Xpndr Control

☒ On ☐ Off

Graphics

☐ On ☒ Off

Transducer Number

☒ 1 ☐ 2 ☐ 3

Kalman Filter Control

☒ Filter Least Squares Position
☐ Filter Ranges

Offset, from the CRP

Fore/Aft: Port/Stbd: Height (+ above CRP):

OK Cancel Apply

Calculation

Primary

The position determined for the vehicle the associated Dynamic Array transponders are attached to will be used in the Primary position calculation for this vehicle.

Secondary

The position determined for the vehicle the associated Dynamic Array transponders are attached to will be used as a Secondary position for monitoring this vehicle's primary position.

Solution Control*

Accuracy*

The standard deviation to be used for each range used in the position solution for this Static Simultaneous transponder. This will depend upon frequency of the acoustics.

Convergence Tolerance*

This is entered using the default distance units.

The position calculation is a least squares solution. The process is an iterative one where the least squares actually determines and applies a correction to a position estimate to arrive at the final position solution. Given reasonable data, this correction will become smaller every iteration, i.e. the solution will converge. The process is considered complete when the correction is less than a specified **convergence tolerance**. You can edit this tolerance to match the accuracy of the acoustics being used, e.g. the tolerance for EHF can be set to a small value to optimize the data, such as 5 cm. This is entered using the default distance units.

Test for outliers*

If checked, after the Dynamic Transponder position adjustment is performed, the residuals are tested to determine observation outliers. If found, the worst is removed from the solution and the solution is re-adjusted. This is repeated until removing anymore would result in a solution not being possible.

Xponder Control

On

The transponder is active.

Off

The transponder is disabled **within** WinFrog, i.e. WinFrog will not communicate with it automatically as configured here.

Xducer Number

This controls which transceiver connected to the control unit will be used to communicate/interrogate the transponder.

Graphics

Turns the display of the raw transponder position **On** and **Off** in the Graphics window. Due to the relatively slow update rate of acoustics, this position may appear to lag behind the vehicle because it is only updated when new acoustic data is received and a position calculation is done.

Kalman Filter Control

Not applicable for this data item.

Offsets

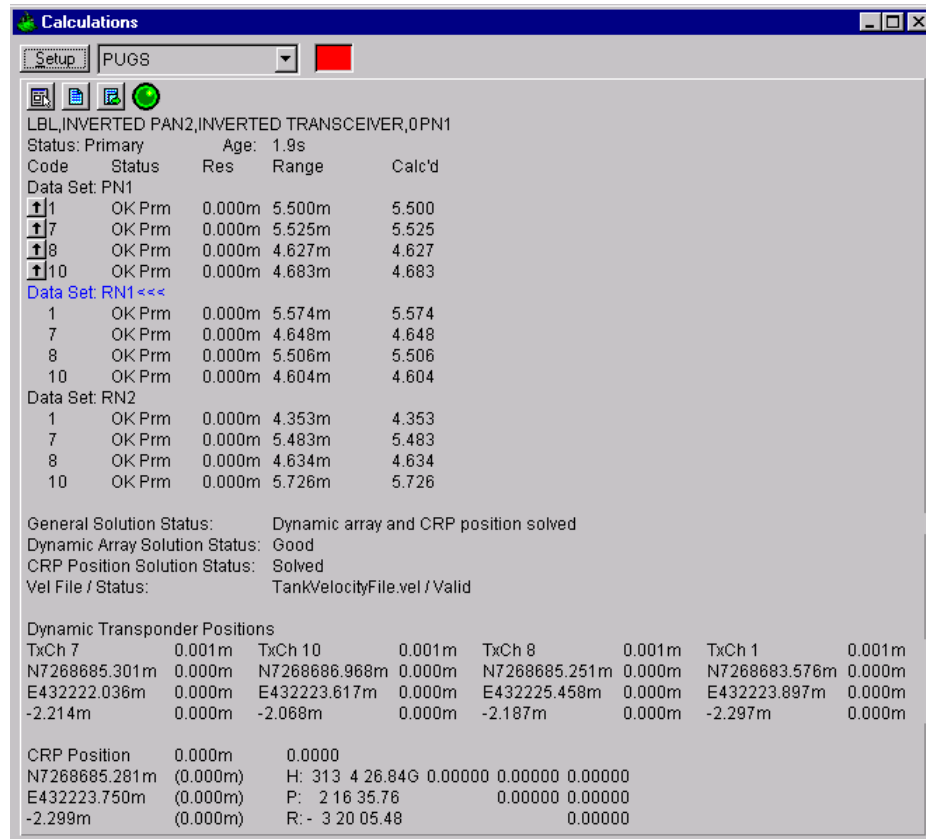
Not applicable for this data item.

- 8 Click **OK** to accept the settings and return to the **Configure Vehicle-Devices** dialog. At this point, the changes will take affect and any interrogations and calculations configured will commence.
- 9 Complete the configuration of the **Vehicle Position Calculations**, i.e. Kalman Filter control.
- 10 Click **OK** to exit the **Configure Vehicle-Devices** dialog.

To Monitor INVERTED LBL Operations in the Calculation Window

The **Calculations** window is used in the same way for both the INVERTED TRANSCEIVER and INVERTED XPONDER data items. The data presentation is almost identical and is discussed as one here.

- 1 Open a **Calculations** window. From the main menu, click on **Views** and then **Calculations**.
- 2 From the drop down list, select the appropriate vehicle.
- 3 Click the **Setup** button.
- 4 In the **Setup Calculation Views** dialog, check **Data Item Text**.
- 5 Highlight the INVERTED LBL data item associated with this vehicle and click **On**. This will provide a display of the available ranges with their status and residuals as shown here.



Understanding and Using the INVERTED LBL Data Items Calculation Window

The information in the **Calculations** window (Data Items option) for an INVERTED LBL data item provides you with the means to monitor the performance of the acoustics in detail.

The window essentially presents the information in five sections. Section one contains two lines of general application information and a status LED. Section two contains a header line followed by a data/status line for each transponder assigned to the data item solution. The third section presents status for specific solution phases. The fourth section contains the Dynamic Array transponder position solution results. The last section presents the results of the CRP position determination and any heading and attitude results that are applicable. In addition, there are four buttons used to access configuration dialogs or alter the data being presented.

It is important to note that this display is updated by other INVERTED data items other than the one configured for display. This allows all the data and solutions to be monitored from a single Calculations window rather than having one window open for each INVERTED data item. There is a limitation to this window in that only those LOPs associated directly with the data item selected for the Calculations window can be accessed via the shortcut buttons.

The Top Buttons



Accesses the configuration for the data item, either the INVERTED TRANSCEIVER or INVERTED XPONDER.



N/A



Toggles the display of the last two columns for the transponder data. The data can be displayed as the following:

- Observed and calculated range in the default distance units
- Observed and calculated TWTT in milliseconds
- Sound velocity value used to reduce the raw data to distance and the transponder address (if applicable).



LED reflects general status of the solution represented in this window. If the solution of the Dynamic Array transponders failed or the status is unknown, the LED is red. If the solution for the Dynamic Array transponders was successful, the LED is yellow. If the latter was successful and also the solution of the CRP position, the LED is green.

Section 1

Line 1

Device base type and operator assigned name, data item, and if INVERTED TRANSCEIVER, transducer number and associated Static Transceiver name or if INVERTED XPONDER, associated Static Simultaneous name.

Line 2

Mode

Either Primary or Secondary as set by the operator for positioning with this device.

Note: If the data item is an INVERTED XPONDER, the status starts with the type of transponder associated with it.

Age

The time in seconds since the last fix based upon new data for the INVERTED data item directly associated with this window was computed.

Section 2

This section displays all the observations used in the Dynamic Array transponder adjustment, including those accessed from other INVERTED data items.

Header	The header Code Status Res Range Calc'd or Code Status Res TWTT Calc'd or Code Status Res Vel Add is displayed depending upon the state of the  toggle.										
Data Set	The name of the Static Transceiver or Xponder associated with the following observation set. The data set that has just received new data and is therefore responsible for a new update is displayed in blue and indicated with  .										
Column 1	The transponder Transmit frequency/channel. In addition there is an up arrow  button that accesses a configuration dialog specifically associated with the transponder for which the line corresponds. See  Button .										
Column 2	The Status will either be a combination of two abbreviations or a single word. In the case of the display of two abbreviations, the first abbreviation possibilities are as follows: <table><tr><td>OK</td><td>The transponder was used in the position calculation.</td></tr><tr><td>NODATA</td><td>The transponder was not used in the position calculation, no data available for it.</td></tr><tr><td>XPDR</td><td>Though there was data available for this transponder, a match in the Working Xponder File to a Dynamic Array transponder that was turned on was not found.</td></tr><tr><td>FILT</td><td>The transponder range was failed the gating filter and was de-weighted from the solution.</td></tr><tr><td>MIN</td><td>The transponder range was less than the minimum acceptable range setting and was de-weighted from the solution.</td></tr></table>	OK	The transponder was used in the position calculation.	NODATA	The transponder was not used in the position calculation, no data available for it.	XPDR	Though there was data available for this transponder, a match in the Working Xponder File to a Dynamic Array transponder that was turned on was not found.	FILT	The transponder range was failed the gating filter and was de-weighted from the solution.	MIN	The transponder range was less than the minimum acceptable range setting and was de-weighted from the solution.
OK	The transponder was used in the position calculation.										
NODATA	The transponder was not used in the position calculation, no data available for it.										
XPDR	Though there was data available for this transponder, a match in the Working Xponder File to a Dynamic Array transponder that was turned on was not found.										
FILT	The transponder range was failed the gating filter and was de-weighted from the solution.										
MIN	The transponder range was less than the minimum acceptable range setting and was de-weighted from the solution.										

NEG	The transponder range when reduced was a negative value and de-weighted from the solution. Probably due to an incorrectly entered TAT for this transponder.
MAN	The transponder range was entered manually and is currently being held static at this value (see  Button).
HLD	The transponder range has been selected from the range observation history and is currently being held static at this value (see  Button).
D Rej	The transponder range has been selected to be rejected by the operator using the Diagonal Ranges to Reject option.
w-IN	The transponder range has been detected as an outlier using the w-test, but due to solution failing if this range is de-weighted due to insufficient ranges, it has been flagged but still used in the solution.
w-OUT	The transponder range has been detected as an outlier using the w-test and de-weighted from the solution. In the case of the display of two abbreviations, the second abbreviation possibilities are as follows:
Prm	This transponder is set to Primary and was used in the calculation.
Sd	This transponder is set to Secondary and was not used in the calculation. The residual is displayed for monitoring. In the case of the display of a single word, the possible displays are as follows:
Off	The operator has set this transponder to Off and the range was not used in the solution.

Column 3

The range residual in milliseconds or distance units, depending upon the state of the  toggle.

Column 4	Depending upon the state of the  toggle:
Range	Observed one-way range in the distance units; or
TWTT	Observed TWTT in milliseconds; or
Velocity	The calculated velocity of sound used to reduce the travel time to distance.

Column 5	Depending upon the state of the  toggle:
Calc'd	The calculated one-way range in distance units or calculated TWTT in milliseconds to correspond with the aforementioned Range or TWTT in column 4; or
Add	The address of the transponder if applicable.

Section 3

Line 1	The Status for the overall solution including the determination of the Dynamic Array transponder positions and the CRP and associated parameters. The status messages are as follows:
Failed	The solution failed completely.
Dynamic Array Solved	The positions of the Dynamic Array transponders were successfully determined.
Dynamic Array and CRP Position Solved	The positions of Dynamic Array transponders and the CRP position and associated parameters were successfully solved.
Unknown	An unknown solution status has been detected.
Line 2	The Status specifically for the determination of the Dynamic Array transponder positions and the CRP and associated parameters. The status messages are as follows:
Good	The positions of the Dynamic Array transponders were successfully determined.

Line 3	No Xponder File	No Working Xponder file was detected.
	No Dynamic Xponders	The Working Xponder file does not contain any Dynamic Array Xponders.
	Initializing	The adjustment is initializing, insufficient data has set be collected to perform the first solution.
	Bad Unknown	The solution failed for undetermined reasons.
	Insufficient usable observations	Insufficient acceptable ranges from this and associated Static Transceivers/Xponders are available to perform an adjustment.
	Poor/singular Geometry, unable to inverse N	The solution failed due to the geometry of the adjustment or insufficient independent observations and as result the Normal matrix could not be inversed.
	Bad Observations, solution did not converge	The adjustment did not converge and failed. This is due to the combination of observation quality, accuracy and convergence tolerance settings. As observation quality deteriorates, the convergence tolerance must be increased if a solution is desired.
	Unknown	The solution status flag is of unknown setting.
		The Status for the CRP and associated parameters solution.
		The status messages are as follows:
	Not Solved Yet	The adjustment has not yet been solved due to the lack of Dynamic Array transponder position data being available.
	Initializing	The adjustment is initializing using the available observation sets.
	Initialized	The adjustment has initialized and will proceed with the computations.
	Failed: Unable to Initialize	The adjustment was unable to initialize due to poor observations.

	Failed: Unable to inverse Covariance Matrix	The use of the covariance matrix from the Dynamic Array adjustment failed due to being unable to perform an inversion of it.
	Failed: Insufficient Observations	The adjustment failed due to insufficient observations.
	Failed: Unable to inverse Normal Matrix	The adjustment failed due to poor geometry of the adjustment or insufficient independent observations. (The least squares was unable to inverse the Normal matrix).
	Failed: Unable to Converge	The adjustment did not converge, probably due to bad data.
	Solved	The adjustment of the unknown parameters was successfully performed.
	Unknown	An unknown solution status has been detected.
Line 4		The name of the current Working Velocity file and the status of the file's data with respect to the solution. If there is no Working Velocity file, this line is red and flashes "No VEL File".
	Insufficient	The status messages are as follows: The solution's depth or one of the fixed transponders lies outside of the scope of the data contained within the Velocity file, i.e. above the shallowest velocity entry or below the deepest velocity entry.
	Valid	The velocity file data covers the depths of the transponders and transceivers involved in the solution and a velocity was successfully determined for all ranges.

Section 4

This section displays the results of the adjustment for the individual Dynamic Array transponders. This information is presented in up to 2 rows, each with up to 5 transponders for a total possible of 10. The data presented for each transponder is presented in 2 columns.

Column 1

Name	Name assigned in the Working Xponder file.
Northing	Adjusted Northing for the transponder's transducer.
Easting	Adjusted Easting for the transponder's transducer.
Depth	Adjusted Depth for the transponder's transducer.

Column 2

RMS	RMS for this transponder from the adjustment for the individual Dynamic Array transponder positions.
Northing Residual	The residual in Northing associated with this transponder in the heading, attitude and CRP solution.
Easting Residual	The residual in Easting associated with this transponder in the heading, attitude and CRP solution.
Depth Residual	The residual in Depth associated with this transponder in the heading, attitude and CRP solution.

Section 5

This section displays the results of the adjustment for the individual CRP position and the associated unknown parameters solved for.

Column 1

Title	
Northing	Adjusted Northing for the CRP.
Easting	Adjusted Easting for the CRP.
Depth	Adjusted Depth for the CRP.

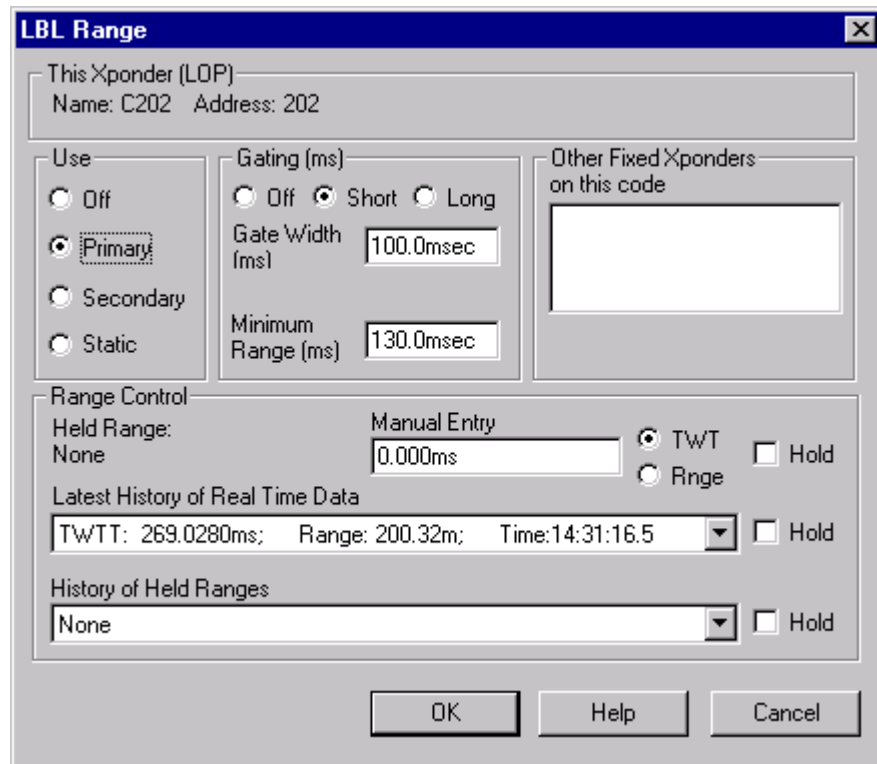
Column 2

Status/RMS	Displays the status of the adjustment if the adjustment has not been solved or if it is not to be solved (Attitude Calculation setting is not set to solve for Heading, Attitude and CRP Position) in which case it displays "Not Solved" or "N/A". Otherwise the RMS for adjustment is displayed.

Northing Residual	The difference of the solved CRP Northing and the vehicle Northing.
Easting Residual	The difference of the solved CRP Easting and the vehicle Easting.
Depth Residual	The difference of the solved CRP Depth and the vehicle Depth.
Column 3	
Status/A Posteriori	Displays the status of the adjustment if the adjustment has not been solved or if it is not to be solved (Attitude Calculation setting is not set to solve for Heading, Attitude and CRP Position) in which case it displays “Not Solved” or “N/A”. Otherwise the A Posteriori variance factor for adjustment is displayed.
Heading	Displays Not Solved if the heading is not to be solved for, otherwise displays the solved Grid heading.
Pitch	Displays Not Solved if the attitude is not to be solved for, otherwise displays the adjusted pitch.
Roll	Displays Not Solved if the attitude is not to be solved for, otherwise displays the adjusted roll.
Columns 4-6	
Covariance Matrix	Displays the upper triangle of the resulting covariance matrix. If not solved for, asterisks are displayed.
 Button	There is an “up arrow” button associated with each transponder displayed in section 2 of this window that is specifically associated with the INVERTED TRANSCEIVER or XPONDER selected for the Data Item text option. Clicking on this button enables an operator to access the configuration for that specific transponder. This configuration is displayed and edited in the LBL Range dialog. See Editing an LBL LOP.

Editing an LBL LOP

When viewing an LBL or INVERTED LBL data item in the Calculations window, there is an up arrow  located to the left of each line displaying range data. Clicking this button accesses the LBL Range dialog enabling you to configure the use of the range within the associated solution.



Edit LBL Range

This Xponder (LOP)

The relevant transponder is identified by the name and the address assigned to it in the **Working Xponder** file.

Use

Set the **use** of this transponder in the solution (see **Select Fixed Transponder Tab**).

Gating

Set the gating control for this transponder in the solution (see **Select Fixed Transponder Tab**).

Other Fixed Xponders

Any other transponders in the **Working Xponder** file with either the same transmit frequency or channel as that assigned to this transponder are listed.

Range Control

This option allows you to configure the range for this transponder to be held static in the solution. In the **Calculations** window, the associated line is displayed in magenta with the status of either **HLD** or **MAN** as is appropriate. Checking one of the **Hold** checkboxes will set the associated data to static. This range is then held static until a new one is selected or the **Hold** box is unchecked. The current status is displayed in the top left of this panel. The options are as follows.

- Manually enter the TWT in milliseconds or the raw slant range in the default distance units.
- Select a range to hold static from the history of the last 20 observed ranges (the list shows the TWT in milliseconds, the raw slant range in meters and the epoch).
- Select a range to hold static from the history of the last 10 ranges that have been held static (the list shows the TWT in milliseconds, the raw slant range in meters and the epoch or manual).

Chapter 18: USBL Acoustics

Ultra Short BaseLine (USBL) acoustic systems provide the means to measure to a subsurface acoustic beacon, providing the range, bearing, and depth from a surface-based hydrophone. This information can be used to position the ship, initiating the measurement using a fixed beacon (stationary with the position known). It can also be used to position a moving beacon and thus the underwater vehicle to which it is attached.

Note: the terms transducer, transceiver and hydrophone are often interchanged. In this chapter, unless otherwise noted, they refer to the hydrophone that is mounted on the reference vehicle.

WinFrog supports the input from USBL acoustic systems for real-time subsurface positioning applications. This chapter discusses the application of USBL devices and their associated data by WinFrog.

It is important to note that USBL systems require calibration. The reader is referred to the **LBL& USBL Calibrations** chapter.

The following are important factors to be noted and/or addressed prior to using a USBL system:

- The **Working Xponders** file must be loaded with the appropriate beacons configured. This is essential for operating the USBL system to position a vehicle from a fixed beacon. In the case of using the USBL system to track a dynamic beacon, though not required for operation it is recommended that the tracking beacons be entered to provide summary of all transponder and beacon information. In future developments the Working Xponders file will be checked to determine the type of tracking beacon is being used.
- It is not necessary that a **Working Velocities** file be present for USBL operations. The velocity information is input directly into the USBL system. WinFrog receives and uses the data as distances or distances and bearings, not travel times, as is the case for LBL operations.
Note the exception to this is if the travel time data provided by several USBL systems is to be used for calibrating the USBL beacon position. In this case, an appropriate velocity file must be loaded. Also, if a correction for ray bending is desired, a velocity profile, transponder file with the appropriate beacon and its turnaround time, and the use of the CSV surveyor's acoustic telegram from the Sonardyne USBL system is also required. Currently, only the Sonardyne USBL system is supported for ray bending.
- If an attitude sensor is present on the vehicle with the USBL hydrophone deck unit, it must be injected directly into the USBL system. WinFrog does not currently support application of attitude data to USBL data or sensor offsets. **Note:** this is the only device for which this is true, all other devices and offsets support application of attitude data.
- If the USBL system supports direct attitude data injection and internal offsets, the offsets from the USBL systems transducer to a reference point on the vessel must be

entered in the USBL system. In most cases, these are already present, as they are required to reference the data output to a Dynamic Positioning (DP) system, to the center of gravity (COG). If this is not the case, offsets to the same Common Reference Point (CRP) that will be used by WinFrog must be entered.

- The WinFrog CRP must be at the water line in order to correctly allow for reduction of acoustic data.
- Several USBL devices provide heading data in the associated telegrams that is specifically for the epoch of the USBL data. These devices can be configured to pass this heading to the vehicle for use in processing the data. If this option is selected for the USBL device, the associated processing uses this heading, specifically the application of offsets and the XYZ data is performed using this heading. In this case, this heading is also logged with the respective data to the calibration file as the vehicle heading for the calibration epoch. The advantage of using this option is that the heading data used is accurately matched to the XYZ data epoch. The disadvantage is that it is not possible to apply a heading correction to the data (not to be confused with a USBL calibration correction).

Note: there are surface-based systems that provide data similar to that data provided by the USBL systems, but for surface positioning applications. Due to the similarities, they have been grouped with the USBL devices. They are added to WinFrog and their data are applied in the same way as the USBL devices. These are noted where applicable.

Overview

Components

A USBL system is comprised of two main components:

- 1 Hydrophone and a deck unit.
- 2 Beacon

The hydrophone is attached to the reference vehicle and, with the deck unit, interrogates and receives signals from beacons. The beacons may be at a fixed location and/or they may be attached to a moving vehicle such as an ROV.

In the case of surface systems that operate in a similar manner, the hydrophone is replaced with a tracking instrument and the beacon with a target.

The Data

The signals received by the hydrophone from the beacon(s) are used to determine the relative spatial relationship between the hydrophone and the beacon(s). This information is then output. The data can be in one of several forms 1) **XYZ** data where **X** is the horizontal distance port/starboard from the hydrophone to the beacon, **Y** is the same for the fore/aft direction, and **Z** is the

vertical distance to the beacon from the hydrophone, 2) **RBD** where **R** is the horizontal range from the hydrophone to the beacon, **B** is the bearing from the hydrophone to the beacon relative to the reference vehicle's heading, and **D** is the depth from the hydrophone to the beacon, and 3) **l,m,twtt** where **l** is the athwart ships direction cosine, **m** is the along ships direction cosine and **twtt** is the two way travel time between the transceiver and beacon.

USBL systems output the depth component as positive. WinFrog converts this to a negative for application in the ship-based local reference coordinate frame.

Application

USBL systems are used for the following applications:

- 1 **Tracking** of a dynamic beacon from a reference vehicle. The beacon will likely be attached to an ROV (or diver) whose position is to be monitored. In this case, the position of the hydrophone is determined using another data source, such as DGPS, and the orientation of the vessel (and thus the hydrophone) is determined from a gyro. The USBL data can then be reduced to determine the position of the beacon.
- 2 **Positioning** of a reference vehicle from a fixed beacon. This is a standard **Dynamic Position (DP)** system application. In this application, the position of the fixed beacon is known and the USBL data are used, in conjunction with the orientation of the vessel and thus, the hydrophone, as determined from a gyro, to enable the computation of the hydrophone position.

Note: if the USBL system is to be used for positioning of the reference vehicle using a fixed beacon, a valid **Working Xponder** file must be available with the appropriate beacon entered and configured in it (see the **Working Files** chapter).

- 3 There is also an application that combines the above, sometimes referred to as **relative beacon tracking**. In this case, the position of the hydrophone is determined using data observed to a fixed beacon. The position of a dynamic beacon is then determined using the data to it. The concept behind this application is the elimination of errors due to local conditions that are inherent in observations to both beacons.

Note: for all applications of the USBL system, the hydrophone must be associated with a reference vehicle. The beacon is only associated with a vehicle if that vehicle is to be tracked.

Attitude Data and Offsets for the Hydrophone

If an attitude sensor is present for the vehicle the USBL hydrophone is on, if possible, it must be injected directly into the USBL system. The output data will

then be attitude-corrected. WinFrog does not currently support application of attitude data to the USBL data itself, nor the hydrophone sensor offsets. **Note:** this is the only device for which this is true, all other devices and offsets support application of attitude data.

Offsets from the USBL system’s hydrophone to a reference point on the vessel must be entered in the USBL system (if the USBL system supports this). In most cases, these are already present because they are required for data output to a **Dynamic Positioning (DP)** system. If this is not the case, offsets to the same **Common Reference Point (CRP)** used by WinFrog should be entered. The data output will then be attitude-corrected and referenced to an attitude-corrected, local, ship-based coordinate reference frame.

The offsets that are entered into the USBL system are also entered into WinFrog as are the standard WinFrog offsets from the CRP to the sensor. The WinFrog CRP must be at the water line in order to correctly allow for reduction of acoustic data.

In the case of surface systems that operate in a similar manner, the attitude is not applied either by the system or by WinFrog to the data itself or the tracking instrument offsets. For these systems, there are also no offsets entered directly into the system nor the corresponding WinFrog configuration.

Attitude Data and Offsets for the Beacon

WinFrog does support the application of the relevant attitude data to the beacon offsets on the vehicle to which the beacon is attached, though the USBL data used to determine the beacon position is not corrected by WinFrog for attitude at the reference vehicle.

USBL Data Types

The USBL devices provide the following data types, depending upon the data output available:

USBL Hydrophone	All devices provide this data type. It must be added to the reference vehicle.
Beacon	All devices provide this data type. It is added to a remote vehicle that is to be tracked and positioned with the USBL. The BEACON data type associated with any one USBL device can be added multiple times to the same or different vehicles. Each instance is then differentiated by the code assigned it during the configuration.

Attitude

Not all devices provide this data type, only those that support the direct injection of the attitude data from an attitude device and provide the output of the attitude data in the data telegram. It is associated with the attitude of the **USBL Hydrophone** vehicle. This data is only output with a beacon telegram and therefore only available at the USBL beacon tracking cycle time. Therefore, the update rate is very slow compared to a standard attitude device and considered to be insufficient for use as an attitude sensor for the reduction of other sensors and vehicle offsets. It should be added to the reference vehicle only to enable the logging of the data to the raw file.

Heading

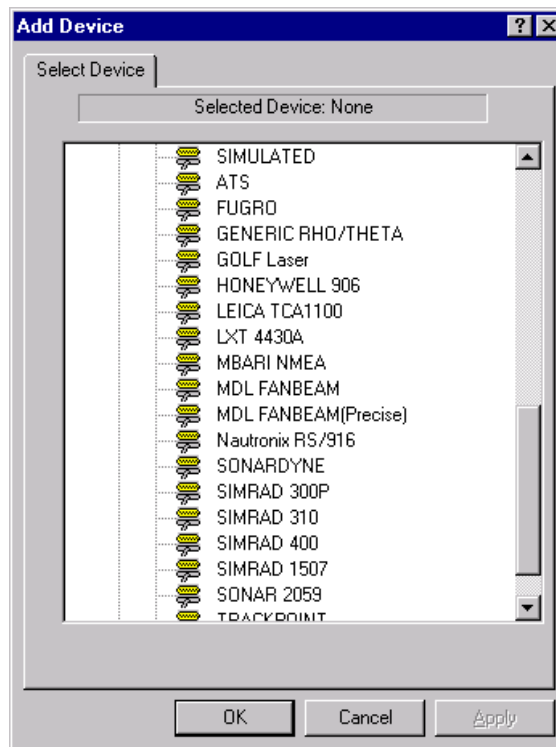
Not all devices provide this data type, only those that support the direct input of the heading data from a heading device and provide the output of the heading data in the data telegram. It is associated with the heading of the **USBL Hydrophone** vehicle. This data is only output with a beacon telegram and therefore only available at the USBL beacon tracking cycle time. Therefore, the update rate is slower than a standard heading device and considered to be insufficient for use as a primary heading sensor. However, where the heading in some operations can be fairly steady (DP operations) is available for use if no other heading data sources are available. It is added to the reference vehicle.

General USBL Setup

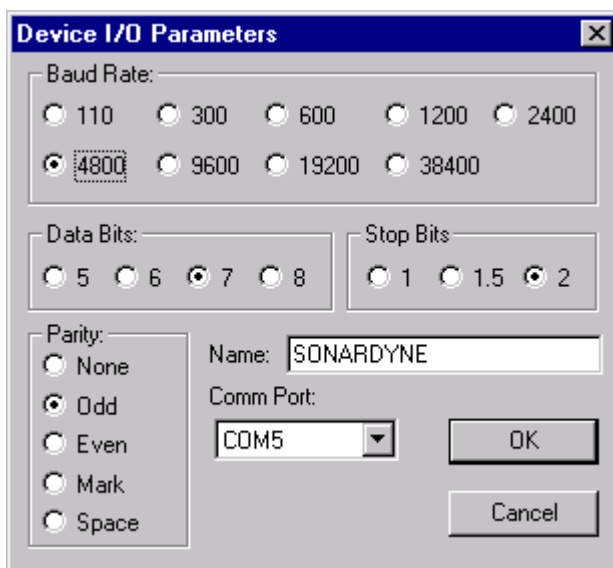
To Add the USBL Device to WinFrog

- 1 Connect the USBL system to a WinFrog com port or Digiboard port.
- 2 From the Main Menu, select **Configure > I/O Devices... Add**, or from within the **I/O Devices** window, click the right mouse button, and click on **Add Device** in the pop-up menu.

- 3 From the **Devices** tree, expand the **USBL** node (click the + next to **USBL** or double-click **USBL**) to display the list of available USBL (and similar) devices.



- 4 Select the appropriate device.
- 5 Click **OK**.



- 6 Enter an appropriate name for the device in the **Name:** field.
- 7 Set all of the communication parameters to match those of the USBL device.

8 Click **OK**.

At this point the USBL device has been added to WinFrog.

The data received from the USBL system are displayed in the **I/O Devices** window. The standard display shows the time of data reception, beacon ID, the age of the data shown, the X, Y, and Z values, and the error status. If available in the output, the heading and attitude data will be displayed.

To Generically Configure a USBL Device in WinFrog

As per many devices found in WinFrog's I/O Device list, some devices listed in the USBL category require a "generic" configuration before the device is added to a vehicle. Listed below are the USBL devices that require this "generic" configuration:

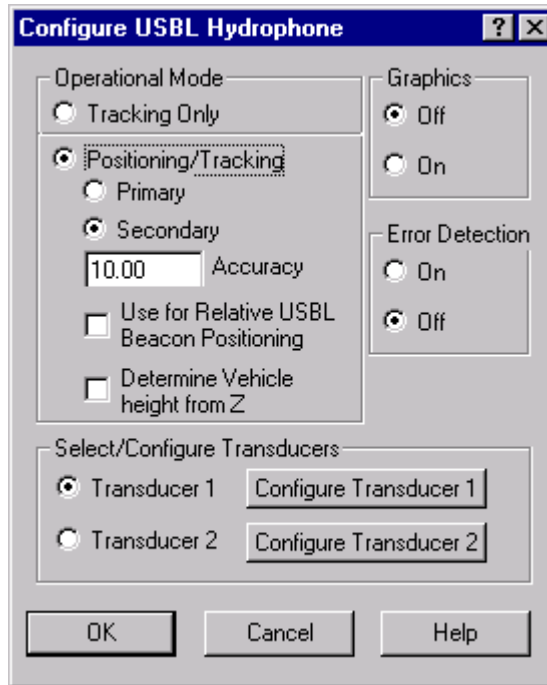
- ATS
- FUGRO
- Generic RHO/THETA
- MDLFanbeam (Precise)
- Simrad 400
- Trackpoint

In order to edit a device's "generic" configuration, highlight the device name in the **I/O Devices** window, right-click, and select **Configure Device**. If you are uncertain about how to proceed with configuring your particular USBL device, see the Appendix C documents, in PDF file format, on the software CD.

To Attach and Configure the USBL HYDROPHONE Data Type

The **USBL HYDROPHONE** data type must be attached to a vehicle for any USBL operation.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate (reference/HYDROPHONE) vehicle.
- 2 Click the **Add** button.
- 3 Select the **USBL, *, USBL HYDROPHONE** data type from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the **USBL HYDROPHONE** data type.
- 6 Click **Edit**.



- 7 Configure the **USBL HYDROPHONE** data type as required:

Operational Mode

Tracking

Select this mode to perform only tracking of beacons from this vehicle. The position of the hydrophone is determined directly from this vehicle's CRP position (generally determined from a surface positioning system such as DGPS) and **HYDROPHONE** offsets. This hydrophone position is then used to determine the positions of the tracked beacons.

Positioning/Tracking

Select this mode to perform positioning of the vehicle from fixed beacons. It is necessary to have a valid **Working Xponder** file with the beacons entered (see the **Working Files** chapter). In this case, the position of the hydrophone is determined from the USBL data for the fixed beacons and their coordinates. This hydrophone position is then used by the vehicle accordingly (see **Primary** and **Secondary** below).

This mode is also selected if the Relative USBL Beacon Positioning mode is required.

	NOTE: When set to Positioning mode, WinFrog will still track dynamic beacons.
Primary	The position determined from the USBL is used to position the vehicle. If the Kalman Filter is enabled, this position is passed into it.
Secondary	The position is used to monitor the vehicle's Primary position, but not actually position the vehicle.
Accuracy	The expected accuracy for the system. It is important that this be set "pessimistically," i.e. 7-10 meters is a reasonable setting, even for the accurate systems.
Use for Relative USBL Beacon Positioning	Controls the use of the USBL positioning of the hydrophone from a fixed beacon for application for Relative USBL Beacon Positioning. In this mode, The difference between the hydrophone position as determined directly from observations to a fixed beacon is compared to the hydrophone position determined from other positioning sources (e.g. DGPS). This difference is then applied to the position determined for any tracked beacon. The concept is that any inherent errors due to local conditions, both environmental and mechanical, are cancelled out. This is independent of the Primary/Secondary setting.
Determine Vehicle Height from Z	If the USBL system is to be used to determine the height of the vehicle, check this box. This is independent of the Primary/Secondary setting. NOTE: this option is intended for accurate surface systems that are grouped with the USBL devices, such as the MDL Fanbeam (Precise) which is capable of utilizing barometric heighting to reduce the observations, though it will function for all devices grouped with the USBL that provide a height/depth component.

Graphics

On

Select this option to display the current (1 or 2) hydrophone's position in the **Graphics** windows. If in **Tracking** mode, the position will be based upon the vehicle's CRP and hydrophone offsets. If in **Positioning** mode, it will be the actual position determined directly from the beacon data and, as such, will reflect any fluctuation in position due to the data. This is a valuable tool to confirm the correct entry of the offset data.

Off

Select this mode to disable the display of the hydrophone's position in the **Graphics** windows. Once the offsets have been confirmed visually (see above) it is often confusing to have too much displayed in the **Graphics** window. The normal setting for this is **Off**.

Error Detection

On

Many USBL systems include an error status in the output telegram. Selecting this mode will cause WinFrog to check the error status of the beacon data and, if bad, the data will not be used.

Off

Disables the error checking, all data are used regardless of the error status.

NOTE: Regardless of this setting, when logging data for a USBL Calibration, if the error status is detected, the data is automatically de-weighted before being logged to the calibration data.

Select/Configure Transducers

Some USBL systems support multiple hydrophones. WinFrog supports 2 independently configured hydrophones.

NOTE: WinFrog does not automatically detect which hydrophone is being used. You must select the correct one.

Transducer1/2

Select the transducer that is currently being used for the USBL system.

Configure Transducer 1/2

Click this button to access the configuration dialog for each transducer. Exit the dialog with **OK** to use the configuration as set.

Configure USBL Transducer

Calibration Corrections

Range Scale Factor	Head Rotation Correction
1.00000	000.0
Pitch Correction	Roll Correction
0.00	0.00

NOTE: Corrections sign conventions are
Roll=(+)Stbd down; Pitch=(+)Stern down

USBL System Internal Offsets

Offsets from the point the data is related to, to the transducer. These values will be subtracted from the USBL output data to get data related to the transducer.

Fore/Aft	Port/Stbd	Z (down +)
5.00m	1.00m	11.00m

WinFrog Offsets, from CRP to Transducer

Fore/Aft	Port/Stbd	Depth (down +)
5.00m	1.00m	11.00m

OK Cancel Help

Note: the offsets entered into WinFrog are in the local, ship-based sub-surface oriented coordinate frame: forward to starboard and down are positive (+) values, while aft to port and up are negative (-). It should be noted that the vertical offset sign convention is the reverse of that used for surface positioning systems such as DGPS. The difference is indicated by the use of the term **Depth** versus **Height**.

In the example here, the offsets reflect the fact that the USBL system's reference point is the same point as the WinFrog vehicle's CRP.

Calibration Corrections

The results of a WinFrog USBL calibration (see the **LBL& USBL Calibration** chapter) are entered here exactly as presented in the calibration results. These allow WinFrog to apply corrections to the USBL data correcting for errors in the velocity as used in the USBL system (scale factor) and unaccounted errors in the alignment of the hydrophone itself with respect to the vehicle's local ship based coordinate reference frame (heading, pitch and roll corrections).

Note: do not enter the results of a USBL calibration into both the USBL system and WinFrog. If this is done, the data will be corrected by the USBL system prior to outputting it to WinFrog and then again by WinFrog. This will result in incorrect data.

Note: permanent USBL installations are often already calibrated and have these values entered into the system. WinFrog is then used to refine this calibration. In this case, the original calibration settings are left in the USBL system and the results of the WinFrog calibration are entered in WinFrog. This is especially true in the case where the orientation of the hydrophone is in error by 180° and a correction has been entered into the USBL system. The WinFrog USBL calibration can not resolve an error of this magnitude.

Range Scale Factor	Scale correction factor (value by which to multiply the USBL data) to correct for velocity errors. It is “unitless.” The default or zero setting is 1.0.
Head Rotation Correction	Correction to the orientation of the hydrophone with respect to the vehicle’s bow. It is entered in degrees. The default or zero setting is 0.0.
Pitch Correction	Correction to the verticality of the hydrophone in the fore/aft direction. It is entered in degrees. The default or zero setting is 0.0.
Roll Correction	Correction to the verticality of the hydrophone in the thwartships direction. It is entered in degrees. The default or zero setting is 0.0.

USBL System Internal Offsets

If the USBL system supports direct attitude data injection and internal offsets, the offsets to relate the USBL system’s transducer to a reference point on the vessel must be entered in the USBL system. In most cases, these are already present because they are required to reference the data output to a **Dynamic Positioning (DP)** system to the vessel’s center of gravity (COG). If this is not the case, offsets to the same Common Reference Point (CRP) that will be used by WinFrog must be entered into the USBL system.

These offsets, also then entered here in WinFrog, are measured from the reference point to the hydrophone.

Fore/Aft	The fore/aft distance from the reference point to the hydrophone.
Port/Stbd	The port/starboard distance from the reference point to the hydrophone.
Z	The vertical distance from the reference point to the hydrophone, down is positive (+).

WinFrog Offsets

These are the standard WinFrog sensor offsets, measured from the CRP to the sensor.

Note: the CRP must be at the water line in order to correctly use the depth component of the USBL data.

Fore/Aft	The fore/aft distance from the CRP to the hydrophone.
Port/Stbd	The port/starboard distance from the CRP to the sensor.
Depth	The vertical distance from the CRP to the hydrophone. Note that down is (+)ve.

- 8 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 9 At the **Configure Vehicle-Devices** dialog, if the **USBL HYDROPHONE** data type is to be used to position the vehicle, it is recommended that the **Range Gate** option in this dialog be set to on (uncheck the **Off** box in the **Range Gate** panel) and an appropriate gating value entered (e.g. 10 to 20 meters).
- 10 Click **OK**.

To Attach and Configure the BEACON Data Type

In order to use the USBL system to track a moving vehicle, the appropriate **BEACON** data type must be attached to the vehicle and configured.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate vehicle.
- 2 Click the **Add** button.
- 3 Select the **USBL, *, BEACON** data type from the **Available Data Items** list, where the * is the operator assigned name for the device.

Note: the **BEACON** must be associated with the same device as the reference vehicle's USBL HYDROPHONE.

- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the **Configure Vehicle-Devices** dialog, highlight the **BEACON** data type.
- 6 Click **Edit**.

Configure USBL Beacon

Calculation
☒ Primary
☐ Secondary

Accuracy
 10.00m

Error Detection
☐ On
☒ Off

Deskewing Options
☐ Deskew Beacon Timestamp
 The data signal reception time is corrected to the signal transmission time based on sound velocity and slant range.
☒ Deskew Hydrophone Position
 The hydrophone position is deskewed to the appropriate beacon epoch based on the hydrophone vehicle's speed and CMG. If not on, the last updated position for the hydrophone is used regardless of age.

Code
 1

ROV Depth from USBL
☒ Yes ☐ No

LBL Calibration
☐ Use For Calibration

Graphics
☒ Off ☐ On

Offset, from the CRP

Fore/Aft	Port/Stbd	Height (+ above CRP)
0.00m	0.00m	5.00m

OK Cancel Help

7 Configure the **BEACON** data type as required:

Calculation

Primary

This USBL beacon will be used to determine a **Primary** position.

Secondary

This USBL beacon will be used to determine a **Secondary** position to monitor the **Primary** positioning source.

Note: more than one beacon can be attached to any given vehicle. They can be configured to **Primary** and/or **Secondary** (in any combination), bearing in mind that if none are set to **Primary**, the USBL will not contribute to the position of the vehicle. All beacons that are set to the **Primary** mode will impact the vehicle position. If multiple beacons are set to **Primary**, it is necessary that the **Kalman Filter** be used for the vehicle (in the **Configure Vehicle-Devices** dialog, make sure the **Kalman Filter Off** box is not checked).

If multiple beacons are used, it is possible to use them to determine the orientation of the vehicle to which they are attached. In the **Configure Vehicle-Devices** dialog, check the **Heading** box in the **Calculations** panel. The accuracy and steadiness of this heading determination depends upon the quality of the

USBL data and the baseline between the beacons. This is not recommended unless there is absolutely no other means to determine the heading.

Accuracy

Enter a “pessimistic” approximation for the accuracy of the system. A value between 7 to 15 meters is reasonable. This is a very important setting if other devices are to be implemented in the **Kalman Filter**, such as a **Doppler Speed Log**.

Error Detection

On

Many USBL systems include an error status in the output telegram. Selecting this mode will cause WinFrog to check the error status of the beacon data and, if bad, the data will not be used.

Off

Disables the error checking, all data are used regardless of the error status.

Deskewing Options

Deskew Beacon Timestamp

Future development.

Deskew Hydrophone Position

When positioning the beacon, WinFrog uses the last calculated position for the associated USBL hydrophone and the latest heading information for the USBL hydrophone vehicle and applies the USBL XYZ to determine the beacon position. The time of the last calculated hydrophone position depends upon the configuration of WinFrog. If the hydrophone vehicle is set to use the Kalman Filter and Dead Reckoning, the age of the last **predicted** position will be less than 200 milliseconds. If these settings are not used, the age could be as high as 1 second, depending upon the update cycle time of the surface positioning system. If this option is checked, the hydrophone position is deskewed to the beacon data epoch using the hydrophone vehicle’s speed and advance.

Note: It is recommended that this be checked.

Code

Enter the integer equivalent for the beacon identifier (code). In most cases, this is a direct entry of the code for the beacon to be used, such as 1. However, some systems refer to the beacons as shapes (Simrad HPR300), in which case it is necessary to determine the integer code for the shape.

If the code is incorrect, the data will not be matched and, therefore, will not be associated with this vehicle and the USBL will contribute its position.

Note: The Kongsberg Simrad HPR 400 and 500 systems and their software package APOS use codes with letters. These codes are entered directly as defined. For details, refer to the Simrad 400 document of Appendix C – Device Documentation.

ROV Depth from USBL

Yes

Uses the Z component of the USBL data for the vehicle height/depth.

No

The height/depth of the vehicle will be determined using another data type attached to the vehicle (i.e. depth sensor contained with the ROV instrumentation).

Note: This does not impact the horizontal component of the beacon position, nor is this other source depth output to the USBL system for its use as a constraint.

LBL Calibration

Use for Calibration

Enables the use of a vehicle with this beacon attached to it to be used as the calibration vehicle for an LBL calibration. This is not the usual configuration for an LBL calibration, but occurs if the calibration vehicle is a towed fish with an LBL transducer (i.e. Sonardyne Flower Pot transducer) mounted in it.

Graphics

On

Enables the display of the position of the beacon with its code, in the **Graphics** window. This is useful when monitoring the affect of the **Kalman Filter**, particularly if other sensors are involved such as a **Doppler Speed Log**.

Off

Disables the display of the beacon position in the **Graphics** window.

Offsets, from the CRP

These are the standard WinFrog sensor offsets, measured from the CRP to the sensor. The offsets are in the local, vehicle-based coordinate frame: forward to starboard and up are positive (+), while aft to port and down are negative (-) (note this differs from the **USBL HYDROPHONE** offsets).

Fore/Aft	The fore/aft distance from the CRP to the beacon.
Port/Stbd	The port/starboard distance from the CRP to the beacon.
Height	The vertical distance from the CRP to the beacon.

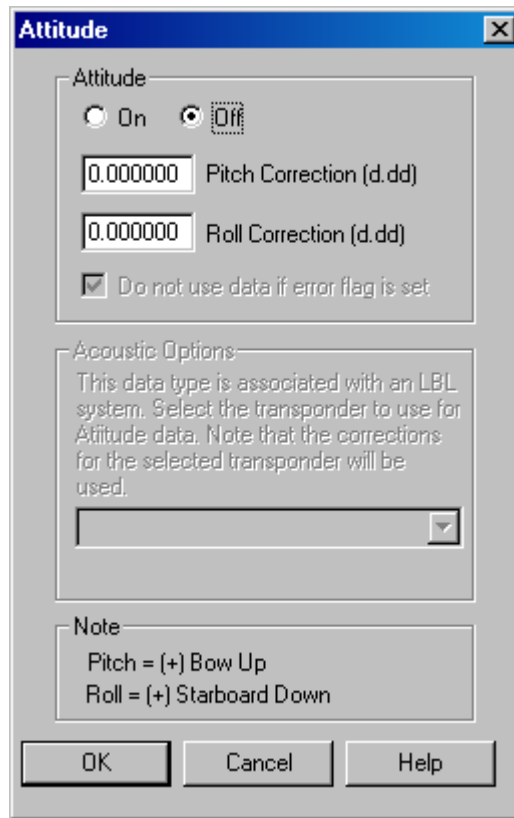
- 8 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 9 It is recommended that the **Kalman Filter** be used, especially if other sensors will be involved in the positioning of the vehicle. Make sure the **Kalman Filter Off** box is **not** checked.
- 10 It is recommended that the range gating be applied. Make sure the **Range Gate Off** box is **not** checked. Enter a reasonable gate width for the USBL system and prevailing conditions, such as 10 to 20 meters.
- 11 Click **OK**.

To Attach and Configure the ATTITUDE Data Type

The **ATTITUDE** data type is attached and configured in the same manner as any **ATTITUDE** data type. It is attached to the reference/HYDROPHONE vehicle.

Note: As stated earlier in this chapter, the update rate of the attitude data available via the USBL system is insufficient for practical or reasonable application. However, attaching it to a vehicle does ensure that it is available for logging to raw data files.

- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate (reference/HYDROPHONE) vehicle.
- 2 Click the **Add** button.
- 3 Select the **USBL, *, ATTITUDE** data type from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the original **Configure Vehicle-Devices** dialog, highlight the **ATTITUDE** data type.
- 6 Click **Edit**.



- 7 Enter the required pitch and roll corrections. These values are added to the raw data to obtain corrected pitch and roll data.

Note: these are corrections to the actual attitude sensor data and not those determined with a USBL calibration (see the **LBL&USBL Calibration** chapter), which address a combination of the attitude sensor error and the installation of the hydrophone.

- 8 Select **On** to use the **ATTITUDE** data to reduce the offsets of all sensors attached to this vehicle, except the USBL HYDROPHONE sensor, and all vehicle offsets. Select **Off** to prevent the use of the **ATTITUDE** data for any reductions.

Note: if the ATTITUDE data type is added to the vehicle, the raw data will be logged to the raw file regardless of being set to **On** or **Off**. This may be of benefit for post-processing issues.

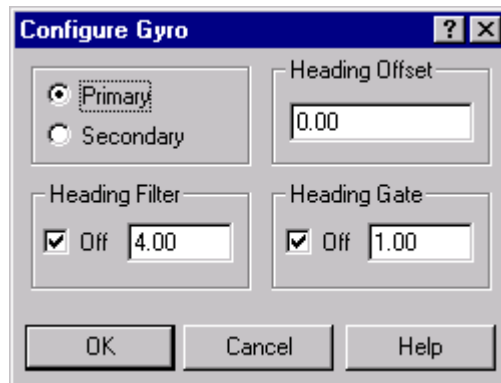
- 9 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 10 At the original **Configure Vehicle-Devices** dialog, click **OK**.

To Attach and Configure the HEADING Data Type

The **HEADING** data type is attached and configured in the same manner as any HEADING data type. It is attached to the reference/HYDROPHONE vehicle.

Note: As stated earlier in this chapter, the update rate of the heading data available via the USBL system is insufficient for practical or reasonable application. However, in low dynamic situations where no other heading data source is available, it is available for use.

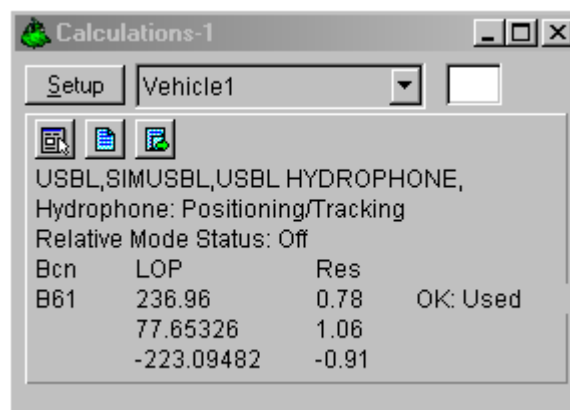
- 1 Access the **Configure Vehicle-Devices** dialog for the appropriate (reference/HYDROPHONE) vehicle.
- 2 Click the **Add** button.
- 3 Select the **USBL, *, HEADING** data type from the **Available Data Items** list, where the * is the operator assigned name for the device.
- 4 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 5 At the original **Configure Vehicle-Devices** dialog, highlight the **HEADING** data type.
- 6 Click **Edit**.



- 7 Enter the **Heading Offset** value. This is added to the raw heading to obtain a corrected heading.
- 8 If you wish to filter the heading data, un-check the **Heading Filter Off** box and enter the desired filter length (number of sequential heading values to be used to filter the heading).
- 9 If you wish to gate the heading data, un-check the **Heading Gate Off** box and enter the desired gate width (in degrees).
- 10 Click **OK** to return to the **Configure Vehicle-Devices** dialog.
- 11 At the original **Configure Vehicle-Devices** dialog, click **OK**.

To Monitor the HYDROPHONE Data Type

- 1 Open a **Calculations** window via the main menu or the **Acoustic Window** (see **Operator Display Windows**).
- 2 Select the **HYDROPHONE** vehicle from the vehicle dropdown list.
- 3 Click the **Setup** button.
- 4 Check the **Data Item Text** box.
- 5 Select the **HYDROPHONE** data type and click the **On** button.
- 6 Click **OK** to return to the **Calculations** window.
- 7 This window displays the following information:
 - The device type, operator assigned name and data type
 - The **Operational Mode** (Tracking Only or Position/Tracking)
 - **Relative USBL Beacon Positioning** mode (On or Off)
 - If in **Relative USBL Beacon Positioning** mode, the Northing and Easting corrections that will be applied to any beacon positions. If the corrections are greater than 30 seconds old, a warning is flashed in red.
 - The USBL beacon code and data is displayed. The data can be displayed in two formats, controlled by toggling the right most of the group of three buttons in the calculation window. The formats are:
 - the **Reduced** (to the map projection) **XYZ** data and their associated status and residuals.
 - The raw and reduced XYZ data.

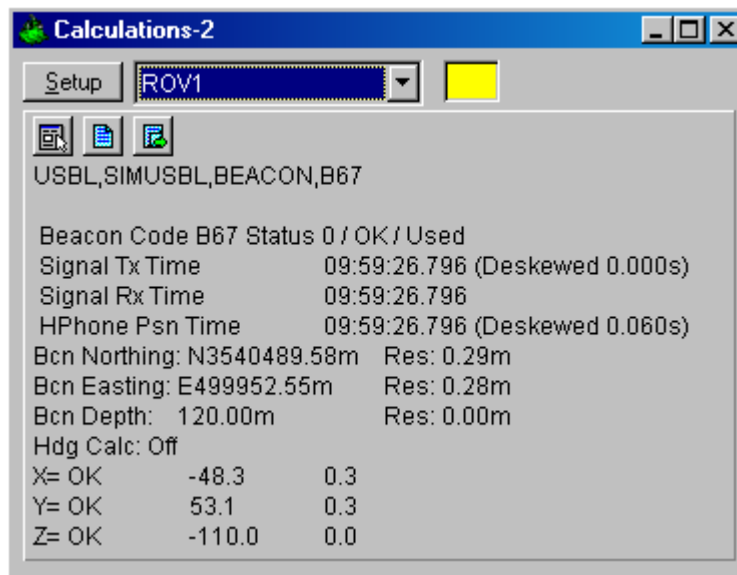


To Monitor the BEACON Data Type

- 1 Open a **Calculations** window via the main menu or the **Acoustic Window** (see **Operator Display Windows**).
- 2 Select the **BEACON** vehicle from the vehicle dropdown list.
- 3 Click the **Setup** button.
- 4 Check the **Data Item Text** box.
- 5 Select the **BEACON** data type and click the **On** button.
- 6 Click **OK** to return to the **Calculations** window.
- 7 This window displays the following information:
 - The device type, operator assigned name and data type, including the beacon code.
 - The pitch and roll for the beacon vehicle **not** the pitch and roll output by the USBL system.
 - The beacon code and the data error status
 - Calculated time of the beacon signal's transmission and the amount in seconds this differs from the time the signal was received (for future development)
 - Time WinFrog received the data from the USBL system, used as the signal receive time.
 - Time of the hydrophone position. If the **Deskew Hydrographic Position** option is checked, this will be the same time as the signal receive time and the amount of time in seconds that this was deskewed is given in brackets. If the **Deskew Hydrographic Position** option is not checked, the deskewed value will be 0.
 - The map projection Northing and Easting and the depth of the beacon based upon the last USBL update and the respective residuals. In this case, the Northing and Easting residuals are the difference between the actual vehicle CRP position used and the vehicle CRP position derived from the aforementioned calculated position. If the Kalman Filter is not active or there is no other beacon used with this vehicle that is set to Primary, these will be 0. In the case of the depth, if the depth of the vehicle is taken from this beacon data, this will always be 0.
 - The beacon data and its status. The residuals are shown but they are a repeat of the above residuals with the Northing residual associated with the Y data and the Easting residual associated with the X data. The status

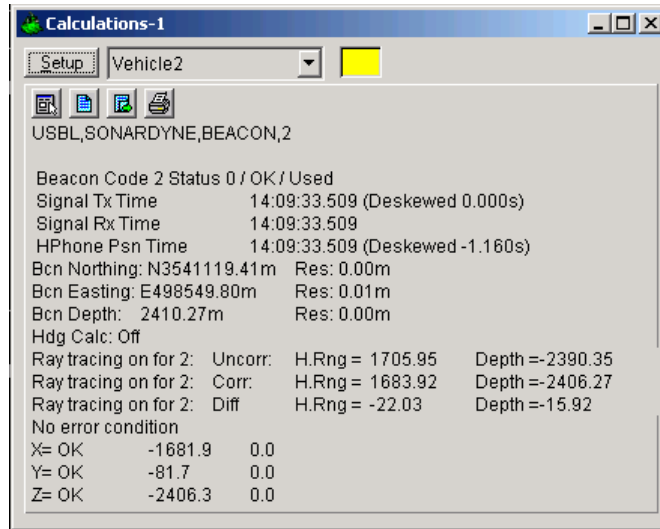
can be one of the following:

- OK, the USBL data had no error flags, was not gated and was successfully used in the solution.
- ER, the USBL data was flagged by the USBL system with an error condition.
- WN, the USBL data was flagged by the USBL system with a warning condition.
- NR, no data was received.
- NT, no hydrophone vehicle was available.
- GA, the data has been gated. If either the X or the Y component is gated, the beacon position solution is aborted.



- If the ray bending correction has been turned on, the following window is displayed. It includes four extra lines:
 - Ray Trace on for (beacon number)
 - Uncorr H.Rng is the uncorrected horizontal range and depth
 - Corr H.Rng is the horizontal range and depth with ray bending applied
 - Diff is the difference, which is essentially the effect of the ray bending
 - The forth line provides a status message, here it indicated no error.

Note that the depth on these three lines actually refers to the vertical distance between the beacon and the transceiver.



Specific USBL Setups

To Configure for Positioning the Hydrophone Vehicle

- 1 Ensure a valid Xponder file is created, opened, and set to **Working** (see the **Working Files** chapter).
- 2 Add a fixed USBL beacon(s) to the **Working Xponder** file, making sure the correct **Name**, **Depth**, **Position**, **Type** (USBL Mode: Fixed) and **USBL Code** are correctly entered and selected for the beacon to be used (see the Working Files chapter for details).
- 3 Add the **USBL** device to WinFrog (see the **To Add the USBL Device to WinFrog** section earlier in this chapter). Monitor the input in the **I/O Devices** window. Make sure the data are being correctly received for the appropriate beacons before proceeding.
- 4 Attach the **USBL HYDROPHONE** data type to the appropriate vehicle (see the **To Attach and Configure the USBL HYDROPHONE Data Type** section earlier in this chapter).
- 5 Configure the **USBL HYDROPHONE** data type as follows. (see the **To Attach and Configure the USBL HYDROPHONE Data Type** section):
 - A Set the **Operational Mode** to **Positioning/Tracking** and **Primary**
 - B **Accuracy = 10** (can be refined accordingly after monitoring performance)
 - C **Determine Vehicle height from Z = unchecked**
 - D Select the appropriate transducer and click the **Configure Transducer** button.

- Enter the appropriate **Calibration Corrections**
- Enter the **USBL System Internal Offsets** (Use the offsets that have been entered directly into the USBL system.)

Note: when entering the **USBL System Internal** offsets (**from** reference point **to** transducer), use the convention forward, starboard, and down are positive (+), while aft, port, and up are negative (-).

- Enter the **WinFrog Offsets** to relate the transducer to the CRP (the CRP should be at water level.)

Note: when entering the WinFrog offsets (**from** the CRP **to** the transducer) use the convention forward, starboard, and down are positive (+), while aft, port, and up are negative (-).

- Click **OK** to return to the **Configure USBL Hydrophone** dialog.

E Graphics/On to confirm offsets are correctly applied (position of hydrophone in the graphics window should appear close to actual location on the ship outline, though it may not be exact due to this display being the raw hydrophone position).

F Error Detection to be set as desired.

G Click **OK** to return to the **Configure Vehicle-Devices** dialog.

6 In the **Configure Vehicle-Devices** dialog, set the following:

A Kalman Filter Off - unchecked

B Kalman Filter = 0.10 (this can be refined after monitoring the performance)

C Dead Reckon - checked

D Range Gate Off - unchecked

E Range gate = 20m (or approximate equivalent in working units, this can be refined after monitoring the performance)

7 Click **OK** to exit the **Configure Vehicle-Devices** dialog.

8 Monitor the performance in the **Calculations** and **Graphics** windows. Turn **HYDROPHONE Graphics** off once offsets are confirmed.

To Configure for Only Tracking the Beacon Vehicle

- 1** Add the **USBL** device to WinFrog (see the **To Add the USBL Device to WinFrog** section earlier in this chapter). Monitor the input in the **I/O Devices** window.

Make sure the data are being correctly received for the appropriate beacons before proceeding.

- 2 Attach the **USBL HYDROPHONE** data type to the appropriate reference vehicle (see the **To Attach and Configure the USBL HYDROPHONE Data Type** section earlier in this chapter).

- 3 Configure the **USBL HYDROPHONE** data type as follows:

A Operational Mode/Tracking

B Accuracy - Not applicable

C Determine Vehicle height from Z - Not applicable

D Select the appropriate transducer and click the **Configure Transducer** button.

- Enter the appropriate **Calibration Corrections**.
- Enter the **USBL System Internal Offsets** (those offsets that have been entered directly into the USBL system - from CRP to the transducer)
- Enter the **WinFrog Offsets** to relate the transducer to the CRP (**from CRP to the transducer**) **Note:** the CRP should be at water level.

Note: when entering offsets remember to use the convention, forward, starboard, and down are positive (+), while aft, port, and up are negative (-).

- Click **OK** to return to the **Configure USBL Hydrophone** dialog.

E Graphics/On to confirm offsets are correctly applied.

F Error Detection - Not applicable.

G Click **OK** to return to the **Configure Vehicle-Devices** dialog.

- 4 In the HYDROPHONE vehicle's **Configure Vehicle-Devices dialog**, ensure all other settings are correct for the positioning of the vehicle.

- 5 Click **OK** to exit the **Configure Vehicle-Devices** dialog.

- 6 Add a **BEACON** to the remote vehicle (see the **To Attach and Configure the BEACON Data Type** section earlier in this chapter).

- 7 Configure the **BEACON** as follows:

A Calculation/Primary

B Accuracy = 10

C Code = beacon ID (for more information see the **To Attach and Configure the BEACON Data Type** section).

- D ROV Depth from USBL = Yes** (unless another depth source is available from another sensor, such as an ROV sensor suite).
 - E** Enter the **Offsets** to relate the beacon to the CRP, using the convention from CRP to the transducer: forward, starboard, and up are positive (+), while aft, port, and down are negative (-).
 - F LBL Calibration/Use for Calibration - unchecked.**
 - G Error Detection - set as desired.**
 - H Graphics - On** to confirm offsets are correctly applied (position of beacon in the graphics window should appear close to actual location on the vehicle outline, though it may not be exact due to this display being the raw beacon position).
 - I** Click **OK** to exit to the **Configure Vehicle-Devices** dialog.
- 8** In the **Configure Vehicle-Devices** dialog, set the following:
- A Kalman Filter Off - unchecked**
 - B Kalman Filter = 0.20** (this can be refined after monitoring the performance)
 - C Dead Reckon - checked**
 - D Range Gate Off - unchecked**
 - E Range Gate = 20m** (or approximate equivalent in working units, this can be refined after monitoring the performance)
- 9** Click **OK** to exit the **Configure Vehicle-Devices** dialog.
- 10** Monitor the performance in the **Calculations** and **Graphics** windows. Turn off **BEACON** and **HYDROPHONE** graphics once offsets are confirmed.

To Configure for Relative USBL Beacon Positioning for a Vehicle

- 1** Follow the steps outlined in **To Configure for Tracking the Beacon Vehicle**.
- 2** When configuring the **USBL HYDROPHONE** on the reference vehicle, set the **Operational Mode** to **Positioning**, **Secondary** or **Primary** and check the **Use for Relative USBL Beacon Positioning** box.
- 3** Continue with the remaining procedure unchanged.

To Configure for Ray Bending

To enable the ray bending calculation, check the box on the Sonardyne USBL device configuration. Only the Sonardyne USBL system sending the CSV surveyor's acoustic telegram that begins with 6,1 contains the necessary information to make the calculations. Also required is a velocity profile and the beacon must be present in the working transponder file along with its turnaround time.

Chapter 19: Special Applications

Doppler Speed Log

The use of a USBL beacon, gyro, and **Doppler Speed Log** attached to a vehicle to obtain precise positioning requires careful configuration. The following sections detail this case.

WinFrog is able to utilize the data from doppler speed logs in the position **Kalman Filter** to enhance the results, specifically for positioning an ROV with USBL. It is critical that it be setup correctly and monitored in order to ensure correct application. It is also important to note that only the **Speed Over Ground** data are used in the **Kalman Filter**.

WinFrog also provides a simple calibration feature to determine the alignment correction for the doppler speed log. This value can then be entered and applied to the data before it is used by WinFrog.

The following documents the application, monitoring and calibration of the doppler speed log. It is important to note that the values and limits stated here for any of the configurations discussed are guidelines. You must evaluate the actual performance and make adjustments accordingly.

General Kalman Filtering

The **Kalman Filtering** performed by WinFrog allows the direct input to the filter of position and velocity data. The application of this data within the filter is a balance between the accuracy attributed to each individual data type and the **Kalman Filter** setting itself. The former is the accuracy entered by the operator for each data type when configuring its use as attached to a vehicle. The latter refers to the **Kalman Filter** setting controlled with the slider bar in the **Configure Vehicle-Devices** dialog box.

It is important to realize that the correct application of the **Kalman Filter** requires careful consideration of the actual accuracy of each data type and the relative accuracy between each data type. If the accuracy relationship is unbalanced, the **Kalman Filter** will be biased towards that data type with the overly optimistic accuracy setting.

The **Kalman Filter** setting controls how reactive the filter will be to new data. The default setting of 0.1 is applicable for most situations. The impact that the new data has in the filter is also affected by the accuracy setting for that data type.

Gyro Requirements

A doppler speed log unit provides WinFrog with fore/aft and port/starboard (and in some cases, up/down) velocities. For use in the **Kalman Filter**, these are converted to Northing and Easting velocity vectors. Therefore, it is necessary to have a reasonably accurate and calibrated vehicle heading source to enable the transformation of the velocities from a vehicle-based X/Y reference frame to an absolute North/East reference. The heading data used are those that are configured for the vehicle, including any offsets applied in the associated HEADING data type configuration.

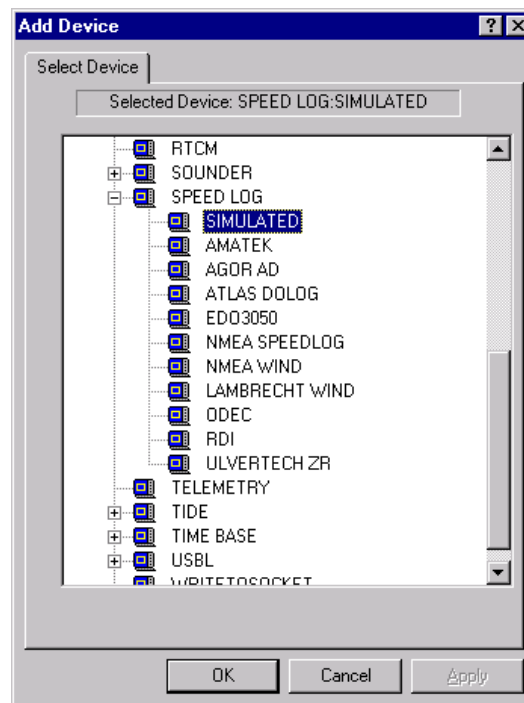
At present, the vertical velocities are not utilized within WinFrog.

Adding the Speed Log to WinFrog and the Vehicle

The device is added in the same way that any device is added.

To Add the Speed Log Device

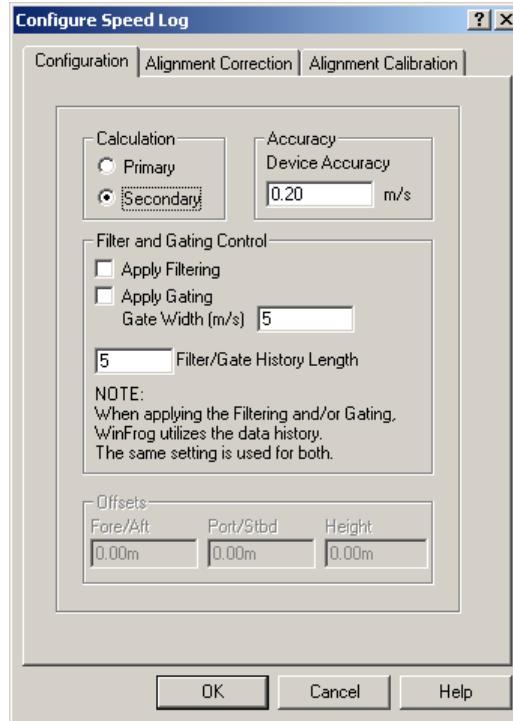
- 1 From the **Devices** window, right mouse click to display available device types
- 2 Scroll down to **Speed Log** and expand the list.



- 3 Select the appropriate doppler speed log.
This device provides the data type SPEED LOG.
- 4 Add this to the appropriate vehicle.

Configuring the SPEED LOG Data Type

The basic configuration options for the **SPEED LOG** data type are shown in the next figure and detailed here. Note that the calibration feature and application of the associated results are discussed later in this section.



Calculation

Primary

Doppler data are used to assist the position of the vehicle.

Secondary

Doppler data are not used to assist the position of the vehicle.

Accuracy

Device Accuracy

Accuracy of the doppler speed log in m/s. The default is 0.2.

Filter and Gating Control

Apply Filtering

Controls the filtering of the raw doppler data prior to its use in the **Kalman Filter**. If selected, a central tendency filter is applied to the data using the number of samples defined in the **Filter/Gate History Length** below, the result of which is used for input to the **Kalman Filter**.

Apply Gating

Controls the gating of the raw data prior to

Gate Width

Filter/Gate History Length

its use in the **Kalman Filter**. If selected, the new data is tested against the data history based upon the number of samples defined in the **Filter/Gate History Length** below. If it exceeds the gate limits, the data is rejected.

Defines the gating limits in m/s. The value must be determined by monitoring the data.

Defines the number of samples (minimum 3, maximum 30) to be used for both the central tendency filtering and the gating. This setting must reflect the application, environment and the doppler performance. It depends upon balancing the need to smooth the data and the required responsiveness to real changes in the data. The longer the filter, the smoother the result, but less responsive to the actual dynamics of the vehicle. The shorter the filter, the less smooth the results, but more responsive to the actual dynamics of the vehicle.

Offsets

This setting is not used.

Note: if the **Apply Filtering** option is selected, but not the **Apply Gating** option, for the purpose of utilizing the filtering function, a default gating value of 10m/s is used.

Associated Configurations

The correct use of the SPEED LOG data type is dependent upon the correct use of associated data types and the configuration of the associated vehicle Position Calculations. In a typical situation, the doppler speed log is mounted on an ROV being positioned with USBL, so this is the setup that will be examined here.

USBL BEACON Data Type Configuration

The ROV is positioned using a USBL BEACON data type. The next figure shows a suitable configuration.

The screenshot shows a Windows-style dialog box titled "Configure USBL Beacon". It contains several configuration sections:

- Calculation:** Two radio buttons, "Primary" (selected) and "Secondary".
- Accuracy:** A text input field containing "10.00m".
- Error Detection:** Two radio buttons, "On" and "Off" (selected).
- Deskewing Options:** A group box containing:
 - ☐ Deskew Beacon Timestamp: A note below states, "The data signal reception time is corrected to the signal transmission time based on sound velocity and slant range."
 - ☒ Deskew Hydrophone Position: A note below states, "The hydrophone position is deskewed to the appropriate beacon epoch based on the hydrophone vehicle's speed and CMG. If not on, the last updated position for the hydrophone is used regardless of age."
- Code:** A text input field containing "1".
- ROV Depth from USBL:** Two radio buttons, "Yes" (selected) and "No".
- LBL Calibration:** A checkbox labeled "Use For Calibration" which is unchecked.
- Graphics:** Two radio buttons, "Off" (selected) and "On".
- Offset, from the CRP:** A group box containing three text input fields:
 - Fore/Aft:** "0.00m"
 - Port/Stbd:** "0.00m"
 - Height (+ above CRP):** "0.00m"

At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

The **Accuracy** is a critical setting. It is generally between 7-15 meters, depending upon the performance of the USBL system. The lower the value, the greater the influence of the USBL data in the Kalman Filter. The higher the value, the less the influence of the USBL data in the Kalman Filter.

Configure Vehicle-Devices Dialog

The **Configure Vehicle Devices** dialog box, shown below, enables you to configure the **Kalman Filter** and the **Position Gating**.

The screenshot shows the 'Configure Vehicle-Devices' dialog box with the following settings:

- Position:** Latitude: N32 00.2404, Longitude: W116 59.8974, Elevation: 0.00m, Heading: 0 0 00.00T. Radio buttons for L/L (selected) and Grid. A 'Copy' button and an 'Update' checkbox are present.
- Data Source:** Radio buttons for Simulated, Real-Time (selected), Network, File, Telemetry, Pipe Track, and Ctrl'd Remote.
- Calculations:** Checkboxes for Heading (unchecked) and Streamer (unchecked). A 'Max Time Variance (s)' field is set to 60s.
- Kalman Filter:** A numerical field is set to 0.10 with a slider below it. Checkboxes for 'Off' (unchecked) and 'Purge' (unchecked). The 'Dead Recon' checkbox is checked.
- Velocity Filter:** A numerical field is set to 20 with a slider below it. A 'Purge' checkbox is unchecked.
- Range Gate:** A checkbox is checked, and the value is set to 100.00m with a slider below it.
- Devices:** An empty list box with 'Add', 'Edit', and 'Delete' buttons below it.
- Buttons:** 'OK', 'Cancel', and 'Help' buttons at the bottom.

Kalman Filter

In order to utilize the **SPEED LOG** data in the determination of the vehicle position, the Kalman Filter must be **on** (i.e. **not** checked **off**).

The responsiveness of the filter to new data is controlled with the untitled numerical entry in the Kalman Filter panel. This value can be entered directly in this box, or controlled with the slider. The smaller the number, the less responsive to new data the filter is. The default is 0.10 and this is appropriate for the majority of applications. In noisy environments on a vehicle with a low dynamics, this can be reduced. Similarly, with good data on a vehicle with high dynamics, this can be increased. However, changes to this value should be made and monitored carefully to ensure that an inappropriate filter is not used. In general, this value will not be less than 0.05, or greater than 0.4. For ROV operations, a range of 0.10 to 0.30 is reasonable.

Range Gate

The **Range Gate** setting (see the previous figure) is used not just for gating ranges, but position data also. It is an invaluable tool when positioning with USBL. This should be set to a value in keeping with the performance of the USBL system. The default of 100m is much too large to be of any use with the USBL. A value of 20m is a reasonable initial setting to use.

Monitoring the Application of the Speed Log

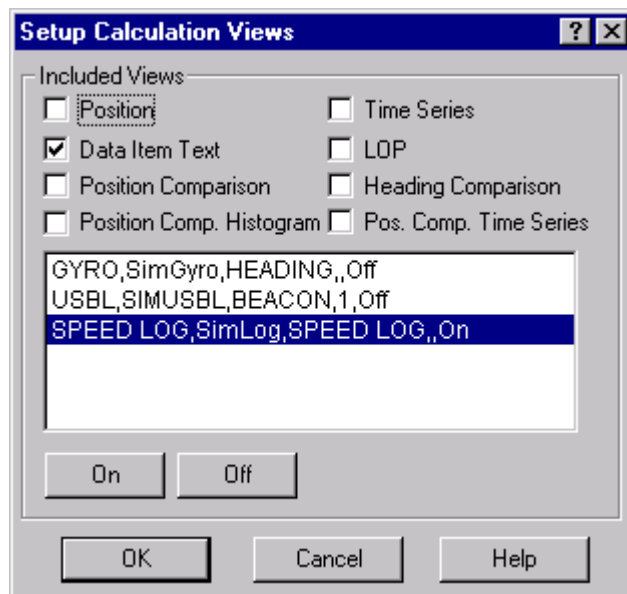
The monitoring of the speed log device falls into 3 categories:

- 1 Input of data.
- 2 Filtering and gating of the speed log data, prior to use in the Kalman Filter.
- 3 Affect of the speed log data on the position.

The **I/O Devices** window should be reviewed regularly to confirm that data are being received.

To Monitor Use of the Speed Log Data Type as Attached to the Vehicle

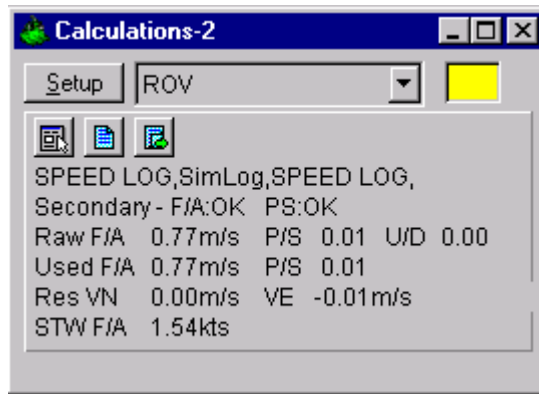
- 1 Open a **Calculations** window. (**View > Calculations**)
- 2 Select the appropriate vehicle from the dropdown list.
- 3 Click the **Setup** button to access the **Setup Calculation Views** dialog box.
- 4 Check the **Data Item Text** box.
- 5 Highlight the **SPEED LOG** item.



6 Click the **On** button.

7 Click **OK** to exit.

The speed log data can then be monitored in this **Calculations** window, as shown in the next figure.



The lines of data provided in the **Calculations** window are detailed below:

- Data Type and Device Name
- Calculation setting (Primary/Secondary) and the status of the F/A and P/S velocity data. The status can be OK, Gate or Bad. OK indicates that the data is valid and used. Gate indicates that the data has been gated and is not used. Bad indicates that the data as received from the speed log was either invalid, or not an Over Ground Speed.
- The raw F/A, P/S, and Up/Down Over Ground velocities in m/s.
- The F/A and P/S velocities used in the Kalman Filter. If the speed log data filtering is turned on, these will be the results of the filter. If not, these will be the raw data repeated.
- The Northing and Easting velocity vector residuals in m/s. The residuals are the Kalman Filter results minus the used data.
- The Speed Through Water, if the device also provides (or only provides) this value

This window provides you with the means to observe the results of the gating and filtering. If excessive gating occurs, or the filtered data does not reasonably represent the raw data, changes to the SPEED LOG data type configuration are required.

It should also be noted that a time series plot of the used fore/aft velocity (and **Speed Through Water** if available) can be displayed by checking the **Time Series** box in the **Configure Vehicle-Devices** window.

To Monitor the Impact of the SPEED LOG Data Type

The monitoring of the impact of the SPEED LOG data type on the positioning of the vehicle requires the setting up of **ghost** vehicles. To minimize the distraction of the ghost vehicles on actual navigation and tracking, you may wish to do the following. From the **Vehicle Presentation** configuration option for the ghost vehicles, select **Vehicle Window Data: Off** to prevent the display of the vehicle data in the **Vehicle** window(s). You may also wish to limit the vehicle shape to a simple cross in a different color to make graphical comparison easier.

The following details the ghost vehicle setup.

1 Add a SPEED LOG data only ghost vehicle.

- Add a vehicle to WinFrog.
- Add the appropriate **HEADING** and **SPEEDLOG** data types.

Make sure to configure the vehicle's positioning parameters (i.e. **Kalman Filter** and **Range Gating**) and the data types exactly as configured on the actual ROV Vehicle. When running with only a SPEED LOG data type as a source of positioning data, the vehicle must be given a starting positioning. Do this by copying the current ROV vehicle's position into the appropriate edit box in the **Configure Vehicle Calculations** dialog box and check the **Update** box. Though the vehicle's position will always appear as yellow in the Vehicle Window, it will actually be positioning based upon the doppler speed log data.

2 Add a USBLBEACON data only ghost vehicle.

- Add a vehicle to WinFrog.
- Add the appropriate **HEADING** and **USBLBEACON** data types.

Make sure to configure the vehicle's positioning parameters (i.e. **Kalman Filter** and **Range Gating**) and the data types exactly as configured on the actual ROV Vehicle.

3 Monitor the difference in positioning between these vehicles and the actual vehicle will illustrate the affect the use of the SPEED LOG data is having in the Kalman Filter.

To Reset the Vehicle's Position

Based upon the monitoring of the aforementioned ghost vehicles, you will be able to determine if the actual ROV position has been overly and incorrectly biased by either the doppler or the USBL to the point where it requires correction. This can be accomplished in several ways.

Option 1 - Purging the Kalman Filter

From the **Configure Vehicle-Devices** dialog box, check the **Purge** checkbox in the **Kalman Filter** area and click **OK** to exit this dialog.

This will reset the **Kalman Filter** and purge the history. The positioning will start afresh with the input of new data of any type currently configured to Primary for that vehicle.

Option 2 - Updating the Vehicle Position

Enter or copy a new initial position in the **Configure Vehicle-Devices** dialog box and check the **Update** checkbox.

This will force the vehicle to this position and the Kalman Filter will take over.

Option 3 - Disabling a Data Source

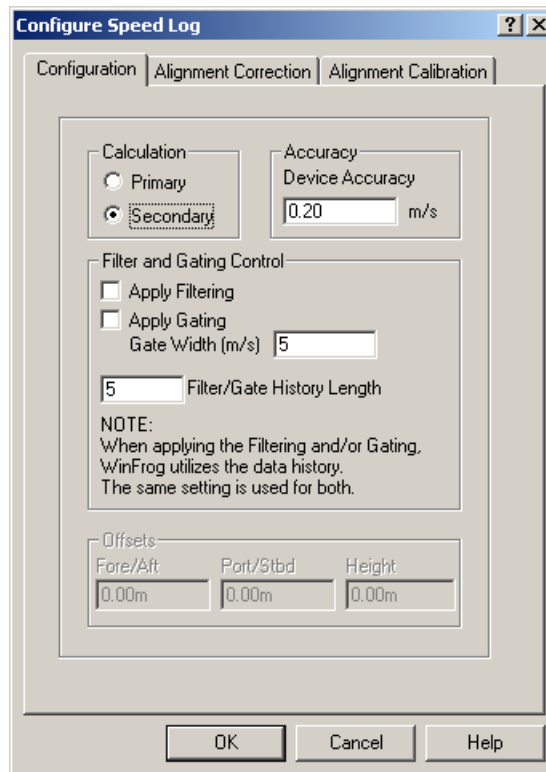
Either the SPEED LOG or USBL BEACON data type can be removed from the solution by setting them to Secondary. The affect of the data will remain for a short period due to the fact that the Kalman Filter uses history to predict the future.

Note: though any of the aforementioned options can be used separately, it generally requires some combination to affect a proper vehicle position reset.

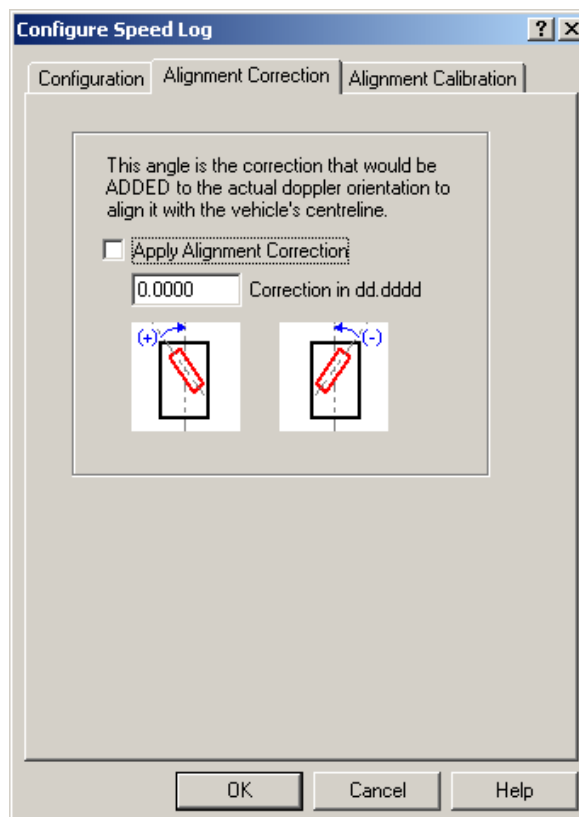
Calibrating the SPEED LOG Data Type

The calibration of the doppler speed log feature provides a simple method to determine an alignment correction and apply this to the doppler data for realtime application.

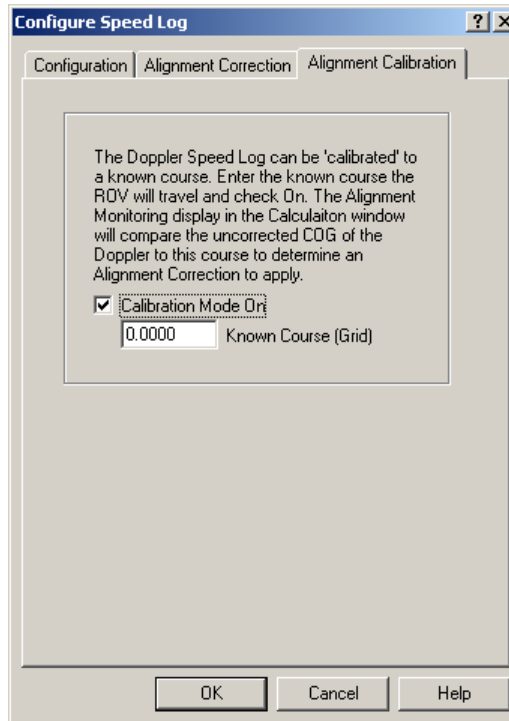
- 1 Select a route of known azimuth that the ROV can track during the calibration. A pipeline is a good option.
- 2 Position the ROV on the selected route and prepare to travel along the route, including aligning with the route and setting down to allow the positioning of the ROV to stabilize.
- 3 Access the **Configure Speed Log** dialog via the **Configure Vehicle-Devices** dialog.
- 4 On the **Configuration** tab, set the doppler speed log to **Secondary**. Use of the Filtering and Gating is optional, but be aware that if applied, it is the result that is monitored during the calibration itself.



- 5 Go to the **Alignment Correction** tab and ensure that the **Apply Alignment Correction** checkbox is not checked.



- 6 Go to the **Alignment Calibration** tab. Enter the **Known Course (Grid)** azimuth and select the **Calibration Mode On** checkbox.



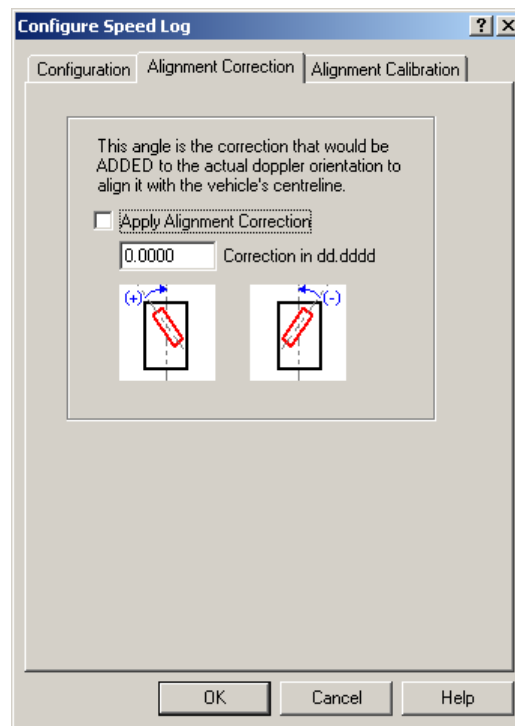
- 7 Click **OK** and return to the **Configure Vehicle-Devices** dialog.
- 8 Click **OK** to exit the **Configure Vehicle-Devices** dialog.
- 9 Open a **Calculations Window** and configure this to view the Data Item Text and turn the SPEED LOG data type on.

The information displayed is as follows:

Uncorr'd Log COG	the resultant grid velocity vector derived from applying the raw fore/aft and port/starboard velocities to the ROV heading
Cal Alignment	the grid azimuth of the selected route
Calc'd Correction	the doppler calibration correction derived from a central tendency filter based on a sample size of 10. This sample and the result is updated with every valid doppler data input. The correction based on the current epoch is given in brackets.
Corr'd Log HDG	the resultant grid velocity vector with the calibration corrections applied. Note that this value will be the same as the uncorrected during calibration if the Apply Calibration Correction

checkbox was unchecked (see step 2). The ROV's Course Over Ground (COG) is displayed in brackets.

- 10 Monitor the Calc'd Correction value to determine the calibration correction to apply. Note that at this time, this data is not logged nor can it be printed.
- 11 When the ROV has completed the course and a calibration value has been determined, access the **Alignment Calibration** tab in the **Configure Speed Log** dialog and uncheck the **Calibration Mode** checkbox.
- 12 In the same dialog, go to the **Alignment Correction** tab and enter the value determined for the calibration correction in the **Correction in dd.dddd** field. Then check the **Apply Alignment Correction** checkbox.



- 13 In the same dialog, go to the **Configuration** tab and re-configure the doppler for use, specifically setting it to **Primary**.
- 14 The performance can be monitored in the Calculation Window in the same way the calibration was monitored. The only difference is that Alignment Calibration has changed to state Alignment Monitoring and the Cal Alignment value now shows the vehicle's COG.

Pipe Bundle Tow Monitoring

WinFrog supports the tracking of a pipe bundle tow through an interface to a third party Bundle Tow software package. This allows you to view the pipe bundle in the Graphics and Profile windows to monitor its position while under tow.

The interface also supports output from WinFrog to the third party package.

This output includes the position and KP data for up to three vessels.

The pipe bundle is handled as a WinFrog Vehicle. The positioning of the bundle is based upon the application of the depth and gyro (true heading) data received from transponders located at specified intervals along the bundle in a three dimensional, open-ended traverse calculation. The starting position for the traverse is derived from position sources located at specified locations on the bundle. The position sources supported are GPS, USBL and LBL. It is expected that the most commonly applied source will be the USBL. The transponder and position source positions are defined by the distance they are from the head of the pipe bundle.

The implementation of the pipe bundle tow monitor option has been done in such a way that most of the standard WinFrog Vehicle functionality is available to the pipe bundle vehicle. The methodology implemented for associating the position sources with the bundle enable multiple sources to be used. WinFrog automatically matches the data to the correct point on the bundle. In addition, it also supports the passing of the base position data for the pipe bundle into the WinFrog Kalman Filter resulting in a smoothed position for the starting point of the traverse.

The standard WinFrog Vehicle capabilities supported include a variation on the Line Tracking. If a Survey Line is selected for the respective vehicle, the line track information is calculated for each point on the bundle that a position is derived for. This information is then available for display in the Numerics window and for alarming in the Alarms windows.

The Pipe Bundle Traverse

The primary legs of the traverse are defined by the following points:

- The head and tail of the pipe bundle; and
- The midpoints between those transponders providing heading data. Based on these transponders, the heading provided by a given transponder is applied to that portion of the pipe bundle starting midway between the preceding transponder and this transponder continuing to the midpoint between this transponder and the following one. In the case of the first

transponder from the head, the leg starts at the head of the bundle. In the case of the last transponder from the head, the leg ends at the tail.

Secondary traverse points are located on the aforementioned primary legs at the transponders themselves.

The primary legs and secondary points are dependent upon the available heading and depth data at each data update, i.e., if a transponder that is set to provide a heading does not provide a valid value, the primary legs are determined as if this transponder did not exist as a heading transponder. It will still exist as a secondary point for the purpose of displaying the transponder position graphically. Similarly, if a depth transponder does not provide a depth, a depth is interpolated for it.

The bundle vehicle also has a Common Reference Point (CRP) defined by a distance from the head of the bundle.

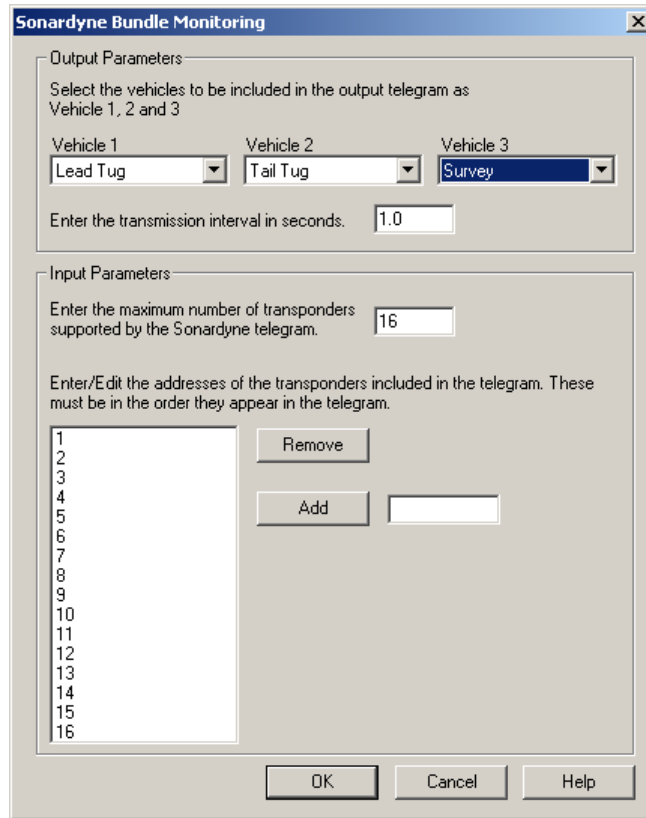
When depth data is updated from the pipe bundle package, depths are applied to the respective depth transponder points. Depths for all other points as defined above are then interpolated or extrapolated from these.

When a position data source is updated, WinFrog matches this with the respective point on the pipe bundle, that is, a point at a known distance from the head of the bundle. This position is then traversed to the CRP. If the vehicle is configured to use the Kalman Filter, this position is passed into the filter and the resulting filtered position is then used for the subsequent traverse calculations. If the Kalman Filter is not to be used, this CRP position is used as is. The CRP position is then used to traverse ahead and back to determine the horizontal positions of the start and end points of the primary legs and of the secondary points.

The heading associated with the Bundle Vehicle is the mean of all the transponders' heading values.

Adding and Configuring the Device

- 1 From the I/O Device window, right-click and select **Add Device**.
- 2 Go to the **COMPASS** devices and select the **Sonardyne Bundle Monitor** device and click **OK**.
- 3 Configure the serial port parameters appropriately and click **OK**.
- 4 In the I/O Device window, select the Bundle Monitor device, right-click and select **Configure Device**. The **Sonardyne Bundle Monitoring** dialog box appears.



5 The top panel allows you to select those vehicles to be included in the output telegram. Note that only those already added to WinFrog are listed.

- Select the desired vehicles.
- Enter the output interval in seconds that the output telegram is to be transmitted.

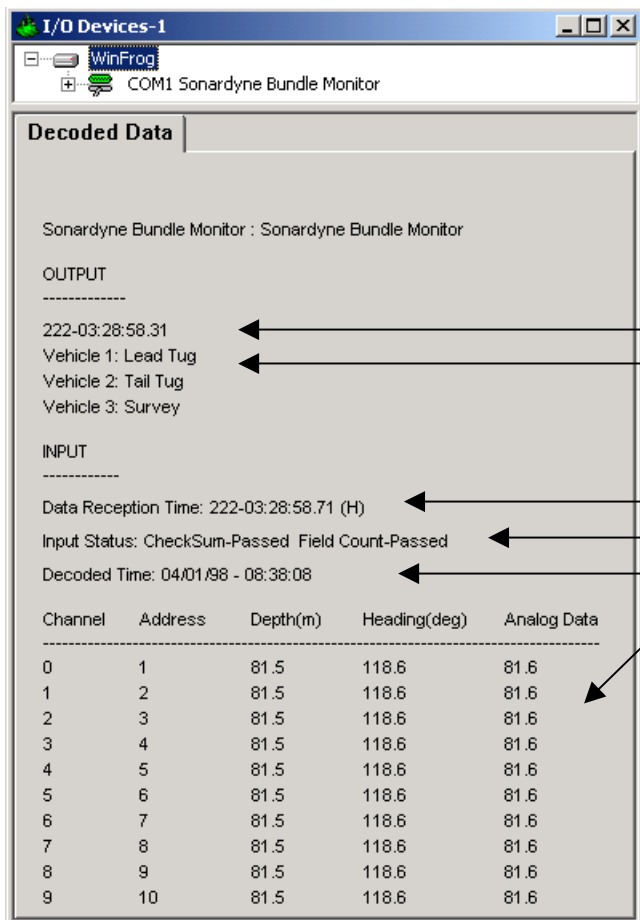
Note: The DATA OUTPUT data item associated with this device must be assigned to the respective vehicles.

6 The lower panel allows you to define the data being received from the pipe bundle software package.

- Enter the maximum number of transponders included in the telegram.
- Enter the channel identifier for the transponders included in the telegram. These must be in the order they will occur in the telegram. The identifier must be the USBL beacon ID associated with the transponder if USBL interrogations of the transponders will be executed. If the transponders will be interrogated with LBL, the transponder address is to be added. Enter the identifier in the field to the right of the **Add** button and click the **Add** button. If an identifier is to be removed, highlight the transponder identifier to be removed and click the **Remove** button.

7 Click **OK**.

The device can be monitored in the device window.



I/O Devices-1

WinFrog

COM1 Sonardyne Bundle Monitor

Decoded Data

Sonardyne Bundle Monitor : Sonardyne Bundle Monitor

OUTPUT

222-03:28:58.31 ← Time the output telegram was transmitted

Vehicle 1: Lead Tug ← Names of the output vehicles

Vehicle 2: Tail Tug

Vehicle 3: Survey

INPUT

Data Reception Time: 222-03:28:58.71 (H) ← WinFrog time telegram was received

Input Status: CheckSum-Passed Field Count-Passed ← Status check on input data

Decoded Time: 04/01/98 - 08:38:08 ← Time included in telegram

Channel	Address	Depth(m)	Heading(deg)	Analog Data
0	1	81.5	118.6	81.6
1	2	81.5	118.6	81.6
2	3	81.5	118.6	81.6
3	4	81.5	118.6	81.6
4	5	81.5	118.6	81.6
5	6	81.5	118.6	81.6
6	7	81.5	118.6	81.6
7	8	81.5	118.6	81.6
8	9	81.5	118.6	81.6
9	10	81.5	118.6	81.6

← Data decoded from telegram

Configuring the Pipe Bundle Vehicle

The configuration of the Pipe Bundle vehicle is essentially the same as any other vehicle. It is important to note that not all vehicle options/features are available. The most notable is the inability to use the Vehicle Offset option.

- 1 Add a vehicle.
- 2 Configure the vehicle shape such that no shape is associated with this vehicle:
 - Select **Ship** mode
 - Enter 0 for the **Width Of** and **Origin To** items
 - Make sure the **Moonpool Used** checkbox is **not** checked.

3 If using USBL to position the Pipe Bundle:

- Add a BEACON data item from the respective USBL system for each beacon that may be used.
- Configure each BEACON data item:
 - Set the Calculation mode to Secondary
 - Enter the appropriate Code
 - Make sure all offsets are 0
 - Select Graphics On.

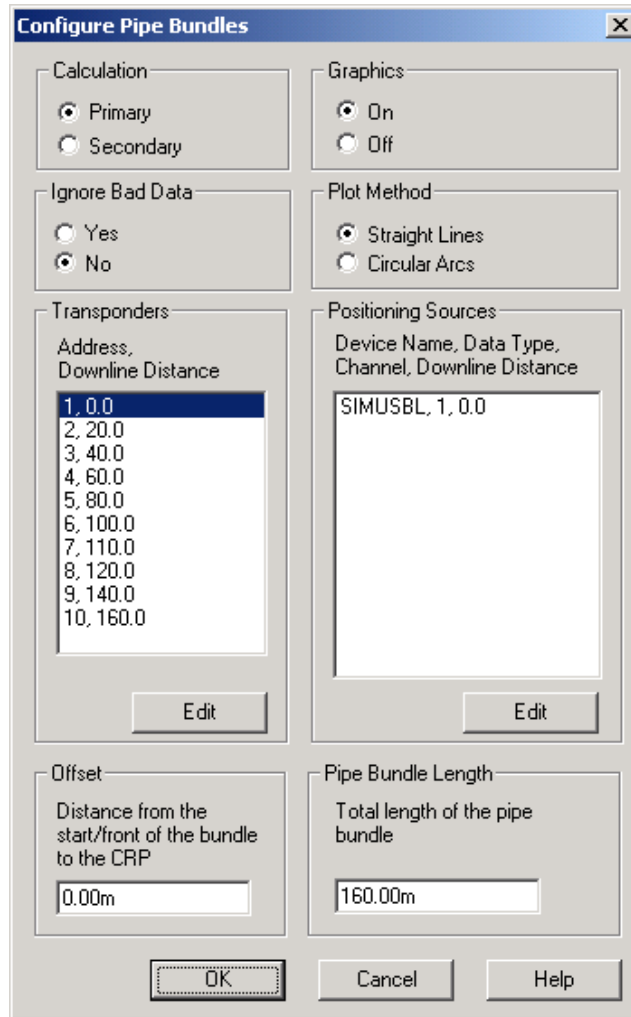
OR

If using LBL to position the Pipe Bundle

- Add a XPONDER data item from the respective LBL system for each transponder that may be used.
- Configure each XPONDER data item for normal operation (see **Chapter 17: LBL Acoustics**), ensuring the following settings are implemented:
 - Set the Calculation mode to Secondary
 - Make sure all offsets are 0
 - Select Graphics On.

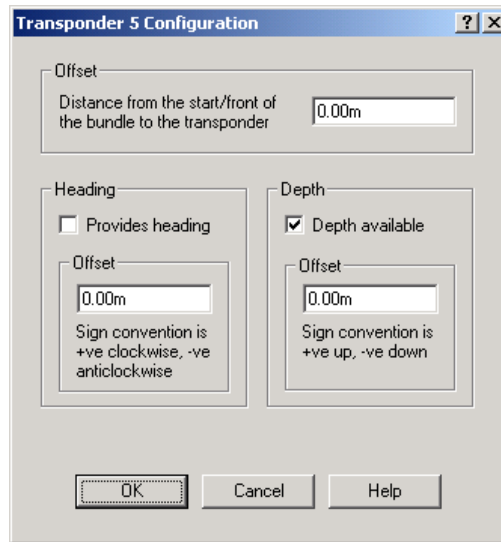
4 Add the **BUNDLE** data item to the vehicle.

5 Click the **Edit** button to access the **BUNDLE** configuration dialog.

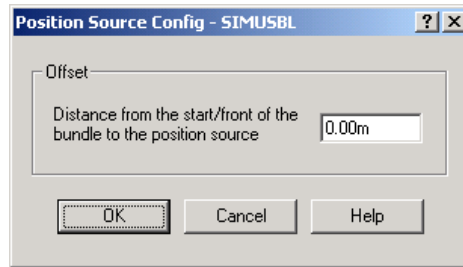


6 Configure the data item:

- Set Calculation Mode to **Primary**.
- Set Graphics **On** to display the transponder identifiers in the Graphics window.
- Set the Ignore Bad Data. If data flagged as bad or invalid is received, you have the option to use it anyway (No) or not (Yes).
- Set the Plot Method. You can choose between straight lines, or lines joined by circular curves.
- In the Transponders panel, all the transponders added to the device configuration are displayed. Each must be configured. Highlight the transponder in the list and click the **Edit** button or double-click the transponder in the list. A **Transponder Configuration** dialog box appears.



- Enter the distance from the head of the pipe bundle to this transponder.
- In the **Heading** panel...
 - If the transponder is providing heading data, check the **Provides heading** checkbox.
 - Enter any heading correction to be added to the raw heading value.
- In the **Depth** panel...
 - If the transponder is providing depth data, check the **Depth available** checkbox.
 - Enter any correction and/or offset to be added to the raw depth value. This includes offsets to that point of the pipe bundle to be positioned, e.g. to the center the bundle, and calibration values.
- Click **OK**.
- In the **Positioning Sources** panel on the **Configure Pipe Bundles** dialog, any positioning data items associated with this vehicle are listed. Each of these must be configured. Highlight the source in the list and click the **Edit** button or double-click the source in the list. A **Position Source Config** dialog box appears.



- Enter the distance from the head of the pipe bundle for this positioning source and click **OK**.
- In the **Offset** panel on the **Configure Pipe Bundles** dialog, enter the distance from the head of the pipe bundle to that point assigned as the CRP.

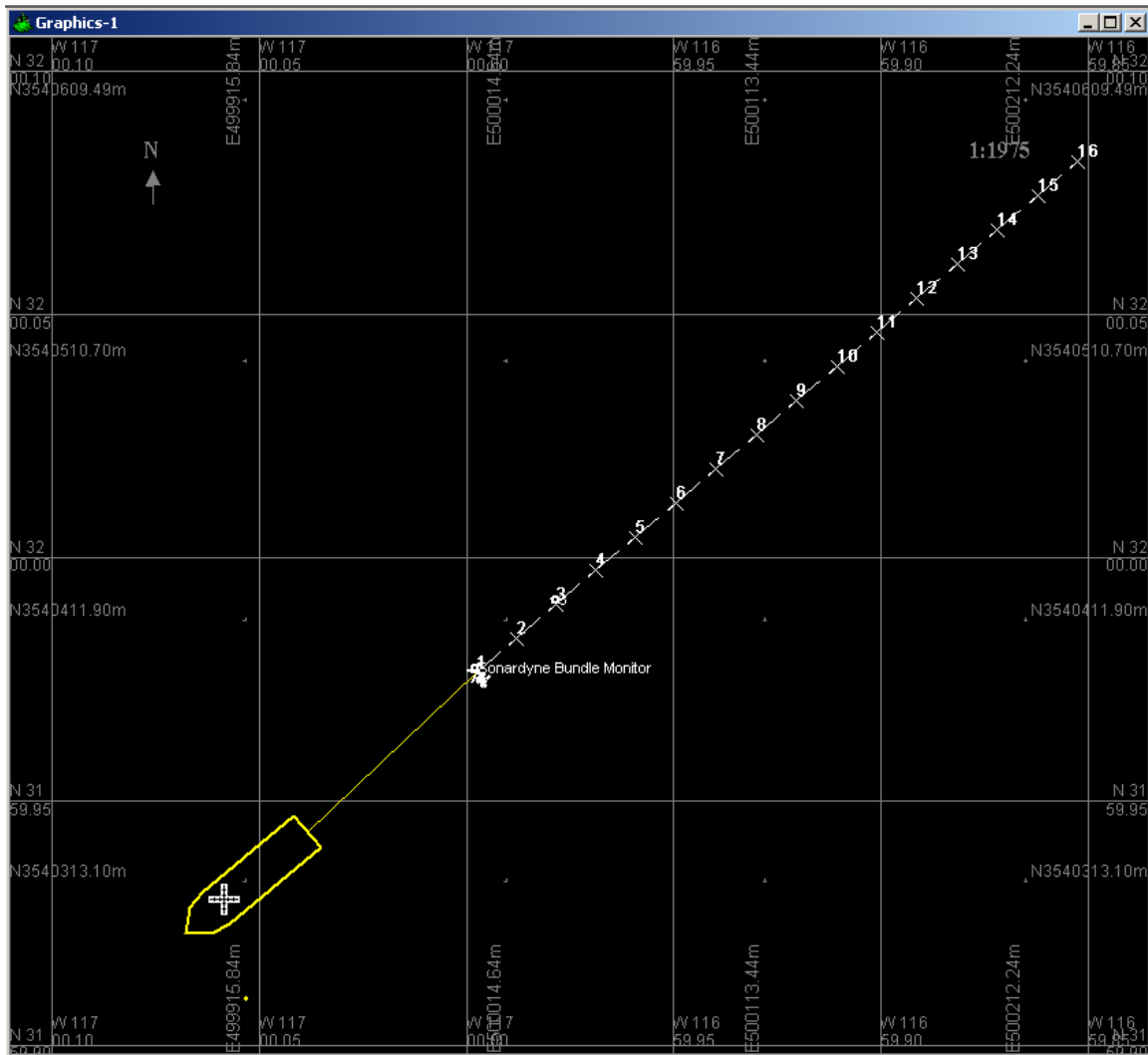
Note: There are two main issues to address when selecting the CRP:

- If one positioning source will be the primary source used, e.g. a specific transponder, this should be used as the CRP.
- Alternatively, if it is desired that a towline be displayed from the lead tow vessel to the pipe bundle, the CRP should be the head of the bundle. This allows you to set up dynamic tracking between the tow vessel and the bundle vehicle utilizing the option to draw a line between the respective vehicle points.
- In the **Pipe Bundle Length** panel, enter the total length of the pipe bundle.
- Click **OK**.

7 Complete the configuration of the vehicle (see **Chapter 6: Vehicles**):

- Configure the vehicle to use the Kalman Filter and Range Gate as desired.
- Configure vehicle trail and color.
- Configure if vehicle is to be displayed in the Graphics window and/or the Profile window.

The pipe bundle vehicle can be viewed in both the **Graphics** and **Profile** windows. The configuration of these windows can be found in **Chapter 8: Operator Display Windows**.



In addition, the data associated with each of the traverse points can be viewed in the Numerics window and used for alarming in the Alarms windows. For more information on the use of these windows, refer to **Chapter 8: Operator Display Windows**. In addition, the following must be noted when using these windows:

Numerics Window

- the names used for the items for the Numerics window must be based upon a name that does not change, therefore the term used is Node n where n is the number of the node from 1 to 64
- the names associated with each traverse point are Nn where n is the node number counting from the head of the bundle to the tail; in the

- case that a transponder is located at the traverse point, the transponder address is appended in brackets, e.g. N3(103)
- therefore the component n in the aforementioned Numerics and traverse point names are correlated
 - the maximum possible number of traverse points must be added to the Numerics window for display; if one is dropped due to no heading data or depth data, the last node(s) displayed change to display *N/A*

Alarms Window

- the naming method for the Alarms windows is the same as that used for the Numerics window so the same rules apply to the configuration
- in the case of the Alarms window, it cannot determine when a traverse point has been dropped and as a result will display all selected nodes despite the possibility that they are no longer valid
- it is best then, to have the Numerics and Alarms windows located and sized such that the correlation between the selected items to display and monitor can easily be determined and therefore ignore those alarms that are invalid

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Chapter 20: LBL & USBL Calibration

Acoustics, as used for the navigation and positioning of surface and subsurface vehicles, are generally either **Long Baseline (LBL)** or **Ultra-short Baseline (USBL)**.

LBL systems utilize a network of transponders located at known positions throughout the work area to which ranges are measured, either directly or indirectly, from a transducer attached to the vehicle to be positioned. These ranges enable a range/range solution for that vehicle's position. A single transducer element within a transceiver is used, either to perform the ranging directly, initiate a sequence of ranging, or send instructions to another transducer system to perform the ranging. The term **Long Baseline Acoustics** is derived from the fact that baselines between the known transponders can be up to several kilometers. LBL acoustics can be used to position surface and subsurface vehicles.

USBL systems utilize multiple-transducers located very close together within a single transceiver head to measure to beacons. They measure a single range to a transponder and by using the very short baselines formed between the multiple transducers, the horizontal and vertical angle can also be determined. The term **Ultra Short Baseline Acoustics** is derived from the fact that the baselines between the transceivers located on the transducer head are very short. USBL acoustics can be used to position surface and subsurface vehicles.

In order to be used to their full capabilities, both systems require calibration. This chapter details the calibration processes required and how WinFrog performs them. **Note:** the actual addition of LBL and USBL devices to WinFrog and their association and use with vehicles is covered in the **LBL and USBL Acoustics** chapters earlier in this manual.

WinFrog's calibration functions use a rigorous **least squares** approach, utilizing all available data. This is an important point to remember when collecting and processing the data and will be covered in detail in the following sections.

LBL Calibrations

The purpose of an LBL calibration is to determine the position of the transponders deployed in the work area. These transponders may be deployed precisely mounted on an underwater structure, deployed using a Remotely Operated Vehicle (ROV), positioned using USBL, or simply dropped from a surface vehicle at the approximate desired location. Regardless of the deployment method, a network, or array, of transponders is placed and the accurate positions for the transponders are required. Until their positions are known, they cannot be used to position another vehicle.

The determination of the positions for newly placed transponders requires range measurements from known points. The reason for stating it in this way is that these known points could be other transponders already deployed and calibrated, a vehicle positioned by alternative means, or a combination of both. In the case of a surface vehicle, the vehicle's position will probably be determined using DGPS. In the case of a subsurface vehicle, its position will probably be determined using DGPS and a calibrated USBL from a surface vehicle. Regardless of the type of known points, the data are processed using a rigorous least squares algorithm to produce either 2D or 3D (depending upon operator selection) position solutions.

The calibration process requires the following steps:

1. transponder array design;
2. transponder deployment;
3. estimation of initial approximate transponder positions;
4. preparation for data collection;
5. data collection;
6. data review and editing;
7. data processing; and
8. application of the results.

The data review and processing is an iterative process.

These topics are covered in detail in the following sections.

Important Notes:

It is critical that a valid **Working Velocity** file be loaded into WinFrog before any LBL operation is undertaken. If an error is made and an invalid velocity file is present at the time of the calibration data collection (or none at all), WinFrog provides you with an option to apply a new velocity file during the processing.

It is important that a correct **Working Transponder** file is loaded and available prior to the configuration for data collection. If an error is made in the **Working Xponders** file, a station left out or incorrectly entered, WinFrog provides full editing options within the Calibration Editing process. It is still however, better to ensure the correctness and completeness of the **Working Xponders** file prior to the Calibration data collection.

LBL Transponder Array Design

While the intricacies of network design are beyond the scope of this manual, the following must be kept in mind.

Like any network of control stations, the array must be designed to provide strong geometry in the required area. If the vertical component of the vehicle

position is to be solved for using the acoustic ranges, the array design must include vertical separation.

The reader should refer to Survey textbooks on this subject for more information.

Other considerations for the array design are as follows:

- structures in the area that may cause blockage or reflection of the acoustic signals;
- operations in the area that may result in damage to transponders, such as anchoring operations resulting in anchor chains being dragged through an array; and
- other acoustic operations in the area and the impact they will have on the LBL acoustics, such as frequency interference.

LBL Transponder Deployment

The deployment of transponders in the array will depend upon the resources available and the tolerance of the array design to variances from design location to actual location.

In the case where the allowable variance from the design position to actual position is very small, the transponders are often positioned in tripods using an ROV tracked from the surface with a calibrated USBL system. Alternatively, they may be lowered using a surface crane, again tracking the transponder using a USBL transponder co-located with the LBL transponder and a calibrated USBL system. If the transponder is being placed within an existing calibrated array, it can be tracked using the existing array.

Where tolerances are less tight, or the resources are not available for the above methods of deployment, the transponders are simply deployed from the surface vessel. In this situation the vessel is positioned such that the transponder deployment point is over the design location and the transponder is released to free fall to the bottom. In this case the transponder is attached to an anchor with a short rope. Since the transponder is free to move with the currents it is inherently less accurate than using tripods.

In either case, it is important to obtain a reasonable approximate position of the transponder deployment location. In the former, the design location will likely be fairly accurate, depending upon the success of the deployment. In the latter, the position of the transponder deployment point at the time of release is used.

LBL Calibration Preparation

Before performing the LBL calibration, WinFrog must be prepared. Although WinFrog provides recourse during the processing to correct for omissions and errors in the setup for the calibration, it is always better (and easier) to perform

the setup correctly and eliminate the need to use these features. The following covers the points to check for prior to calibration.

- 1 Ensure that there is a valid **Working Velocity** and **Working Xponder** file opened in WinFrog. When performing the calibration, and when operating the LBL for positioning, it is advised that the option to display the names of the **Working Velocity** and **Xponder** files in the **Vehicle** window be exercised.
- 2 The **Xponder** file must contain, at a minimum, all transponders that are to be calibrated. The initial approximate positions and depths for the transponders must also be entered accordingly. The depth is important because it is involved in the reduction of the observations to the map grid. Depths for the transponders can be determined using depth interrogations if they are equipped with a depth sensor. Alternatively, the ship can pass directly over the deployment position while ranging to the transponder and the shortest time travel converted to a distance and used for a depth. Other options include passing over the transponder with a calibrated sounder and using this information and the known height above the water bottom of the transponder to determine the depth. One may also obtain the approximate depth from a chart. Issues of **Double Occupancy** (see the section **Xponder Files, Special Case: Double Occupancy** in the **Working Files** chapter) must be addressed. These are applicable when a USBL system is used to observe surface ranges and an LBL system is used to observe baselines or if multiple transponders are required at locations to support accurate baseline observations (EHF) and deep water surface ranges (MF).
- 3 Ensure that all positioning and related devices are correctly configured, including operational settings and sensor offsets. The **LBL TRANSCEIVER** data item must be attached to the vehicle being used for the calibration and, while it is recommended that it be configured to Positioning - Secondary, it can be configured to Positioning - Primary without affecting the data collection and subsequent processing. However, during the data collection process WinFrog will perform a position determination using the LBL data collected. Since this determination will be based upon estimated positions for the array transponders, it may not agree with the other positioning systems, resulting in a jump in the vehicle's position. This may cause comments and even alarm among those personnel using the WinFrog screens, such as the helmsman. If a USBL system is to be used to collect surface ranges, the **USBL HYDROPHONE** data item must be attached to the vehicle and configured. The same issues as applied to the **LBL TRANSCEIVER** configuration with respect to Primary and Secondary, apply to this data item.
- 4 The computer directories should be setup such that the calibration data have a specific location to which they are saved. The saving and archival process for the files should be decided upon at the beginning of the project to ensure that the necessary steps are followed for safe file saving and archiving.

LBL Calibration Data Collection

The calibration data collection process involves setting up WinFrog to collect and log the data and the design of the path the vessel will take to collect the data. WinFrog provides the capability to perform a rigorous least squares solution using all available data in a single solution. This data includes surface navigation (DGPS positions), subsurface ranges (surface to transponder ranges), baselines (inter-transponder ranges) and depth observations. The collection process should reflect this.

Note: if the calibration is for the purpose of extending an existing array, it is probably not necessary to collect the surface to array data. Therefore, in these circumstances the data collection process can proceed as detailed in the **WinFrog Setup for LBL Calibration Baseline Data Collection** section later in this chapter.

There is no limit to the number of data points collected and used for the calibration, other than the constraints of the available RAM and disk space on the computer.

Overview of the Acoustic Calibration Dialog for Data Collection

The **Acoustic Calibration** dialog, from which all data collection, saving, loading, editing, processing, and reporting is performed, can be accessed several ways.

To Access the Acoustic Calibration Dialog

- 1 Set the **Vehicle Text** window to display the information for the vehicle to which the LBL Transceiver is attached.
- 2 With the cursor in the **Vehicle Text** window, right-click to access the pop-up menu.
- 3 Select **Acoustic Calibration**.

Or

- 4 From the Main Menu, select **Configure > Vehicles**.
- 5 Highlight the vehicle to which the LBL Transceiver is attached, and click the **Acoustic Calibration** button.

Or

- 6 From the **Acoustic Window**, click on **Configure > Select Vehicle for Calibration**, then click on the vehicle to which the LBL Transceiver is attached.
- 7 Then click on **Configure > Calibration**.

Note: WinFrog is a multi-vehicle system. Ensure the vehicle that has the **LBL TRANSCEIVER** data item added to it is the one selected/displayed before clicking the **Cal** button or using the right mouse button to access the pop-up menu. If the incorrect vehicle is selected and the **Calibration** dialog is accessed, you will still be permitted to setup the calibration data collection, but no calibration will take place because no LBL data items are associated with that vehicle. If it appears that no data are being collected, check for this problem.

This problem is minimized accessing the dialog via the Acoustic Window. Only those vehicles with LBL data items attached are listed and available for selection, and the Calibration dialog cannot be opened until a vehicle is selected.

The **Calibration** dialog box is shown in the next figure. This dialog box is modeless and does not restrict access to other WinFrog windows while open. It is recommended that this be left open during the data collection process.

Calibration for Vehicle1

Data Collection/Control

☒ Off ☐ LBL Ranges ☐ II Ranges ☐ USBL Data

Apply Data Collection Setup Now

0 Points in Memory

Clear

Min Interval (seconds)

1

Graphics

☐ On ☒ Off

☐ LBL Baselines ☐ Depths

Setup

Setup

Data Load/Save

Current File

Load Save AutoSave AutoSave Off

Calibration Calculations

Edit Data Recalc LBL Xpdr Report

Calculate Reset USBL USBL Report

Statistics Recalc USBL Edit Xponder

OK Cancel Help

The following details those controls associated with the LBL Calibration data collection process.

Note: A Calibration data set for a given vehicle is initiated as soon as the Calibration dialog is opened for that vehicle.

Note: Whenever the Calibration dialog is opened, WinFrog checks the current Working Xponders file against the Xponder station information contained in the Calibration data set. If no Xponder station information exists in this set, for example, when the Calibration dialog is first opened, WinFrog automatically copies the complete Working Xponders file into the Calibration data set. On subsequent openings of this dialog, WinFrog performs a check and informs you of differences between the Working Xponder file and the Calibration Xponder station data (coordinate variations and discrepancies in stations present). You can then decide whether to update or over write the Calibration data set station information with that from the Working Xponders file, or ignore the differences and keep the Calibration data set station information untouched.

Data Collection Control

You control the type of data to collect with the controls in this section. Once selected, the **Apply...** button will change to reflect the changes that will be applied if it is clicked. Alternatively, selecting the data collection type and exiting the dialog with **OK** will also apply the settings.

Off	Stops data collection
LBL Ranges	Turns on the collection of LBL range data. This is applicable to all LBL devices.
II Ranges	This allows you to specify the transponder to interrogate using the Individual Interrogation Frequency (IIF) for that transponder. You then use the dropdown list box to select the transponder to range to with this command. Note: This is specific to Sonardyne LBL Compatts. Only those transponders in the Working Xponder file set to LBL Mode Fixed and Model LBL MK-II or MK-IV are available for selection. Note: Regardless of the Transmit Code configured in the associated TRANSCIEVER data item prior to using this mode, the Transmit Code will be set to None when this mode is stopped.
USBL Data	Turns on the collection of USBL data.
Min Interval	This controls the minimum data collection interval for the above three data collection options. The value entered is in seconds.

	During data collection, WinFrog checks for the presence of new data from the associated devices and then checks to see if the minimum interval has been reached or exceeded, and if so, logs the data. If either of the preceding checks fails, no data are logged.
LBL Baselines	Turns on the collection of baseline measurements between transponders. This is not available to all LBL units. This is setup via the associated Setup button and is discussed later in this chapter. In addition, there is a text display to the right of the Setup button that presents the status of the baseline collection process with respect to completed or aborted.
Depths	Turns on the collection of depth observations by transponders. This is not available to all LBL units. This is setup via the associated Setup button and is discussed later in this chapter. In addition, there is a text display to the right of the Setup button that presents the status of the depth collection process with respect to completed or aborted.
Apply... button	The text of this button displays the collection setup that will be applied when clicked. Click this button to cause the current Data Collection setting(s) to be applied without exiting the dialog box with OK.
Points In Memory	The total number of points currently loaded/present in WinFrog memory. It is very important to note that when collecting calibration data, WinFrog logs the data to memory and not directly to disk. It is only written to disk when specifically directed by the operator.
Clear	This will clear the current calibration data in memory. Note: if these data have not been saved to disk, they are not recoverable after this is executed. A confirmation prompt appears when the Clear button is clicked.
Graphics On/Off	Controls the display of the data collection positions in the Graphics and Bird's Eye windows. Note: baseline data does constitute

a data collection point and they will be displayed if present. Thus, the **Graphics** display provides both a means for monitoring the progress of the data collection and clear illustration of the geometry. After setting this option, the **Apply...** button must be clicked to the dialog exited with **OK** in order for the changes to take affect. There are additional graphic features available directly within the **Graphics Window** configuration options. (see the **Operator Display Windows** chapter).

Data Load/Save

Current File

This is a read only control giving the path and name of the currently loaded calibration file or the last one that had been in WinFrog memory.

Load

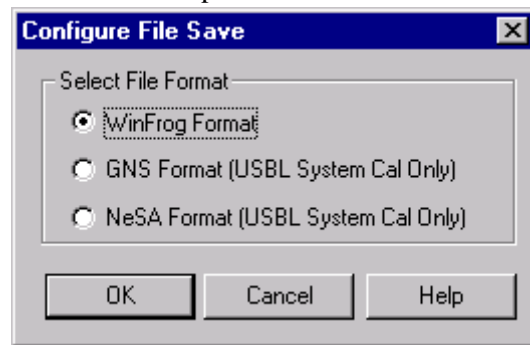
Enables the browsing of available storage media to select a calibration file (*.cal) and load it into memory. **Note:** this action automatically clears all data calibration observation data currently in memory. You are warned of this and given the option to cancel the action. You are also prompted as to whether or not you wish to purge the current Calibration data set station information. If there is a difference between the station information of the Calibration data being loaded and the current Working Xponders file, you are informed of the difference detected and given the option to either update or over write the Calibration data set station information from the Working Xponder file or ignore the Working Xponder file.

Note: When loading a calibration file pre-version 13, the data is scanned to generate data summary records (see **LBL Calibration Data Editing** section). These generated records are not as complete as those generated and saved with the calibration file post version 12.

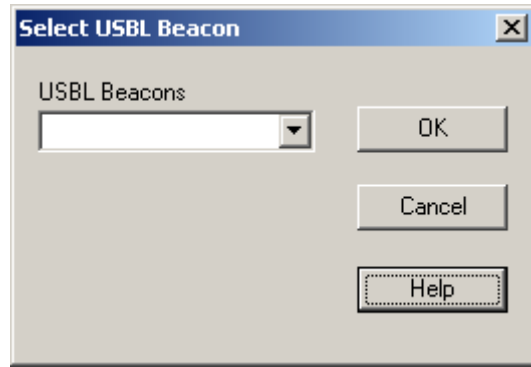
Save

This is only available if there are calibration data in memory.

Enables browsing of available storage media to select an existing file or enter a new file name to save all the data currently in memory to disk. **Note:** when data are saved to an existing file, that file's contents are replaced with the contents of the memory. When this option is accessed, WinFrog scans the calibration data in memory to determine if there are any USBL data present. If there are, you are prompted for the file format to use. The next figure shows the available options.



The WinFrog format supports both LBL and USBL calibration data, the GNS and NeSA formats support only USBL calibration data. In all cases, the data should first be saved using the WinFrog format. It can subsequently be re-saved in either of the other formats. However, if only saved in either GNS or NeSA formats, some data will be un-recoverable and the file will not be able to be processed by WinFrog to the fullest capability of the software. If the radio button for either the GNS or NeSA format is clicked, you will immediately be prompted to select the USBL beacon for which to save the data on the **Select USBL Beacon** dialog box.



Select the beacon from the drop down list and click OK to exit. Upon exiting the **Configure File Save** dialog box with OK, you are then able to browse the directories.

If there are no USBL data present, the WinFrog format is defaulted to and WinFrog goes directly to the browse.

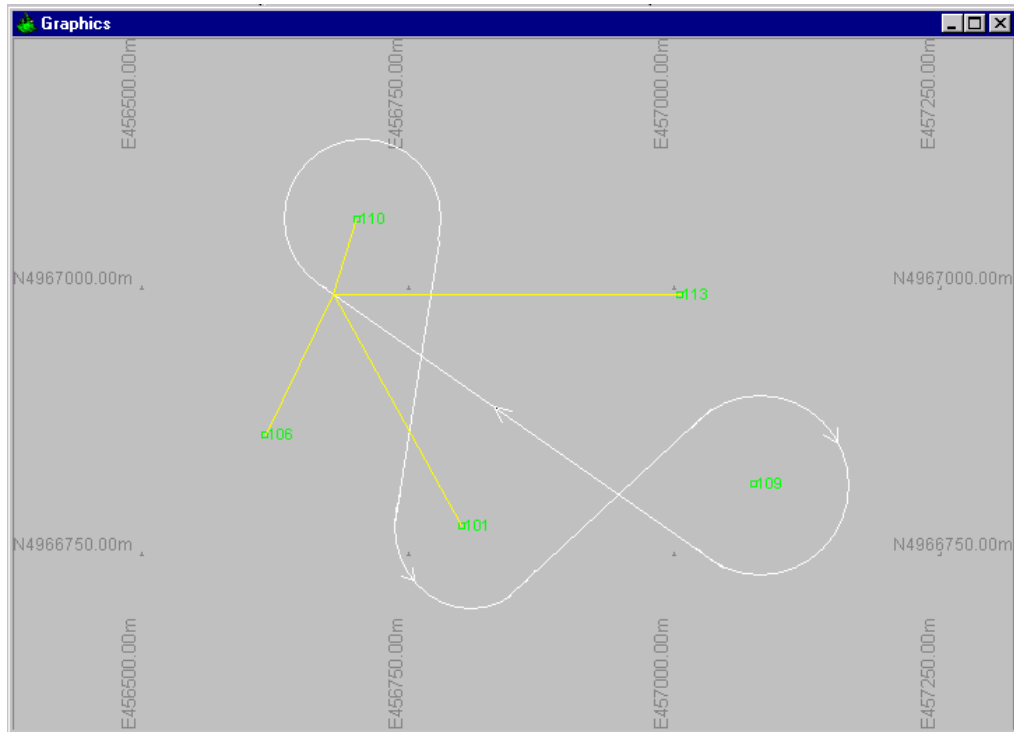
Future development.

AutoSave

LBL Calibration Range Data Collection Vessel Track

The ideal data collection scenario would have the surface vessel circle each transponder in the array, at a distance of approximately 1.5 times the water depth, while collecting range data to all the transponders. However, due to local restrictions, such as other vessels and structures in the area and the expense of ship time to perform this, it is not always possible, nor feasible, particularly with arrays of more than 6 transponders.

Another consideration is the ability to measure baselines between the transponders. If this is an option, as is the case with Sonardyne COMPATTs, the requirement to circle each transponder is lessened.



Be cautioned that collecting ranges to a transponder from only one side without supplemental data, such as baselines, may bias the results of the solution. Range data should be collected at opposing points around a transponder. Collecting data in this manner will reduce the affect of error sources such as sound velocity errors.

The collection track should therefore be designed with the idea of circling as many transponders as is reasonably possible, including those transponders at the extreme reaches of the array. The figure above illustrates a possible vessel track for a 5-transponder array with baseline measurement capabilities.

The lines drawn from a point on the track to transponders 101, 106, 110, and 113 represent the ranges to those transponders, all of which are logged. Transponder 109 is considered out of range at this point for this example and, therefore, a range to it is not available from this point on the track. It is not required that the data for any one specific transponder be logged sequentially. The track (illustrated above) circles or “boxes in” transponders 101, 109, and 110 and also provides additional ranges to transponders 106 and 113 from all points along the track.

WinFrog Setup for LBL Calibration Range Data Collection

This section covers the collection of range data between the LBL transceiver affixed to the data collection vehicle and the array transponders.

This section assumes that the LBL device has been added to WinFrog and the associated **LBL TRANSCEIVER** data item, along with all other required data items (i.e. POSITION, HEADING), have been added to the appropriate vehicle.

Vehicle Configuration

The vehicle configuration consists of editing the data items associated with the calibration vehicle. This is accomplished using that vehicle's **Configure Vehicle Calculations** dialog.

Note: all **POSITION**, **LBL TRANSCEIVER** and **USBL HYDROPHONE** (and **PSEUDORANGE** if used) data associated with the calibration vehicle are logged to the calibration file, along with general vehicle data. In addition, a standard deviation is logged for each data item. This is used to determine the initial weighting for that data item in the calibration processing (inverse of standard deviation squared). If a **POSITION** data item is configured as **Primary**, the standard deviation logged for that data item is the associated accuracy as entered. If a **POSITION** data item is configured as **Secondary**, the standard deviation logged for that data item is 0, or Off. The standard deviation logged for the **LBL TRANSCEIVER** and **USBL HYDROPHONE** is the accuracy entered for the respective data item. If the LBL equipment has baseline capability, the standard deviation is based upon the frequency used.

The next figure illustrates a typical **LBL TRANSCEIVER** configuration as attached to a vehicle. The Calculation should be changed to **Secondary**. As previously mentioned, while setting this to **Primary** will not affect the calibration processing, it will affect the real-time positioning. If set to **Primary**, WinFrog will attempt to use the range data to the uncalibrated transponder array to position the vehicle. This will likely produce incorrect positioning and thus position jumps that may result in the mistrust of the navigation by those using it.

Note: In the case of Sonardyne hardware, do not set the **Transmit Code to II**. If it is desirable to use the **II** command for Calibration data collection, select the respective option from the Calibration dialog.

Configure LBL Transceiver [?] [X]

Basic Configuration | Select Fixed Transponders

Calculation Mode
☒ Primary ☐ Secondary

Solution Control
 Accuracy Convergence Tolerance

Depth Calculation Mode
☐ Calculated
☐ Use Depth for CRP from other source
 Depth interrogation interval in cycles
☐ DigiQuartz
☒ Use entered Depth for CRP (0 for ship)
 CRP Depth (+ve below water surface)

Tow Fish Depth interrogation
☒ Off ☐ FD3 ☐ FD1 Interval in cycles

Interrogating Transducer Control
☒ 1 ☐ 2 ☐ 3

Transmit Control
☒ On ☐ Off Transmit Code

Interrogation Cycle Control
☒ Cycle ☐ Time Interval

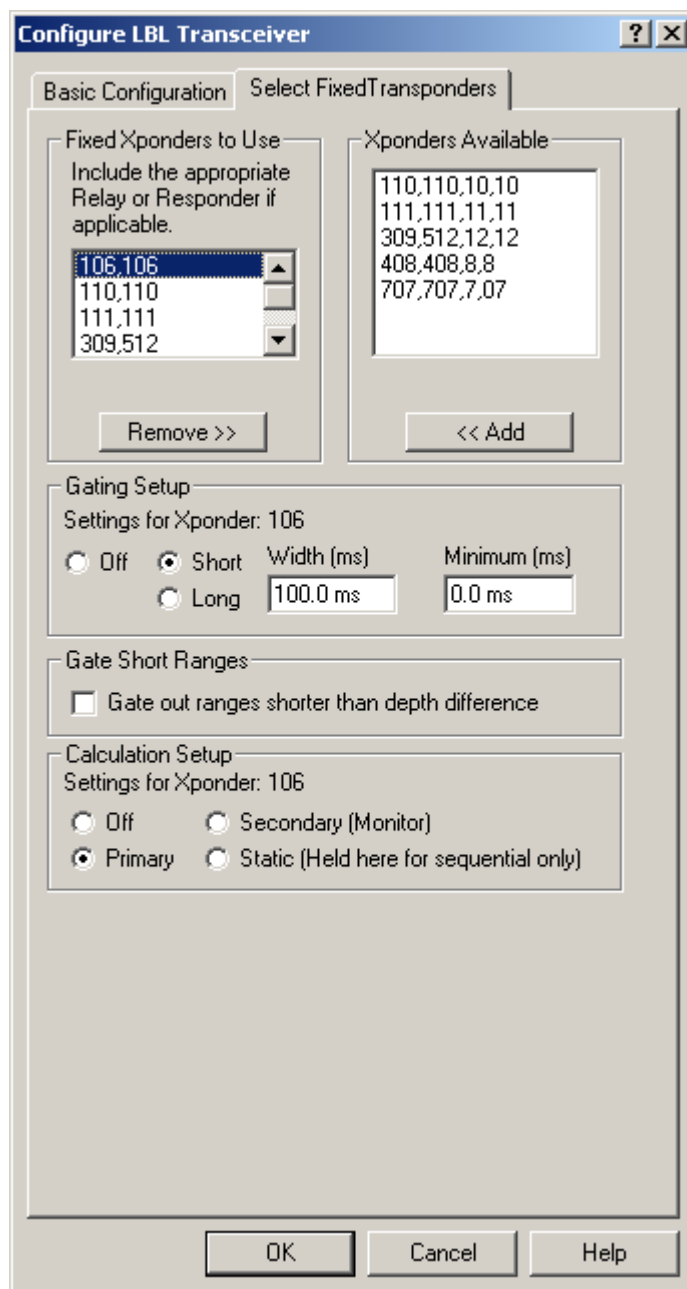
Receive
☒ On ☐ Off

Graphics
☐ On ☒ Off

Offsets
 Fore/Aft Port/Stbd Depth (+down)

[OK] [Cancel] [Help]

The transponders that are to be ranged to must also be configured. This includes those transponders to be ranged to using the **II** command. The next figure illustrates an example of selected transponders. This is covered in greater detail in the LBL Acoustics chapter. If the transponders are not selected, the associated data will not be collected for the calibration data.



In the case of the **USBL HYDROPHONE** data item, the specific transponders to observe are not selected directly. WinFrog logs all USBL data output by the USBL system that corresponds to Fixed USBL transponders in the **Working Xponder File**.

Calibration Data Collection Configuration

The calibration data collection configuration is accomplished using the **Calibration** dialog.

To Initiate Data Collection of Surface Range Data

- 1 Set the minimum data logging interval.

Make sure this interval is not too long or any problems (i.e. acoustic noise) during the data collection may result in unacceptable gaps in the data.

- 2 Toggle the **LBL** radio button to interrogate all enabled transponders and click the **Apply** button.

Or

- 3 Toggle the **II Ranges** radio button and select the transponder to interrogate from the associated drop down list to interrogate only a specific transponder and click the **Apply** button.

Or

- 4 Toggle the **USBL** radio button to interrogate all enabled transponders and click the **Apply** button.

As points are collected, the **Points in Memory** text will update and, if the **Graphics On** is selected, the data collection points will display in the **Graphics** windows.

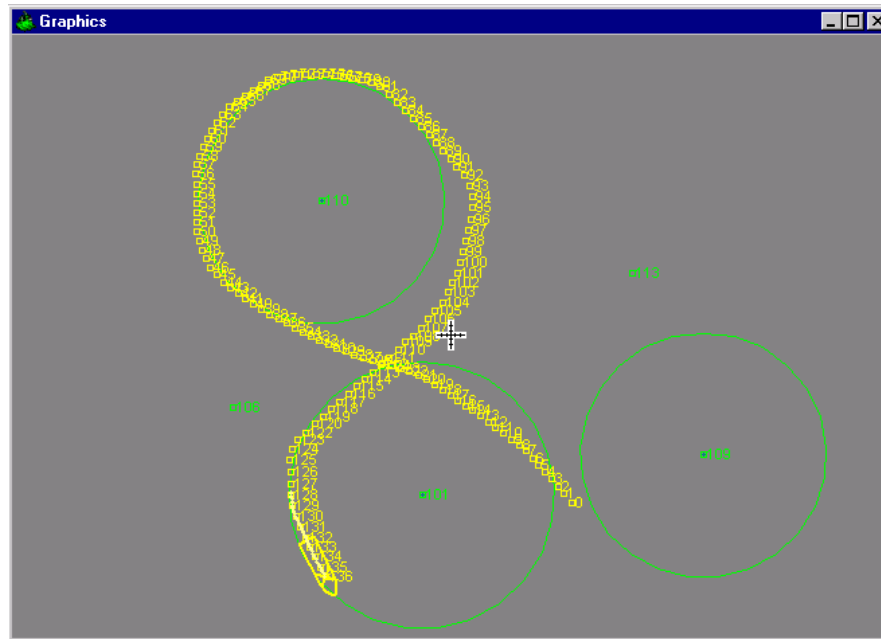
New data will not be collected until the minimum time has elapsed and then only when the next data set is received.

- 5 When data collection is complete, or at any time the collection is to be suspended, toggle the **Off** radio button and click the **Apply** button.

It is important to note that data collection can be suspended and resumed at any time. In addition, an existing data file can be loaded and data collection turned on to add more calibration data.

Note: Because WinFrog does not write the calibration data directly to disk as it is collected, it is very strongly recommended that the data be regularly saved to a file during the collection process. As mentioned above, when data are saved to an existing file, the contents of that file are replaced with the complete data currently in memory. Thus, though this provides an easy technique for repeatedly saving the data to the same file during the data collection process, care must be exercised to ensure that the correct file is selected.

The next figure illustrates a calibration collection in progress based upon the track plan shown previously. Note the rings around the transponder locations to assist the vessel in maintaining the required distance from the transponders.



WinFrog Setup for LBL Calibration Baseline Data Collection

If the LBL system being used is capable of measuring baselines between transponders (for example, Sonardyne's PAN with their COMPATTs), you can configure WinFrog to initiate the measurement of these baselines and log them with the rest of the calibration data.

In the **Calibration** dialog box, turn off current data collection. Click on the **Setup** button associated with LBL Baselines. The next figure shows the baseline configuration options.

WinFrog provides the option to select between a manually controlled baseline measurement process or an automated baseline measurement process. Although the automated option is the simplest to implement, it is recommended that it only be used in a good acoustical environment.

Xponder	Selection of this option enables you to manually select the transponder stations to measure between (from/to). The associated From and To dropdown lists present those transponders in the Xponder file that are available for baseline measurements, i.e. set to LBL Fixed . WinFrog initiates the measurement of this baseline and stops when this is completed. You must then re-enter this dialog box to setup for the next baseline measurement.
Network	Selection of this option allows you to select the network within which baselines will be measured. WinFrog then automatically steps through this network measuring all possible baselines. When all of the possible baselines have been measured, the process is completed and stops. Note: in a poor acoustic environment, this approach can produce a lot of non-measurements resulting in potentially more operator intervention than if the baselines were configured manually.
Measurements per Xponder	Enter the number of times the baseline configured is to be measured.
Forward	The selected baseline is measured Forward only, i.e. only from the From to the To transponder.
Reverse	The selected baseline is measured in Reverse only, i.e. only from the To to the From transponder.
Both	The selected baseline is measured first Forward and then in Reverse .

Once the baseline setup is complete, exit this dialog using **OK**. In the **Calibration** dialog box, make sure to toggle the **LBL Baselines** option and click the **Apply...** button. At this time, the **Apply** button will display **Pause Baseline Collection**. If you wish to pause the process, click this button. If the baseline measurement process has been paused, this button will display **Restart Baseline Collection** until it is pushed again to resume collecting baselines. To halt the baseline collection before the set is complete, select the **Off** radio button and click **Apply**.

You are informed of the completion or abortion of the baseline measurement cycle with a message to the right of the Setup button.

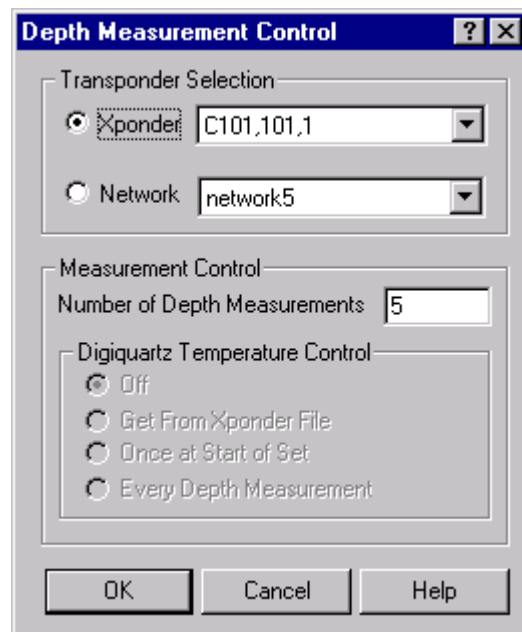
Note When collecting baselines, WinFrog performs the following automated editing:

- The standard deviation (weight) assigned to a baseline is based upon the acoustic frequency in use
 - LF, 0.5m
 - MF, 0.15m
 - HF, 0.04m
 - EHF, 0.02m
- If a baseline observation is flagged with an error, it is de-weighted.
- If a zero baseline is detected, it is considered a failed observation and de-weighted
- If a baseline that is not with +/- 50% of the expected baseline distance it is considered a failed observation and de-weighted.

WinFrog Setup for LBL Calibration Depth Data Collection

If the LBL system being used is capable of measuring the depths of the transponders (for example, Sonardyne's PAN with their Compatts), you can configure WinFrog to initiate the measurement of the depths and log them with the rest of the calibration data.

In the **Calibration** dialog box, turn off current data collection. Click on the **Setup** button associated with Depths. The next figure shows the depth configuration options.



WinFrog provides the option to select between a manually controlled depth measurement process or an automated depth measurement process. Like the case of baseline observations, although the automated option is the simplest to implement, it is recommended that it only be used in a good acoustical environment.

Transponder Selection

Xponder

Selection of this option enables you to manually select the transponder stations to measure depths for. The associated dropdown list presents those transponders in the **Xponder** file that are available for depth measurements, i.e. set to **LBL Fixed**. WinFrog initiates the measurement of this depth and stops when it is completed. You must then re-enter this dialog box to setup for the next depth measurement.

Network

Selection of this option allows you to select the network within which depths will be measured. WinFrog then automatically steps through this network measuring all depths. When all the possible depths have been measured, the process is completed and stops.

Measurement Control

Number of Depth Measurements

Enter the number of times the depths configured are to be measured.

Digiquartz Temperature Control

If the selected transponder is configured for a digiquartz depth sensor, or if any of the transponders in the selected network are configured for a digiquartz depth sensor, the following options are available to configure the collection of the required Temperature count data.

Off

The Temperature Count query is never issued for the transponder.

Get From Xponder File Once at the Start of Set

Future development.

The Temperature Count query is sent once at the start of each depth measurement set. If set to interrogate the network, each transponder is queried before proceeding with the depth queries.

Every Depth Measurement

Each depth query is accompanied by a Temperature Count query. This is very time consuming and should only be used if deemed to be necessary.

Once the depth setup is complete, exit this dialog using **OK**. In the **Calibration** dialog box, make sure to toggle the **Depth** option and click the **Apply...** button. At this time, the **Apply** button will display **Pause Depth Collection**. If you wish to pause the process, click this button. If the depth measurement process has been paused, this button will display **Restart Depth Collection** until it is pushed again to resume collecting depths. To halt the depth collection before the set is complete, select the **Off** radio button and click **Apply**.

You are informed of the completion or abortion of the depth measurement cycle with a message to the right of the Setup button.

LBL Data Collection - Monitoring

The number of points collected are displayed in the Calibration configuration dialog box. However, the data collection process is best monitored with the **Calibration Status** window in the **Acoustic Window** (see the **Operator Display Windows** section). Alternatively, the calibration summary data can also be viewed via the **Calibration** dialog box by clicking the **Edit Data** button (see **LBL Calibration Data Editing**). LBL Data Collection - General Issues

It is important to stress the versatility of the WinFrog calibration process, both the data collection and the processing. It is not necessary to perform the data collection in a set sequence, be this all data for a specific transponder uninterrupted by data associated with another transponder, or all the ranges and then all the baselines.

The calibration files (*.cal) are written to disk using ASCII text and, as such, are easily accessible and readable. The format for these files is found in the **WinFrog File Formats** appendix.

Note: once the data collection is completed, the original calibration data file should be archived and set to read only. A copy is then made for actual use in WinFrog. In this way, you always have recourse to the original data file if necessary.

LBL Calibration Data Editing

The editing of the data can be performed at any stage when data are present in WinFrog memory, whether loaded from an existing file or logged during a data collection process.

The purpose of viewing and editing the data is to locate and remove those data that are considered to be invalid. WinFrog provides graphical editors that enable easy inspection of the data, detection of any trends, and direct editing capabilities. The graphical editors allow you to view the LOP data directly and the LOP residuals. The former is best used for investigating trends and visually detecting outliers, usually visible due to the break in the trend, especially prior to any calibration calculations. The latter is valuable for refining the editing in subsequent iterations.

Note: the term **editing the data** consists of setting the weighting value for any given LOP and changing data item offsets. You do not have access to the actual data for the purpose of altering values. The only exception to this is the Temperature Count value used for reducing digiquartz data to a depth.

An initial review of the data should be made prior to any calibration calculations. The purpose of this review is to find obvious flyers and bad data and to remove them from the solution immediately. Then, after each calibration solution, the data should be viewed again for analysis and any further required editing.

Viewing and Editing the Data – The Calibration Station Window

From the **Calibration** dialog box, click the **Edit Data** button. (This button is only available if there are data present in memory).

Calibration for Vehicle1

Data Collection/Control

☒ Off Apply Data Collection Setup Now

☐ LBL Ranges 55 Points in Memory

☐ II Ranges Clear

☐ USBL Data Min Interval (seconds)

Graphics

☐ On ☒ Off

☐ LBL Baselines Setup

☐ Depths Setup

Data Load/Save

Current File

Load Save AutoSave AutoSave Off

Calibration Calculations

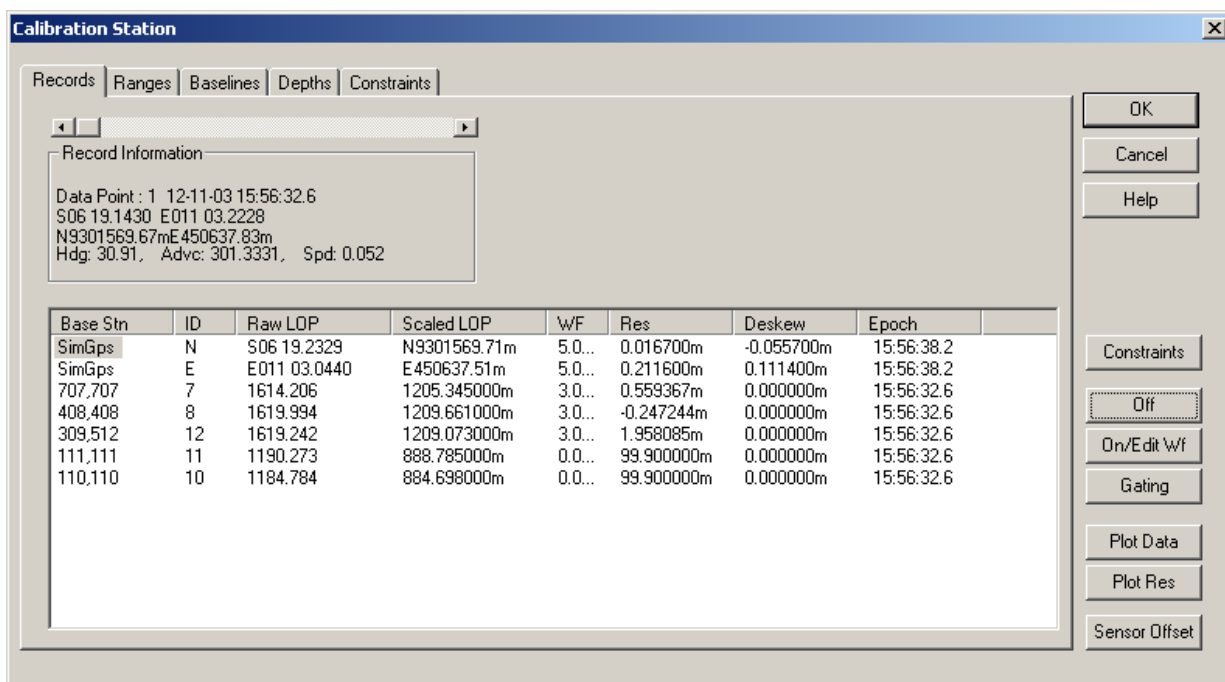
Edit Data Recalc LBL Xpdr Report

Calculate Reset USBL USBL Report

Statistics Recalc USBL Edit Xponder

OK Cancel Help

WinFrog opens a **Calibration Station** dialog box as shown in the next figure. You can view all LOPs in the Calibration data set alphanumerically from this dialog. The example here shows the display of vessel position and LBL ranges or Lines of Position (LOPs).



The Calibration Station dialog box presents you with several options for viewing the calibration data. The available editing options accessed via the buttons located on the right side of the dialog depend on the tab selected, and in the case of the **Records** tab, the type of LOP selected.

To edit an LOP, simply select it and click the appropriate button on the right. Make the editing changes as required and exit the editing dialog with **OK** to save the editing changes or **Cancel** to discard any changes made.

The following details the options available and the associated windows and dialog boxes.

Constraints

If constraints have been added to the calibration, clicking this button will automatically find the Constraint data and display it in this dialog. This button is present only if constraints have been added to the data set. This option is only available with the **Records** tab.

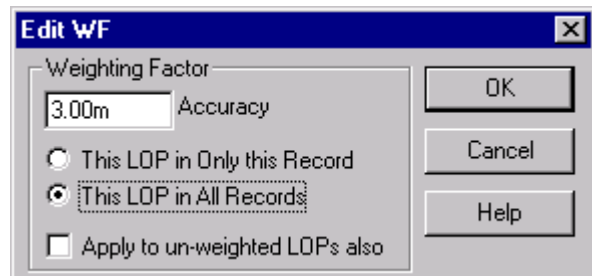
Off

This simply sets the weighting factor for the selected LOP to 0, which de-weights it from the solution. This option is only available with the **Records** and **Constraints** tabs. When associated with a constraint, this toggles it between applied and not applied.

On/Edit Wf

This enables you to edit the actual weighting factor for the selected LOP. This

control extends to applying the new weighting factor to the selected LOP in the displayed epoch only, or in all epochs in which this LOP is present. You can also control if the new weighting factor is to be applied to those LOPs already de-weighted. The next figure shows the associated dialog box.

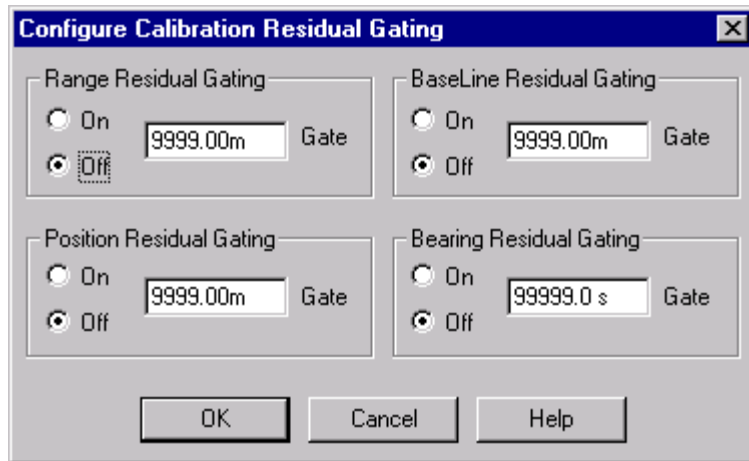


Note: When a tab other than **Records** is selected, the **This LOP in Only this Record** option is not applicable and is disabled.

Gating

This enables you to apply **residual gating** to the **complete** data set based on the current results. This is a powerful tool for quickly editing out flyers, but it can also edit out good data and leave in bad if applied incorrectly. It is important to note the following points:

- The gating is only applied when this option is accessed and exited with **OK**.
- The gating is applied based upon the current residuals. If the gating is applied before any editing or any processing of solutions, the residuals will be based upon approximate transponder coordinates and as a result, the gating may have unexpected and erroneous results.
- If the gating is turned off for any LOP type and the dialog is exited with **OK**, all LOPs of that type will be re-weighted into the solution if they contain a non-zero value. The next figure shows the **Residual Gating** options.



This option is only available with the **Records** tab.

Plot Data button

Click this button to access a graphical editor for all of the instances of the selected LOP in the Calibration data set. See **Using the Plot Panel: LOPs** section later in this chapter for details on this editing window.

Plot Res(iduals) button

Click this button to access a graphical editor for the residuals for all instances of the selected LOP in the Calibration data set. See **Using the Plot Panel: Residuals** later in this section for details on this editing window.

Sensor Offset button

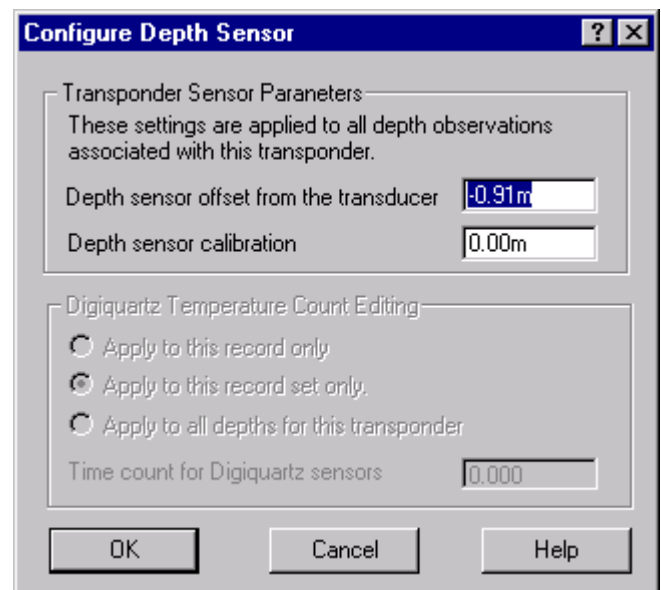
This button is only available for those data records involving sensor offsets, specifically Position, LBL and USBL Surface Range and Transponder Depth LOPs. It allows you to change the offsets for any sensor involved in the LBL calibration. This provides for corrections in the case of incorrect configuration of the system prior to data collection. You can enter the new offsets and then select whether to apply them to the associated system for the current epoch only or for all epochs. This option is only available with the **Records** and **Ranges** tabs.

The following shows the **Cal System Offsets** dialog for those LOPs associated with surface observations, i.e. ranges and position LOPs.



Note: In the case of USBL observations, this only affects the WinFrog offsets. The USBL system offsets entered as part of the **USBL HYDROPHONE** data item configuration cannot be edited. In addition, offsets applied when a USBL slant range LOP is selected are appropriately applied to all LOPs associated with the selected LOP's system.

The following shows the **Configure Depth Sensor** dialog for the depth LOPs.



For all depth sensors, you can modify the offset used to associate the sensor location with the transponder's transducer. In addition, a calibration value can be entered. For details on these settings, refer

to the **Working Xponders** sections in the **Working Files** chapter. These changes are applied to all depth LOPs associated with this station and transponder.

If the depth sensor is a digiquartz sensor, you have the additional option of entering a new temperature count value and selecting whether to apply it to the reduction of the raw depth observation for the selected depth LOP only, or to all the depths LOPs in the associated record, or to all depths associated with this station and transponder.

After each major stage of data editing, it is recommended that you save the calibration file to disk. You should give each calibration file a unique name (i.e., the name can have a lettering or numbering code or even a short descriptive message appended indicating the processing stage represented by the file) so that it does not write over a preceding copy of the same calibration set. When given a unique name, at any point in the processing you wish to return to a known point or state in the editing and calculation process, you can reload the appropriate file and resume the processing from that point.

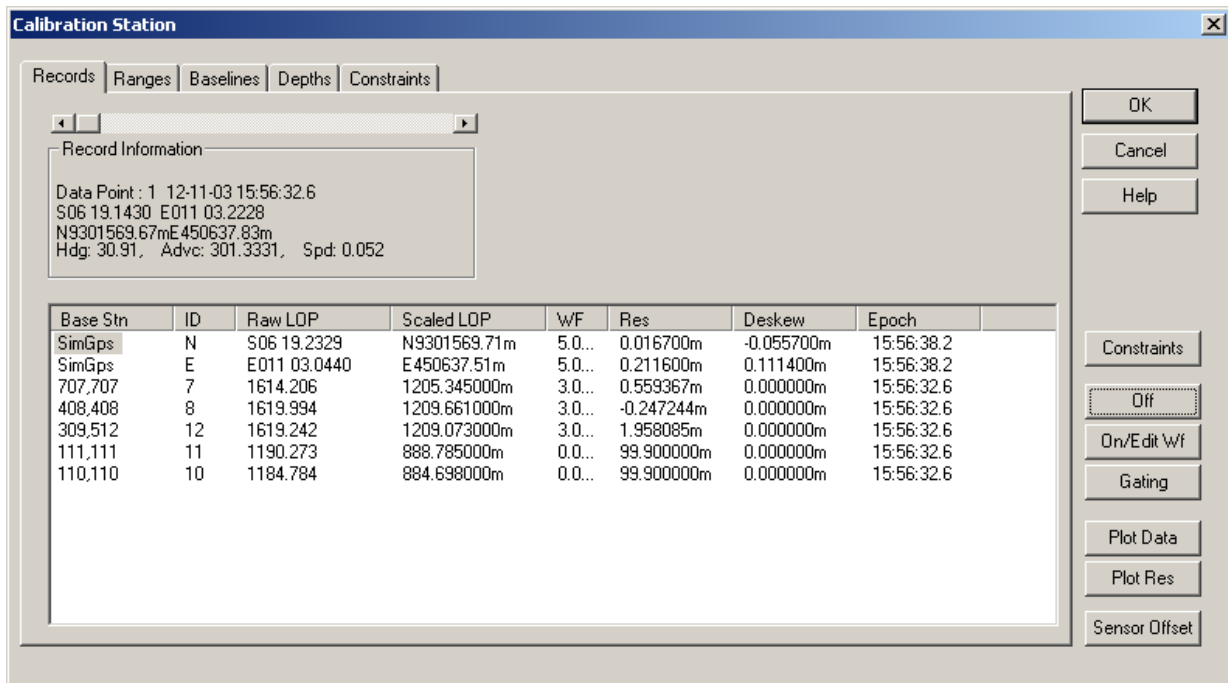
Records Tab

This tab is in two sections. A slider bar located in the top left allows you to go scroll through the complete data set essentially in chronological order. As you move the slider, the data for the respective calibration record displays. Also in the top left panel is the summary of the data record. This information varies depending upon the data item being viewed.

The second section is the data panel itself. The List View window presents the LOPs contained in the currently selected record. Again, this varies depending upon the data item of the selected record.

LBL Calibration Data Editing – LBL Position and Range LOPs

The components of the Calibration Station window when viewing a Position and LBL Range record are as follows:



Data Point Selection

This section is the top left panel and provides you with the option of scrolling through the complete data set using the slider bar. The position information for the vehicle used to collect the data for the selected epoch is displayed in this panel.

- Line 1** The calibration point number and the date and time for the selected point.
- Line 2** The geographic coordinate for vehicle's CRP on the working ellipsoid.
- Line 3** The map grid coordinate for the vehicle's CRP.
- Line 4** The vehicle's heading, CMG, and speed in knots.

Data Point Summary

This section is the lower, larger panel and presents the data (LOPs) collected at the selected epoch in a list window. **Note:** the list window does not support sorting; the data are displayed in the order that the data items are added to the calibration file. It is also important to note that the selection of an LOP is only possible from the first column. The order does not affect the calibration processing.

A single position data item provides two LOPs, a latitude and a longitude.

An LBL data item provides as many LOPs as there were transponders that were logged at a given epoch.

Base Stn	This lists the name of the LOP. In the case of a position LOP, the name of the associated device is shown, in the case of a range LOP (transponder), the name of the station and address of the transponder are listed.
ID	This lists the associated ID of the LOP. In the case of a position LOP, it is the denotation of either N(orthing) or E(asting). In the case of an LBL range LOP, it is the transmit channel or frequency of the transponder.
Raw LOP	This is the raw LOP, or actual data, logged for the LOP. For a position LOP it is the WGS 84 latitude and/or longitude. For an LBL range LOP, it is the two way travel time in milliseconds.
Scaled LOP	This is the scaled LOP, or data reduced to the map projection. In the case of a position data item, the WGS 84 position is transformed to the working ellipsoid and then projected onto the working map projection. For an LBL range LOP, the data are corrected for any time delays, reduced to a one way travel time, converted to a distance using a calculated sound velocity, and then projected onto the map grid.
WF	This is the weighting factor used for the LOP in the solution.
Res	This is the residual of the LOP for the selected epoch.
Deskew	The individual LOPs collected for a given calibration epoch are actually valid for different times. The calibration point epoch is defined by the LBL data epoch and, therefore, the deskew time for an LBL range LOP is always 0. Other LOPs are then deskewed to that epoch, using velocity vectors generated as part of the standard real-time positioning,

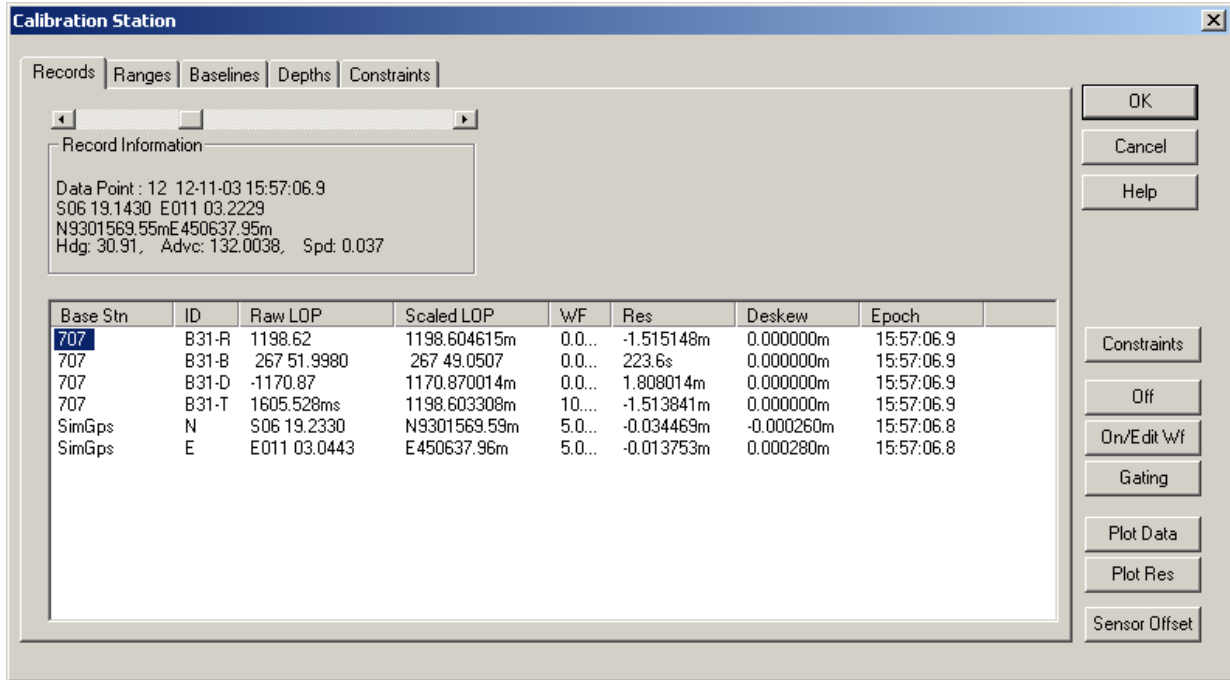
and processed and logged with the calibration data.

Epoch

This is the time stamp for the LOP.

LBL Calibration Data Editing – USBL Position and Range LOPs

LBL calibrations can include surface ranges from a USBL system. The following shows the **Records Tab** for this data item.



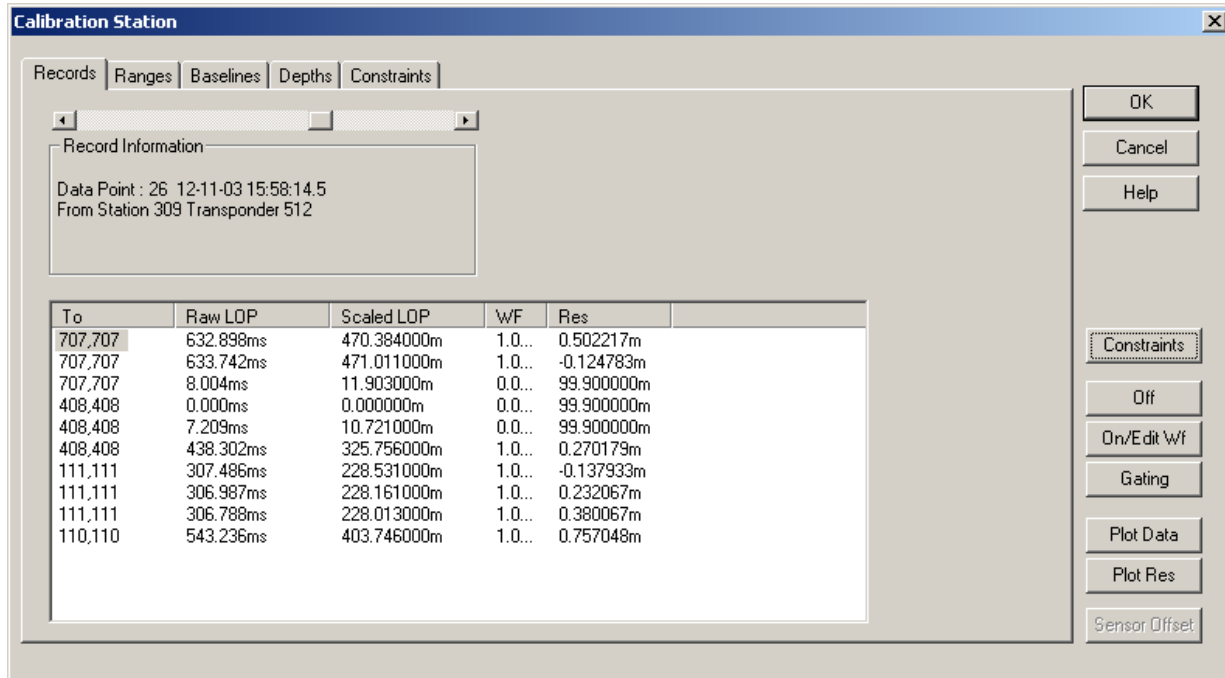
The display and editing of the USBL epoch is the same as that for the LBL epoch. The exception to this is the display of the USBL data itself. The USBL data recorded by WinFrog consists of the XYZ data directly from the USBL device, corrected for the USBL system offsets as entered into WinFrog for the respective **USBL HYDROPHONE** data item. The data is listed as 3 LOPs in this dialog, the calculated **slant range**, calculated **bearing**, and the **depth**. If the USBL system used supports the output of travel time data, this is presented as a 4th LOP similarly to the LBL surface range travel time. The LOP type is indicated in the **ID** column where the character appended to the beacon code describes the LOP as follows:

R = Range, B = Bearing, D = Depth and T = TWT'T.

Note: Even if the travel time data is provided by the USBL system as a one-way travel time, WinFrog converts this to a two-way travel time (TWT'T) value in milliseconds to conform to the process already in place for standard LBL observations.

LBL Calibration Data Editing - Baseline LOPs

The components of the **Calibration Station** window when a baseline record is being viewed are as follows:



Data Point Selection

This section, within the top left panel, provides you with the option of scrolling through the complete data set using the slider. In addition, the basic record information is displayed in this panel.

Line 1

The calibration point number and the date and time for the first baseline logged in the selected record.

Line 2

The name of the **From** Station and the address of the transponder.

Data Point Summary

This section is the lower, larger panel and presents the data (LOPs) that make up this record in a list window. **Note:** the list window does not support sorting; the data are displayed in the order that the data items are added to the calibration file. It is also important to note selection of an LOP is only possible from the first column.

To

This lists the name of the **To** station and the address of the transponder.

Raw LOP

This is the raw LOP (the observed

Scaled LOP

two way travel time in milliseconds)
logged for the LOP.

This is the scaled LOP, the observed LOP corrected for turn-around-time, reduced to a one way travel time, converted to a distance using a calculated sound velocity and then projected onto the map projection.

WF

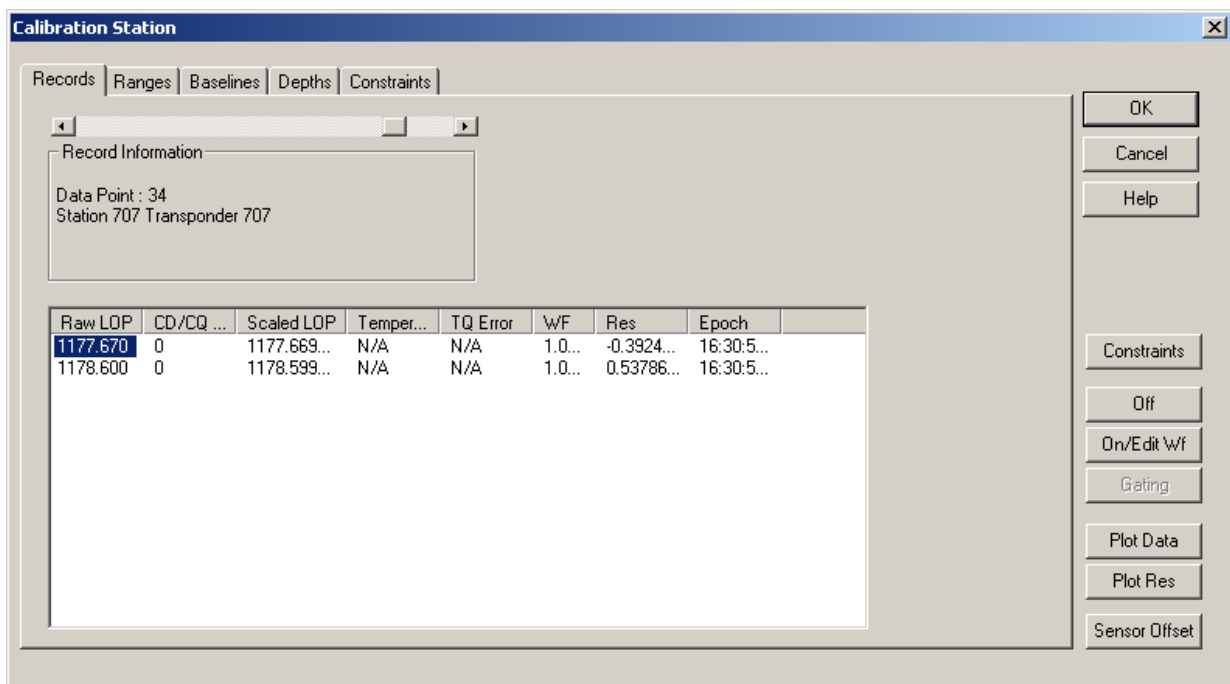
This is the weighting factor used for the LOP in the solution.

Res

This is the residual for the LOP.

LBL Calibration Data Editing - Depth LOPs

The components of the **Calibration Station** window when a depth record is being viewed are as follows:



Data Point Selection

This section, within the top left panel, provides you with the option of scrolling through the complete data set using the slider. In addition, the basic record information is displayed in this panel.

Line 1

The calibration point number.

Line 2

The name of the Station and the address of the transponder.

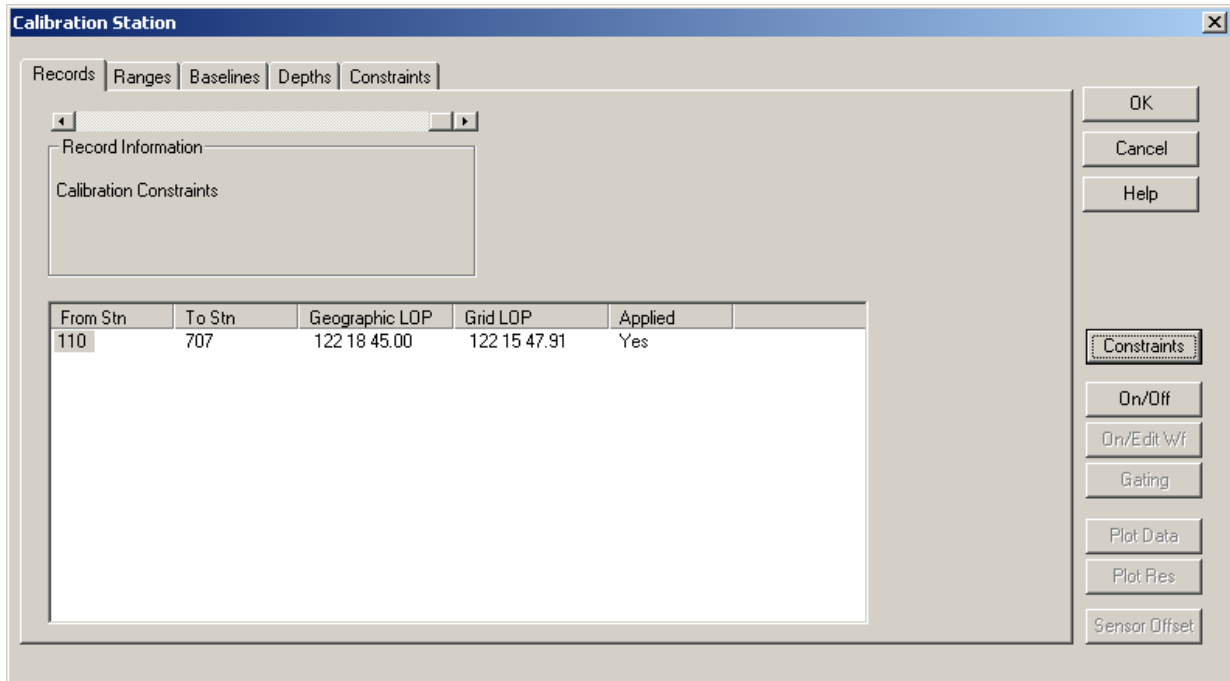
Data Point Summary

This section is the lower, larger panel and presents the data (LOPs) that make up this record in a list window. **Note:** the list window does not support sorting; the data are displayed in the order that the data items are added to the calibration file. It is also important to note selection of an LOP is only possible from the first column.

Raw LOP	This is the raw LOP. If the sensor is a strain gauge depth sensor, this is the observed depth value in metres. If the sensor is a digiquartz depth sensor, this is the count of the frequency output of the sensor.
CD/CQ Error	This is the error state of the associated query, 0 indicates no error.
Scaled LOP	This is the scaled LOP, the observed data reduced to represent the depth of the station monument (see the Working Xponders section in the Working Files chapter).
Temperature Count	This is the temperature count value associated with the digiquartz observation. If the sensor is a strain gauge, N/A is displayed.
TQ Error	This is the error state of the query for the temperature count, 0 indicates no error. If the sensor is a strain gauge, N/A is displayed.
WF	This is the weighting factor used for the LOP in the solution.
Res	This is the residual for the LOP.
Epoch	This is the time stamp for the depth query.

LBL Calibration Data Editing - Constraints

The components of the **Calibration Station** window when a constraint record is being viewed are as follows:



Data Point Selection

This section, within the top left panel, provides you with the option of scrolling through the complete data set using the slider. In addition, the basic record information is displayed in this panel.

Line 1	Calibration Constraints
Line 2	Blank
Line 3	Blank
Line 4	Blank

Data Point Summary

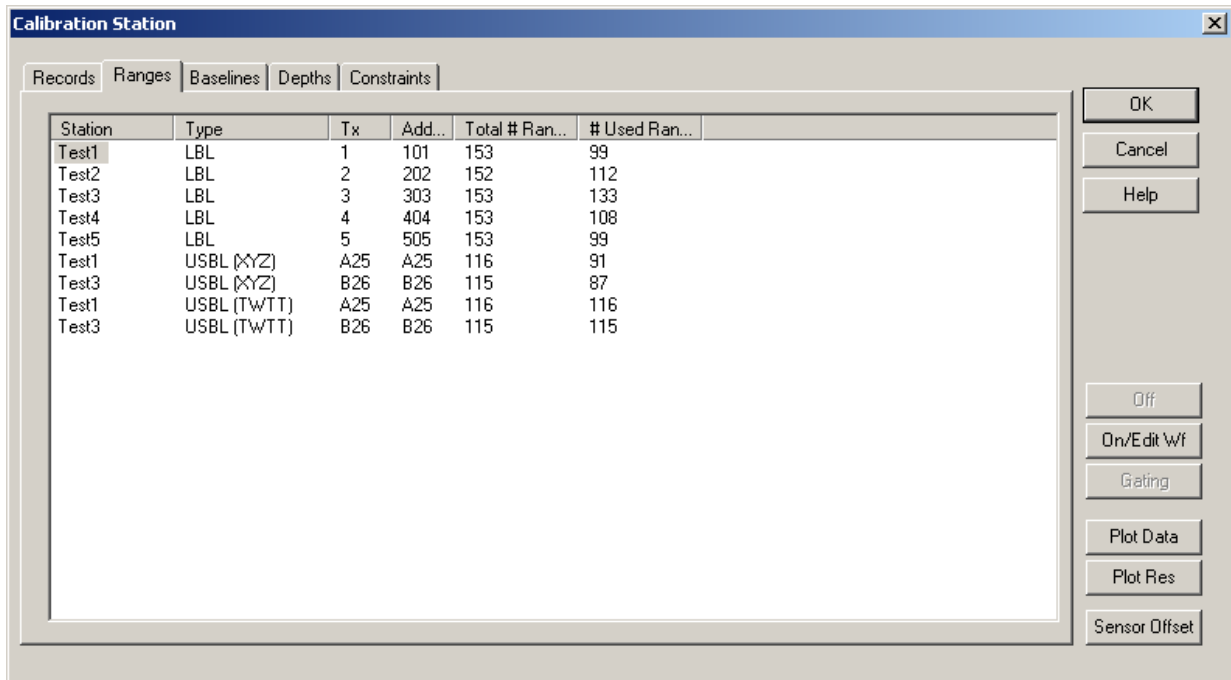
This section is the lower, larger panel and presents the data (LOPs) that make up this record in a list window. **Note:** there are no sort capabilities available, the data are displayed in the order that they were collected. It is also important to note selection of an LOP is only possible from the first column.

From Station	This lists the name of the From station.
To Station	This lists the name of the To station.
Geographic LOP	This is the constraint on the working ellipsoid.
Grid LOP	This is the constraint on the Map Projection.
Applied	This is the Applied status, either Yes or No .

The only editing options associated with a Constraint LOP from this window is to toggle the **Applied** status between **Yes** and **No**. This is accomplished by selecting the appropriate constraint LOP and clicking the **On/Off** button.

Ranges Tab

This tab allows you to view a summary of all surface ranges observed and contained in the calibration file. The information presented is detailed here.



Station	Type	Tx	Add...	Total # Ran...	# Used Ran...
Test1	LBL	1	101	153	99
Test2	LBL	2	202	152	112
Test3	LBL	3	303	153	133
Test4	LBL	4	404	153	108
Test5	LBL	5	505	153	99
Test1	USBL (XYZ)	A25	A25	116	91
Test3	USBL (XYZ)	B26	B26	115	87
Test1	USBL (TWTT)	A25	A25	116	116
Test3	USBL (TWTT)	B26	B26	115	115

Station

The name of the **Xponder** station observed to.

Type

The surface range may be a standard LBL TWTT (**LBL**) observation, a USBL XYZ based observation (**USBL (XYZ)**) or a USBL travel time observation (**USBL (TWTT)**).

Tx

The transmit channel (or frequency) or beacon ID of the **Xponder** station observed to.

Address

The address of the **Xponder** station observed to, which in the case of a USBL beacon duplicates the ID.

Total # Ranges

The total number of observations made to the **Xponder** station.

Used Ranges

The total number of observations made to the **Xponder** station that are weighted into the solution.

The range data summaries are sorted by type (LBL, USBL derived from XYZ and USBL TWTT). Within each of these subsets, the summaries are sorted by station name and, for cases of double occupancy, then by address or beacon code depending upon the data item. Thus, the order they are displayed in will remain constant for a given calibration file.

Baselines Tab

This tab allows the operator to view a summary of all the baselines observed and contained in the calibration file. The data for each baseline pair is given in two lines in the window, one line for forward and one line for reverse. This provides a more complete review of the data for analysis. The baseline summaries are generated from the baseline data. To provide consistency in the presentation, thus facilitate evaluation, the summaries are created and sorted as follows:

- For a given baseline pair, regardless of the direction any of the observations are actually made, the **FORWARD** direction is always from the station whose name is alphanumerically less than the other. For example, given a baseline pair with the stations *Transponder 1* and *Transponder 2*, **FORWARD** is from *Transponder 1* to *Transponder 2*.
- The primary sorting of baseline pairs is based on the **FROM** station name. In the case of stations with the same name (double occupancy), these are further sorted based on the **FROM transponder's** address.
- The secondary sorting of baseline pairs is based on the **TO** station name. In the case of stations with the same name (double occupancy), these are further sorted based on the **TO transponder's** address.

This results in the display of the baseline summary data for a given calibration file to always be in the same order with the same convention for forward and reverse, regardless of the order or direction the data is collected in or subsequent editing actions. This is also true for the display of this summary information in the **CALIBRATION STATUS** window (see **ACOUSTIC WINDOW section in the OPERATOR DISPLAY WINDOWS** chapter).

The information presented is detailed here.

Note: The summary includes baselines of zero length if any were observed. These are considered to be failed observations.

Calibration Station										
Records Ranges Baselines Depths Constraints										
From Stn	Add/Tx	To Stn	Add/Tx	Dir	# Good	# Failed	# Weig...	Mean Raw	Mean Red	Expected
Test1	101/1	Test2	202/2	Fwd	2	3	2	307.182	227.991m	228.333m
				Rev	2	3	1	307.865	228.498m	
Test1	101/1	Test3	303/3	Fwd	4	1	3	484.802	359.821m	359.758m
				Rev	3	2	3	485.901	360.637m	
Test1	101/1	Test4	404/4	Fwd	1	4	1	492.265	365.361m	366.851m
				Rev	2	3	2	493.721	366.441m	
Test1	101/1	Test5	505/5	Fwd	4	1	4	252.079	187.094m	187.228m
				Rev	3	2	2	252.153	187.149m	
Test2	202/2	Test3	303/3	Fwd	3	2	3	347.422	257.857m	257.166m
				Rev	5	0	5	345.426	256.376m	
Test2	202/2	Test4	404/4	Fwd	3	2	3	504.637	374.543m	375.039m
				Rev	1	4	1	504.125	374.163m	
Test2	202/2	Test5	505/5	Fwd	5	0	4	545.440	404.827m	405.450m
				Rev	4	1	4	546.231	405.415m	
Test3	303/3	Test4	404/4	Fwd	2	3	2	242.805	180.211m	180.075m
				Rev	2	3	2	241.211	179.027m	
Test3	303/3	Test5	505/5	Fwd	4	1	3	615.273	456.657m	456.948m
				Rev	3	2	3	616.271	457.398m	
Test4	404/4	Test5	505/5	Fwd	3	2	2	515.514	382.615m	383.465m
				Rev	3	2	3	516.372	383.253m	

From Stn

The name of the **From Xponder** station in the baseline pair.

Add/Tx

The address and transmit channel (or frequency) of the **From Stn**.

To Stn

The name of the **To Xponder** station in the baseline pair.

Add/Tx

The address and transmit channel (or frequency) of the **To Stn**.

Dir

Describes the observation direction for that line of data in the window for the given baseline pair, either forward (**Fwd**) or reverse (**Rev**).

Good

The total number of successful baseline observations. Note that being successful does necessarily mean that the observations themselves were good or valid.

Failed

The total number of failed baseline observations.

Weighted

The total number of baseline observations currently weighted in the solution.

Mean Raw

The mean raw observation (TWTT) of those baselines weighted into the solution.

Mean Red

The mean reduced baseline (slant range) of those baselines weighted into the solution.

Expected

The calculated baseline (slant range) length.

Depths Tab

This tab allows the operator to view a summary of all the depths observed and contained in the calibration file.

The depth summaries are sorted by station name. In the case of stations with the same name (double occupancy), a secondary sorting based on the station's transponder address is done. This normalizes the presentation of the data to facilitate evaluation, both in this tab and the **CALIBRATION STATUS** window (see **ACOUSTIC WINDOW** section in the **OPERATOR DISPLAY WINDOWS** chapter).

The information presented is detailed here.

Station	Address	Tx	Digi...	# Attempted	# Succes...	# Weighted	Mean Raw	Mean Depth	Expected
Test1	101	1	No	5	4	4	101.450	100.540m	101.000m
Test2	202	2	No	5	4	4	102.775	101.865m	102.000m
Test3	303	3	No	5	4	2	104.050	103.140m	103.000m
Test4	404	4	No	5	4	4	104.925	104.015m	104.000m
Test5	505	5	No	5	4	3	106.033	105.123m	105.000m

Station

The name of the **Xpounder** station.

Address

The address of the transponder.

Tx

The transmit channel (or frequency) of the transponder.

Digiquartz

Indicates if the depth sensor is a digiquartz.

Attempted

The total number of attempts made to observe a depth.

Successful

The total number of successful depth

observations. Note that being successful does necessarily mean that the observations themselves were good or valid.

Weighted

The total number of depth observations currently weighted in the solution.

Mean Raw

The mean raw observation of those depths weighted into the solution.

Mean Red

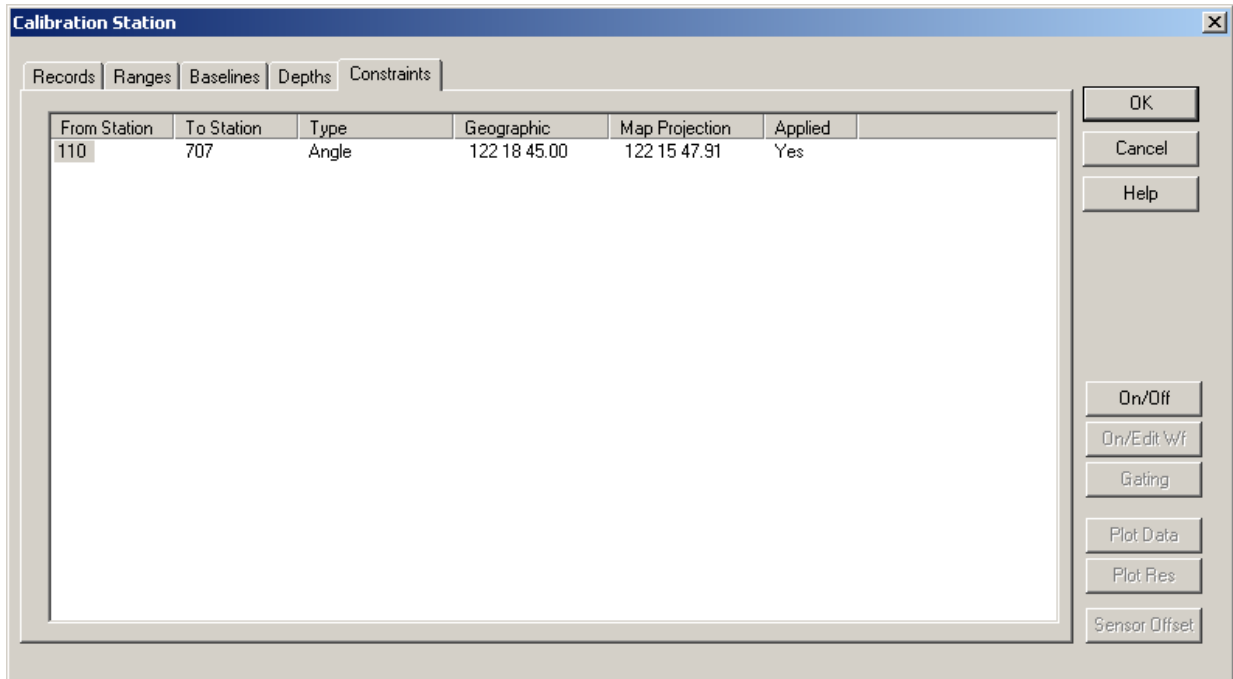
The mean reduced depth of those weighted into the solution.

Expected

The calculated depth.

Constraints Tab

This tab allows the operator to view a summary of all the constraints added to the calibration file. The information presented is detailed here.



From Station

The name of the **From Xponder** station in the constraint pair.

To Station

The name of the **To Xponder** station in the constraint pair.

Type

The type of constraint, either **Angle** (azimuth) or **Distance**.

Geographic

The constraint on the working ellipsoid.

Map Projection

The constraint projected onto the Working Map Projection.

Applied

Shows whether or not the constraint is enabled (**Yes**) or not (**No**).

Using the Plot Panel: LOPS - Position and Surface Ranges

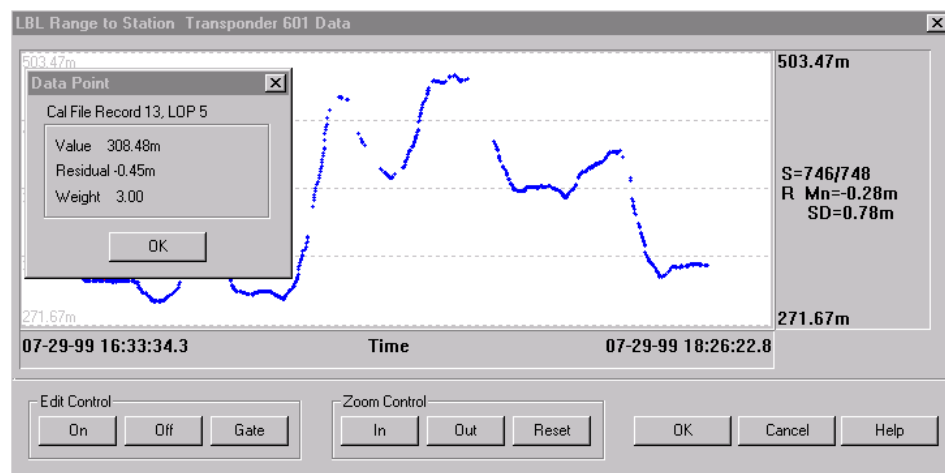
When the **Plot Data** button in the **Calibration Station** window is clicked with a Position or LBL range LOP selected, the following graphical editor is opened. In the case of a USBL range or bearing LOP, a prompt pops up asking if you wish to plot **X** or **Y** data respectively.



Answering **Yes** to either of these prompts results in the graphical editor plotting the scaled X or Y data used to produce the scaled range and bearing LOPs. Answering **No** results in the graphical editor plotting the scaled range and bearing LOPs respectively. The viewing of the X and Y data is representative of viewing the components of the bearing LOP in greater detail. This provides for comprehensive data viewing and editing options.

Note: it is recommended that you view the slant range or TWTT residuals when editing USBL data for the determination of a beacon position.

The LOP data are plotted as LOP (Y axis) versus epoch time (X axis). This provides a valuable visual editing tool as the data trends are clearly evident and breaks in trends indicating problems can easily be seen and examined. Outliers are also easily detected. Data that are weighted in the solution are drawn in blue; those that are de-weighted are drawn in red.



Time Axis

The time axis (horizontal) is labeled with the time/date for the left and right most extents of the window. When the panel is originally drawn and on a **Reset** (see below) this axis is extended 10% of the total time span before and after the actual data time span.

LOP Axis

The LOP axis (vertical) is labeled with the LOP value for the top and bottom, along with the summary of the LOPs. This summary includes the number of LOPs weighted in the solution and the total number of LOPs in the data set, and the mean residual and its standard deviation based upon those LOPs currently weighted in the solution. When the panel is originally drawn and on a **Reset** (see below) this axis is extended 10% of the total LOP values span at top and bottom.

Point Exam

Double-click the left mouse button in the plot panel to cause WinFrog to locate the closest data point and display the information for that point in a message dialog box, as shown in the above figure.

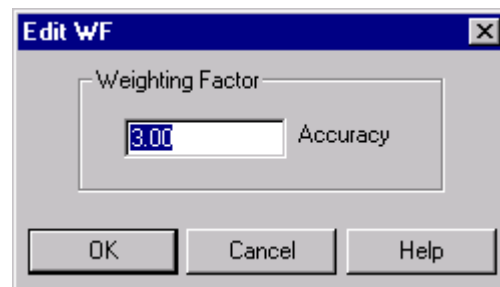
Windowing

Using the left mouse button (click and drag) you can draw a window in the plot panel. This provides WinFrog with the outline of the area in which to perform subsequent actions, as detailed below.

Edit Control

On

If an area of the plot panel has been selected, you are presented with the option to enter a weighting factor to be applied to all points in the selected area. The next figure shows the associated dialog box.

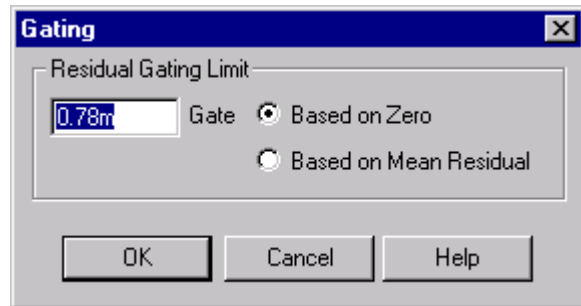


Off

If an area has been selected in the plot panel, all LOPs in that area will be de-weighted (weighting factor set to 0).

Gate

This allows you to apply gating to a specific LOP. This is preferred over blindly applying gating to the complete data set, as described above. The gating is applied to the data in a selected area or if an area in the plot panel has not been selected, to the complete LOP set. The next figure shows the options available for the gating.



You can enter the gating value and then select the application of the gate value. If **Based on Zero** is selected, any LOP whose residual is outside $\pm$ gate is de-weighted. If the **Based on Mean Residual** option is selected, any LOP whose residual is outside the mean residual $\pm$ gate is deweighted. The default gate is the standard deviation for the residuals for the respective weighted LOPs.

Zoom Control

In

If an area has been selected in the plot panel, this area is drawn to the extents of the display. Otherwise the plot panel is zoomed in by a factor of 2 vertically. The horizontal time span remains the same.

Out

Regardless of whether an area is selected in the plot panel, this causes a zoom out of 10% vertically. The horizontal time span remains unchanged.

Reset

Re-draws the plot panel to the original coverage.

To close the window and apply all changes made with this editor, click **OK**. Clicking **Cancel** closes the window, discarding all changes made.

Note: If the data being viewed is a USBL XYZ based LOP (i.e., a calculated slant range, X, bearing, Y or depth LOP but not the TWTT LOP), and LOPs are de-weighted in the above process, the associated XYZ based LOPs are automatically de-weighted. This does not apply to the weighting in of LOPs.

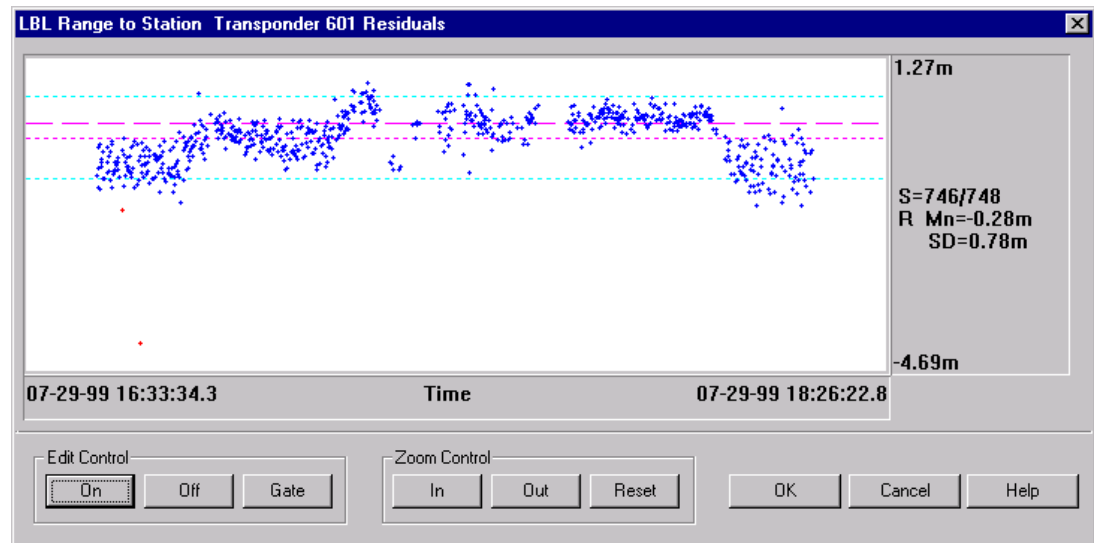
Using the Plot Panel: Residuals

When the **Plot Res** button in the **Calibration Station** window is clicked with any LOP selected, the following window is presented. In the case of a USBL range or bearing LOP, a prompt pops up asking if you wish to plot **X** or **Y** data respectively.



Answering **Yes** to either of these prompts results in the graphical editor plotting the scaled X or Y residuals. Answering **No** results in the graphical editor plotting the scaled range and bearing residuals respectively.

Note: It is recommended that you view the slant range or TWTT residuals when editing USBL data for the determination of a beacon position.



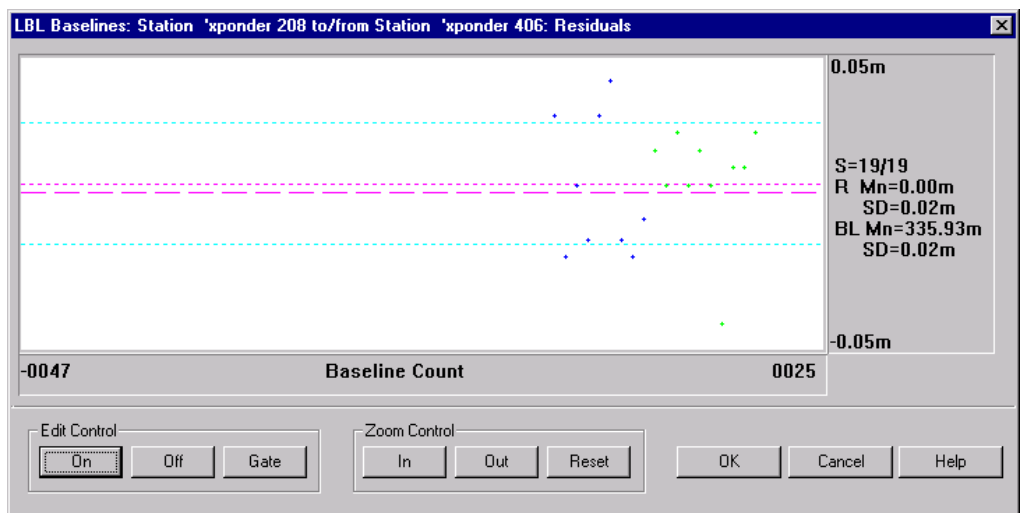
The window title gives the LOP type and the name of the specific LOP. The capabilities and options are the same in this window as detailed in **Using the Plot Panel: LOPS - Position and LBL Ranges**.

The horizontal lines represent the following:

- Long dashed magenta line is 0.
- Short dashed magenta line is the mean of all the residuals.
- Short dashed light blue line is the mean residual $\pm$ standard deviation.

If the LOP being viewed is a Position, LBL range or Depth LOP, the residuals are plotted against time, that is the time stamp for the data reception. Data weighted in the solution is plotted in blue, that de-weighted is plotted in red. The above figure is an example of an LBL range LOP.

If the LOP being viewed is a Baseline LOP, the residuals are plotted against a baseline count. Forward baselines weighted in the solution are plotted in blue, reverse baselines weighted in the solution are plotted in green. Any points representing data that is deweighted from the solution are plotted in red.



Note: Though the graphically editing of Residuals is useful, it must be done carefully and always after the initial calibration processing. It is important to be aware that the least squares technique minimizes the residuals of all observations. Consequently, it distributes any errors throughout the whole array. The error from a single observation will appear in the residuals of all the observations. The amount that appears in each observation depends upon the geometry, number of observations, and the weight assigned to each observation. One cannot assume that the observation with the largest residual is necessarily the observation with the error (although this is where one generally begins to investigate). Consequently, do not eliminate large blocks of observations all at one time. Remove only a few of the largest then solve again.

Note: If the residuals being viewed are for a USBL XYZ based LOP (i.e., a calculated slant range, X, bearing, Y or depth LOP but not the TWTT LOP), and LOPs are de-weighted in the above process, the associated XYZ based LOPs are automatically de-weighted. This does not apply to the weighting in of LOPs.

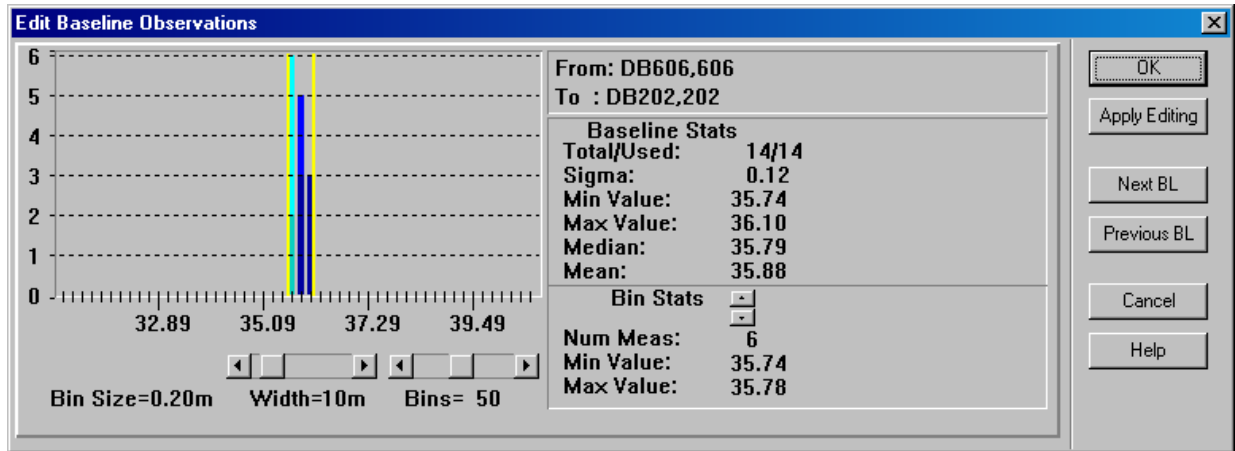
To evaluate the residuals to detect bad data

- 1 First ensure all the obvious bad data has been removed by looking at the LOP (see **Using the Plot Panel: LOPS**).
- 2 **Next**, examine all the residuals. Then select only one observation at a time to be turned off. This can be the largest but also consider what was happening during the data collection phase. If the ship rolled sharply at some point or hit a wave that caused it to shudder, one may want to select the observation(s) that occurred at this time. One may see some residuals that do not part from the trend by very much but combined with knowledge of a large ship roll may indicate the offending observations. After turning off the bad observation re-solve, if the statistical test still fails turn this observation back on and select another then repeat the procedure. One can shorten the process by selecting a few observations to turn off then re-solve and if the test passes turn back on, one observation at a time, re-solving after each, until the bad observation is found. One should also consider the number of observations there are. Given a large data set if a few good ones are turned off along with a bad one there will not be much accomplished by spending time finding the good ones to turn them back on.

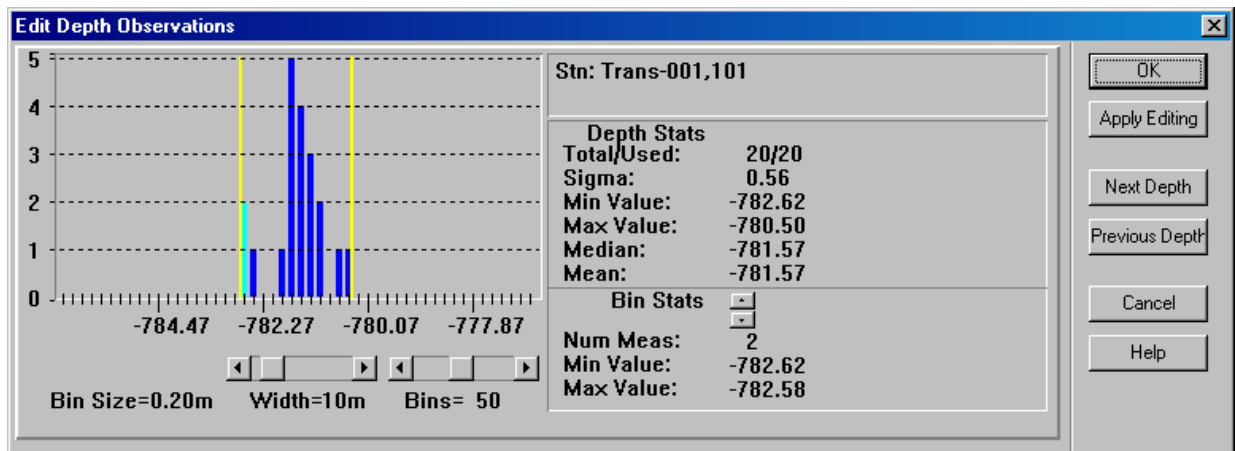
Using the Plot Panel: Baseline and Depth LOPs

When the **Plot Data** button in the **Calibration Station** window is clicked with a baseline or a depth LOP selected, the graphical editor opened plots the data in histogram format.

If the LOP selected is a baseline, the data set is searched for all baselines with the same **From** and **To** transponders as the one selected. It then searches for all the reverse baselines. These are displayed in the histogram. This is a powerful editing tool in that, in general, the correct baseline is the shortest observed baseline, which is easily visible using a histogram.



If the LOP is a depth, the data set is searched for all depths associated with the selected station and transponder.



How WinFrog Bins the Data

- 1 Determines the central value of the set and calculates the bin size.
- 2 Using the following formula, calculates the difference between the central value and the individual baseline values.

$$((\text{baseline} - \text{centralBaselineValue}) + \text{width}/2) / \text{binSize}$$

- 3 With this information, determines which bin to place the baseline.

Using the Histogram Panel

The histogram display itself consists of the individual bins drawn with the top of the panel representing the maximum number of baselines in the most populated bin.

What the colors mean:

- Bins containing data that are weighted in the solution are drawn in blue.

- Bins containing data that are de-weighted in the solution are drawn in red.
- The portion of the bin representing the forward baselines (if applicable) is lighter in color than that portion representing the reverse baselines. If a bin has both forward and reverse baselines in it, the forward are on top.
- The bin that is currently selected for the display of its statistics is drawn in light blue.

The Controls and Panels:

Edit Bars

The edit bars represent the limits of the data that are weighted in the solution and are drawn in yellow, from the top to the bottom of the panel. These can be moved to graphically edit the data. Click and drag either bar. When these are moved, the previous position is drawn in dark blue until the mouse releases the bar, at which time the old position marker disappears. Any bin outside the new edit bar position is de-weighted from the solution, any bin inside the new position is weighted in the solution. All statistics are updated immediately in the window, but the actual editing is not applied until the Apply Editing button is clicked.

Histogram Controls

Control of the width of the whole panel and the number of bins in the panel. The actual bin size is a derivative of these settings and is displayed.

Width

The width the histogram panel represents.

Bins

The total number of bins to be used to represent the panel width.

Bin Size

Width divided by number of bins.

Station Information

In the case of baselines, the names and addresses of the **From** and **To** transponders are given. In the case of Depths, the station name and transponder are given.

Baseline/Depth Stats

Total/Used

The total number of measurements made versus the total number weighted in the solution.

Note: Zero length baselines are not included in the histogram nor are they considered when determining the total number of baselines as displayed here. As a result, the

total displayed here may not match that derived from the Baseline Summary tab (see **Baseline Tab**).

Sigma	The standard deviation of the variance.
Min Value	The minimum value.
Max Value	The maximum value.
Median	The median of this data set.
Mean	The mean of this data set.

Bin Stats

Num Meas	Number of data in the selected bin.
Min Value	Minimum value in the selected bin.
Max Value	Maximum value in the selected bin.
up/down arrows	Scrolls up and down the bins selecting the bin for which to display the Bin Specs.

Button Controls

Apply Editing button	Applies editing performed with the histogram. Note that closing the window with OK does not accomplish this.
Next BL/Depth button	Looks for the next baseline or depth in the calibration data set and displays the histogram for it. Note that the changes made to the histogram before clicking this button are not applied unless the Apply Editing button is clicked first.
Previous BL/Depth button	Looks for the previous baseline or depth in the calibration data set and displays the histogram for it. Note that the changes made to the histogram before clicking this button are not applied unless the Apply Editing button is clicked first.

Note: WinFrog bases the display of the number of observations used and the color-coding of the histogram's bins on the left and right most bins with weighted in observations. Thus, if a de-weighted baseline/depth lies in a bin that includes weighted in observations (this can be a result of an observation that agrees with other good observations but is flagged with an error when decoded), it is included in the count of used baselines/depths and is included in a bin colored as weighted in. This can result in an apparent discrepancy between the baseline and/or depth summary display and the associated histogram.

LBL Calibration Calculations

WinFrog applies a rigorous least squares technique to the calibration calculations, processing all of the data in a single adjustment. As this approach is quite new, some users tend to wish to employ older techniques. These older process includes: independently processing areas of several key transponders, performing a second calculation where these transponder's coordinates are held fixed, and then computing the remaining transponders coordinates using baseline observations. The flexibility of WinFrog allows you to perform the calibration the "old way," but you are losing the benefit (and speed) of combining all the data to perform a more rigorous and complete solution.

From the **Calibration** dialog, click the **Calculate** button.

Calibration for Vehicle1

Data Collection/Control

☒ Off Apply Data Collection Setup Now

☐ LBL Ranges 55 Points in Memory

☐ II Ranges Clear

☐ USBL Data Graphics

Min Interval (seconds) ☐ On ☒ Off

☐ LBL Baselines Setup

☐ Depths Setup

Data Load/Save

Current File

C:\NAVDATA\sonardyne.cal

Load Save AutoSave AutoSave Off

Calibration Calculations

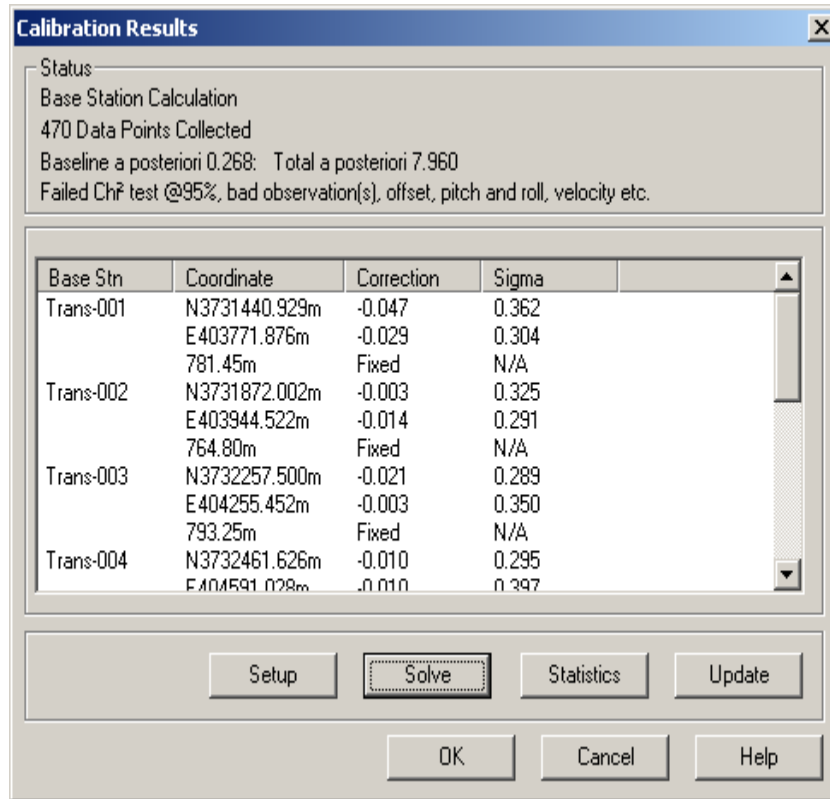
Edit Data Recalc LBL Xpdr Report

Calculate Reset USBL USBL Report

Statistics Recalc USBL Edit Xponder

OK Cancel Help

The **Calibration Results** dialog opens.

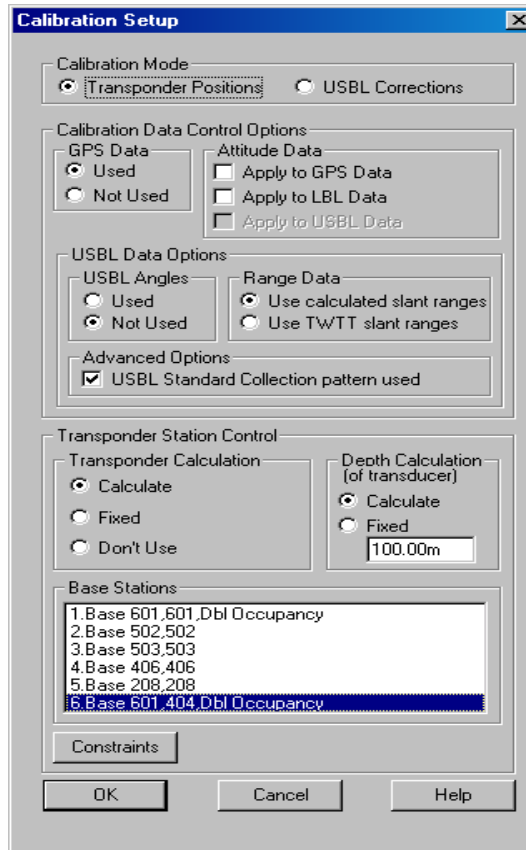


Note: the calibration edit settings are saved to the calibration file. Therefore, if the data being processed are from a loaded file that was already processed, this dialog box will present the options that have already been set. In addition, the statistical results will also be available and displayed.

From this dialog you can configure the calculations (**Setup**), process the data (**Solve**) and update the **Working Xponder** file (**Update**). At any stage, this dialog displays the current solution results.

To Setup the LBL Calibration Solution

- 1 Click the **Setup** button to display the **Calibration Setup** dialog shown in the next figure.



You now have the following options:

Calibration Mode

Transponder Positions

WinFrog will solve for the positions of the transponders as configured. This must be selected for LBL Calibrations.

USBL Corrections

WinFrog will solve the USBL calibration corrections.

Calibration Data Control Options

GPS Data

Used

Controls the use of the logged GPS data.

The GPS position data are used in the calibration solution. This option must be selected if you are performing a calibration using the LOPs from the LBL transceiver to the transponders.

Not Used

The GPS position data are not used in the calibration solution. Choosing this option results in all LOPs from the transceiver to the transponders to be not used, as they require the GPS coordinates. Only baseline

	LOPs will remain unaffected and will be used in the solution.
Attitude Data	
Apply to GPS Data	The pitch and roll data logged with the GPS LOPs are applied to the GPS sensor offsets in the solution.
Apply to LBL Data	The pitch and roll data logged with the LBL range LOPs are applied to the LBL sensor offsets in the solution.
Apply to USBL Data	This is only available if the option to use Use TWTT slant ranges has been selected, in which case the pitch and roll data logged with the USBL TWTT LOPs are applied to the USBL sensor offsets in the solution.
USBL Angles	This applies to the application of USBL data. For more information refer to the USBL Calibration section later in this chapter.
Range Data	
Use calculated slant ranges	Select this option if the slant range data to be used for the transponder beacon position determination is derived from the XYZ data (typical).
Use TWTT slant ranges	Select this option if the slant range data to be used for the transponder beacon position determination is derived from the observed signal travel time. Note that if this option is selected, the Attitude Data option Use Apply to USBL Data becomes available. This is because the travel time data is not corrected to a vertical datum and therefore the application of pitch and roll to the application of the sensor offsets can improve the solution.
Advanced Options	
USBL Xponder Standard Cal	This applies to the processing of a transponder position for a USBL corrections calibration. See the USBL Calibration section later in this chapter.

Transponder Station Control

Transponder Calculation

This controls the horizontal position solution for the station currently selected in the **Base Stations** list box (see below).

Calculate

Solves for the Northing and Easting of the station.

Fixed

The station is held fixed (known) in the solution.

Don't Use

The station is not used at all in the solution.

Note: it is important that if a transponder appears in the list, but there are no data for it in the calibration data set, this option must be selected for that transponder. Otherwise, the solution will fail.

Depth Calculation

Calculate

Solves for the depth of the station. If depth observations are available and weighted in the solution, they will be used.

Fixed

Constrains the depth of the station in the solution. You may enter a value here to use as the fixed depth. The default is the last depth value for this station, either originally from the **Working Xponder** file when the calibration was first started, or from the last solution.

Base Stations

This lists all stations available for the calibration solution by station name and transponder address. Note that if a station is entered twice with different transponders assigned to it, it is considered a single station and cannot be set to **Calculate** for one instance and **Fixed** for the other. If the data for one transponder but not the other is to be used, this must be done in the appropriate weighting of the respective data. All data associated with a given station, regardless of how many transponders are located on that station, is used as weighted and the station is solved for only once.

It is important to note that when the **Calibration** dialog is first opened, the current **Working Xponder** file is copied to the calibration data set station information. It is this information that is used throughout the

calibration process, not the actual **Working Xponder** file.

Note: it is for this reason that it is very important to ensure that the **Xponder** file contains all transponders involved in the calibration and has their approximate starting coordinates entered prior to starting the calibration data collection, editing, and calculation process.

Additional Controls

Constraints

Click this button to configure constraints for the Least Squares Adjustment (see **To Enter Constraints for the Least Squares Adjustment**).

- 2 Set the appropriate configuration settings.
- 3 Select each transponder and configure appropriately using the options available in this panel.
- 4 If constraints are to be applied, click the **Constraints** button and configure the constraints.
- 5 Click **OK** to exit and use the configuration, or **Cancel** to exit this dialog and discard the settings.

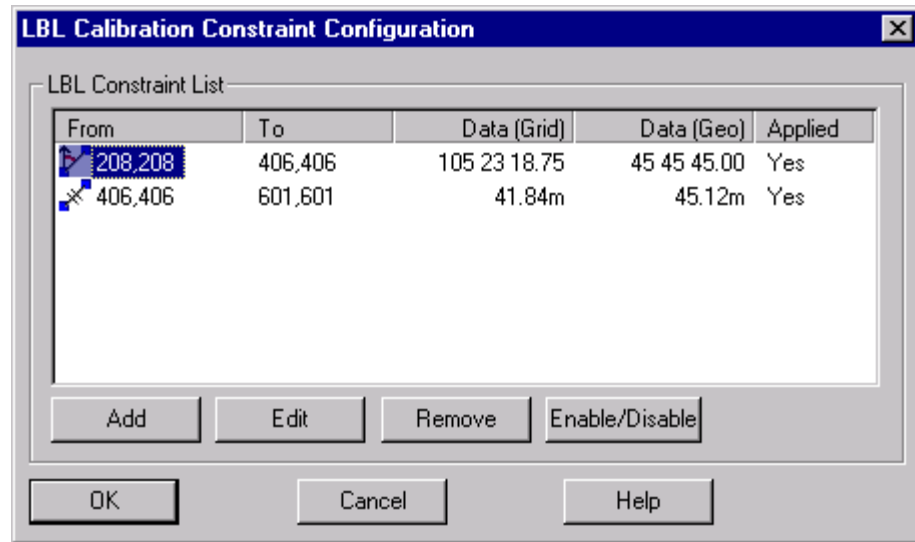
To Enter Constraints for the Least Squares Adjustment

The LBL calibration solution supports azimuth and baseline constraints. The azimuth constraint allows the solution of an LBL array to be oriented as set by the constraint. The baseline constraint allows for the entry of known distances between stations that may not have been observed, for example between transponders mounted on opposite sides of a structure that is being positioned.

The constraints are saved and loaded with the Calibration data set.

There is a limit of 10 constraints.

- 1 In the **Calibration Setup** dialog, click the **Constraints** button.



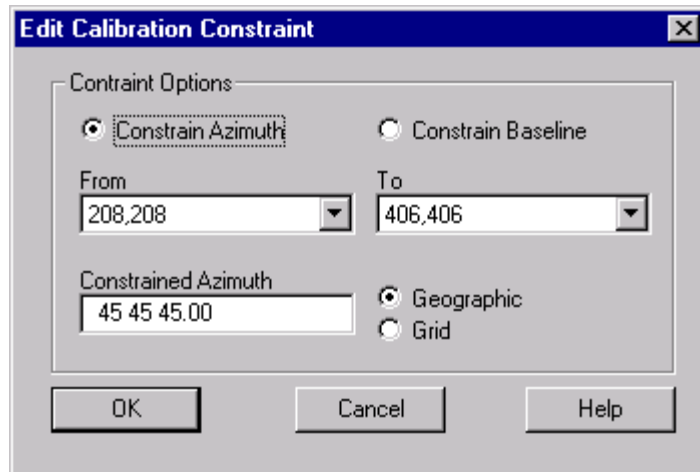
2 The overview window presents all the currently configured constraints. The information presented is as follows:

- An icon indicating if the constraint is an azimuth or a baseline.
- The name and transponder address for the **From Station**
- The name and transponder address for the **To Station**.
- The constraint, **Data (Grid)**, projected onto the Map Projection grid
- The constraint, **Data (Geo)**, on the Working Ellipsoid.
- The status, **Applied**, of the constraint, **Yes** indicating that it is or will be used in the solution, **No** indicating that it will not be used in the solution. This enables you to enter a constraint and turn it off and on without having to actually re-enter the constraint each time. This can also be controlled from the Calibration Station dialog.

The options available from this dialog are as follows:

- **Add**, allows you to enter a new constraint.
- **Edit**, allows you to edit the constraint currently highlighted in the list view. Double clicking on the constraint in the list view also allows editing of the constraint.
- **Remove**, allows you to remove the constraint from the list. Note that once a constraint is removed, it must be added again if it is to be used.
- **Enable/Disable**, toggles the **Applied Yes/No** setting for the currently highlighted constraint.

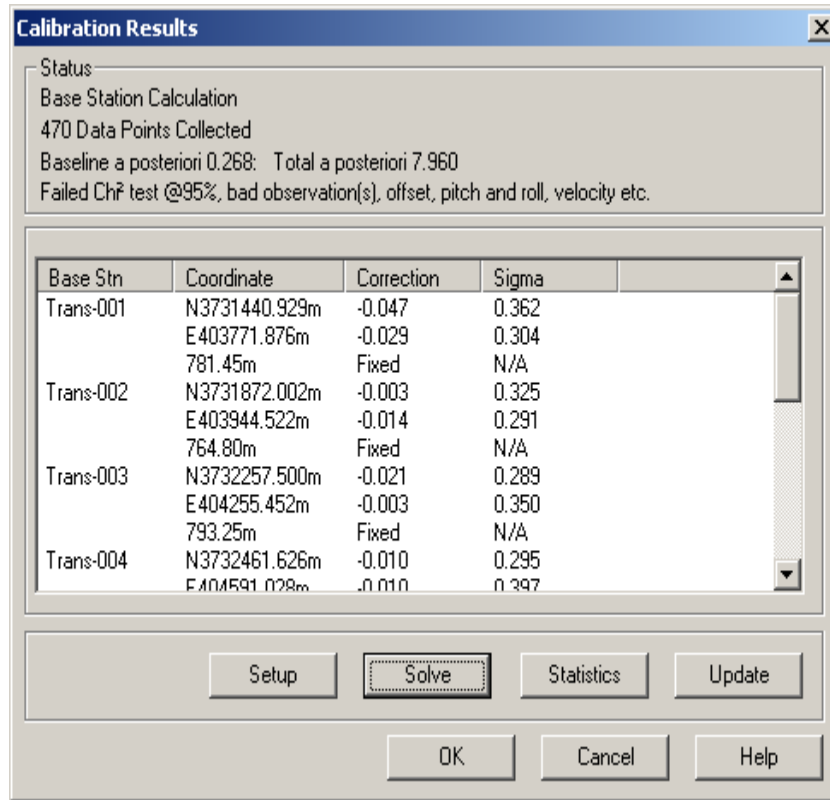
3 Clicking **Add** or highlight an existing constraint and clicking **Edit**, or double clicking an existing constraint accesses the **Edit Calibration Constraint** dialog.



- Select the Constraint type, either **Azimuth** or **Baseline**. Note that the data entry controls will change slightly to reflect the different data entries, angle or distance.
 - Select a **From** and **To** station from the respective drop down lists. The stations are listed by name and transponder address. If a station is occupied by more than one transponder, only the first instance is listed.
 - Enter the **Constraint**. This can be entered as either a geographic or a grid value by selecting the appropriate radio button, **Geographic** or **Grid** respectively.
 - Exit with **OK** to keep the constraints added/edited, or **Cancel** to discard the addition or editing of the constraint. Note that the default **Applied** setting is **Yes**.
- 4 Click **OK** to exit and apply the constraints added/edited, or **Cancel** to discard the changes.

To Calculate the LBL Calibration Solution

Once the solution is configured, you perform the iterative calibration calculation directly from the **Calibration Results** dialog box.



The following details the components.

Status Panel

Displays the current status of the solution on the first line and the number of points used in the solution on the second line. A third and fourth line are used to present statistical information and are discussed later in this chapter (see **Analyzing the Results**). The following are possible status messages:

No Calibration Solution Defined

The **Setup** has not been performed for the calibration. A solution is not possible.

Solution Re-Defined, should Re-Process

The **Setup** has been re-executed and therefore the solution should be re-calculated.

Solution Must be Recalculated

The solution has been reset and it must be re-calculated.

Base Station Calculation

The solution for transponders was successful.

Solution Calculation Failed	The solution failed. There are major problems with the data that must be investigated.
Processing...	Calibration processing is occurring.
Data Panel	
Station	The name of the station. If a station is occupied by more than one transponder, each instance is listed but only the first lists the following data. Subsequent listings simply state Double Occupancy .
Coordinates	The Northing, Easting, and Depth for the station. Note: the Units/Coordinates/Grid Coordinate Order controls the order of the Northing or Easting.
Corrections	The corrections determined and applied in the last adjustment iteration. If the associated coordinate component has been held Fixed , instead of the correction value, the term Fixed is displayed in brackets.
Sigmas	The sigma of the associated coordinate component as determined from the last adjustment iteration.

As mentioned previously, the least squares solution is an iterative one.

- 1 Click the **Solve** button to perform one adjustment. If the solution is successful (converges), the results of the adjustment are displayed.
- 2 Continue to click the **Solve** button until the value no longer changes with each click.

The correction values continue to converge (get smaller) with each click eventually reaching a value that remains unchanged on subsequent clicks of the **Solve** button. This indicates that the calibration adjustment is complete based upon the currently weighted data.

Note: in a “perfect” solution, the correction values would converge to zero. However, in an actual calibration, they should converge to values consistent with the accuracy of the acoustic system being used.

Problems with the calibration data are indicated by the following:

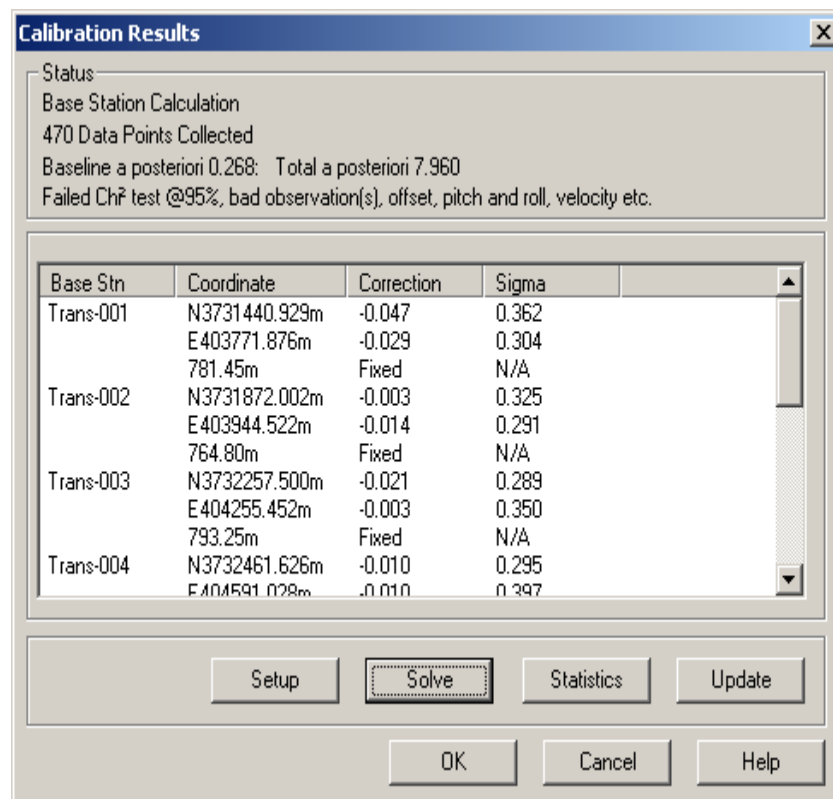
- Once the data appear to have converged, the value oscillates back and forth between two values with each click of the **Solve** button.
- The correction values converge, but not to a value consistent with the

accuracy capabilities of the acoustic system being calibrated. This indicates that there are probably still bad data weighted in the solution. The LOPs should be re-examined using the graphical editor.

- The correction values jump about without converging, or appear to converge, but before reaching a static result start to increase again. This again indicates that there are probably still bad data weighted in the solution. The LOPs should be re-examined using the graphical editor.
- **GPS Data** is set to **Not Used** and there are no transponders held fixed and/or there are insufficient baseline LOPs
- The solution fails. Probable causes are:
 - A** A transponder has no data associated with it but is not set to **Don't Use**.
 - B** The initial transponder coordinates and/or depths are not sufficiently close to the actual locations. Also check that the correct transponder was dropped or located at the correct location, **see Editing Calibration Station Information**.
 - C** There are flyers that have not been de-weighted from the solution, **see LBL Calibration Data Editing**.
 - D** Incorrect transponders in the file, **see Editing Calibration Station Information**.

Analyzing the Results: the Chi Squared Test and A Posteriori Variance factor

Once you click the **Solve** button, at least once, two more status lines display.



Two **a posteriori** values (**baseline** and **total**) display on the first new line and, on the second new line, the results of a statistical test performed on the total **a posteriori**. Before the **a posteriori** values can be used, the solution must reach convergence or it is no longer productive to click the **Solve** button.

The **a posteriori** is a variance and is the sum of the square of each residual multiplied by its weight all divided by the number of observations less the number of unknowns. The **baseline a posteriori** is calculated just using baseline residuals. These values can be used as an aid in assessing the quality of the least squares adjustment.

Unless indicated, a reference to **a posteriori** refers to the **Total a posteriori** not the **Baseline a posteriori**. The **a posteriori** is compared statistically to the **a priori variance** using the statistical test termed the **Chi squared test**. This test is performed at a 95% confidence interval. The value of the **a priori variance** is 1 because the standard deviation of each observation is known and set by the operator.

Why could the Chi Squared Test Fail?

If the test fails and the **a posteriori** variance is large, the adjustment and consequently the calculated coordinates of the transponders are unreliable. A failure of this statistical test can occur for three reasons:

- bad mathematical model
- unmodeled biases in the data (some bad observations)
- incorrect initial weighting (wrong Weighting Factor)

The first possible cause of the failure can be discounted as the mathematical model has been proven sound by several authors over many years.

The second cause of the failure, **unmodeled biases in the data**, is usually the cause that requires investigation. This can be due to the following:

- There is one or more bad observation: a baseline, surface-to-transponder range, depth or GPS fix.
- Excessive pitch and roll of the vessel during recording of the transceiver-to-transponder ranges without an attitude sensor input to WinFrog and enabled for use in the Vehicle positioning. This could effect all surface-to-transponder ranges and GPS positions. In this case, the unmodeled bias in the data is the un-calculated change in range due to pitch and roll. (Actually the ship rocks so the offset between the GPS antenna and the transponder is not correct so the transponder coordinates are calculated incorrectly at the time the observation is made.) If an attitude sensor is available when the data is observed, WinFrog can be configured to use it and log the data to the calibration file for use during the calibration process.

If an attitude sensor is not available and there is excessive ship pitch and roll the residuals will show a marked sinusoid pattern. The crests and troughs will usually straddle the mean, but not always evenly as the ship may roll to one side more than the other. If there are a large number of observations and all the larger outliers are removed, the pitch or roll to one side should cancel the pitch or roll to the other and the adjustment should be good. However, you should change the weight factor on the observations to reflect this error. If this is not done you should multiply the geometric error ellipses by the square root of the **total a posteriori variance** to obtain the actual absolute error ellipses. This will then reflect the uncertainty in the absolute accuracy of the transponders due to the un-modeled pitch and roll.

- Certain inter-transponder baselines may be subject to excessive ray bending causing the range to be short or long yet appearing consistent. Generally this is more likely to happen with the longer baselines than the shorter or otherwise the error is likely to be larger with the longer rather than the shorter. Should this happen the residuals and the a posteriori will be large. Redesigning the array is the best solution, however, you can improve the adjustment by increasing the standard deviation of those baselines that are suffering from the ray bending while leaving the others as they are. Conversely, all of them may be changed as a function of distance. Excepting obvious bad measurements, judging the poorest measurement based upon the residual is not valid as the errors get pushed into the baselines with the poorest geometry.
- Invalid velocity profile.

The size of the **a posteriori** is a qualitative indicator of how many bad observations there are. It usually only requires one bad observation to cause the failure. However, when this happens the **a posteriori** variance is usually smaller (say less than 10). The more bad observations there are, the larger the **a posteriori variance** can become. If it is greater than 999, it indicates that there are several bad observations. **Note:** one large error is roughly equivalent to a few smaller errors.

The third possible reason that the test on the **a posteriori variance** factor can fail is **incorrect initial weighting**. The initial weighting is the weighting factor value assigned to each observation. The status line may display the message, **OK, but residuals much smaller than initial WF indicates**. This means that the statistical test failed, but not due to bad data. This is caused by assigning weighting factor values that were too pessimistic to the observations, i.e. the standard error of each observation is better than that entered, as determined by the least squares adjustment. In this case, the solution is still good and the coordinates are reliable.

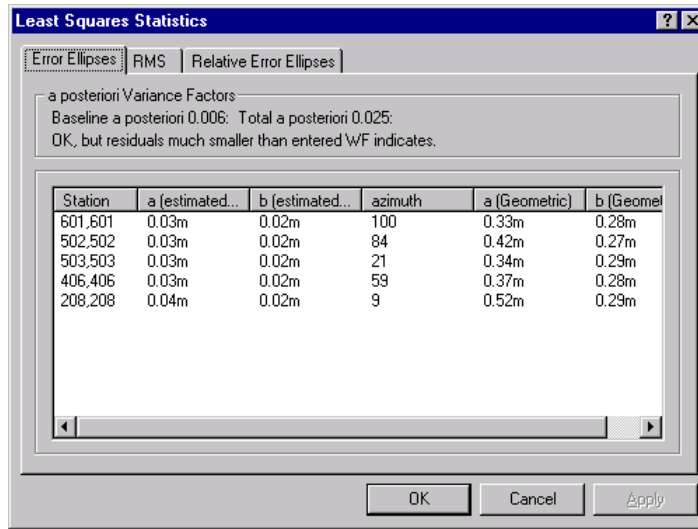
The weighting factors can be reduced and the solution re-processed to determine if this improves the a posteriori variances. However, it is important not to reduce

them to unreasonably small values simply to achieve satisfactory **a posteriori variances**. If the weighting factors are reasonable, accept the results and use the geometric error ellipses for the absolute error ellipses and the error ellipses estimated from the Baseline a posteriori as the bottom relative error ellipses.

It should also be noted that there is a phenomenon with electronic instruments in that they produce precise results over short periods of time under steady environmental conditions. This can lead to the **a posteriori variances** indicating that the weighting factors are too pessimistic for the observations. Data collected over a short period of time when the seas are very calm and the water column has no discontinuity in velocity.

Analyzing the Results: the Error Ellipse and RMS

Clicking on the **Statistics** button in the **Calibration Results** dialog accesses **Least Squares Statistics** dialog.



You can view the Station Error Ellipse, the Relative Error Ellipse and the solution RMS values.

For details, see **Viewing the LBL Solution Statistics** section later in this chapter.

Examining the Results and Repeating the Process

The process of reviewing and editing the data and then performing an adjustment should be repeated several times. The actual number of cycles depends upon the quality of the data. The objective is to achieve a reliable solution with acceptable statistics while using most of the data.

When editing the data by looking at the residuals, be aware that the least squares technique minimizes the residuals of all of the observations. Consequently, it distributes any errors throughout the whole array. The error from a single observation will appear in the residuals of all the observations. The

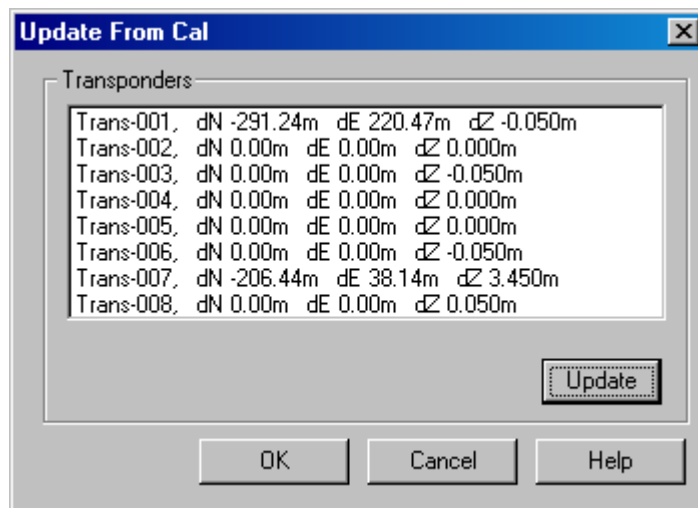
amount that appears in each observation depends upon the geometry, number of observations, and the weight assigned to each observation. One cannot assume that the observation with the largest residual is necessarily the observation with the error (although this is where one generally begins). Consequently, do not eliminate large blocks of observations all at one time. Remove only a few of the largest and then solve again.

Note: as previously mentioned, it is recommended that the calibration be saved after each cycle. In this way, you can return to a known point or resume processing, if required. Once the calibration is considered complete and the **final** calibration file is saved to a new file, the intermediate files can be removed. At that time, the remaining files are the original untouched file and the final result file. By loading the final result file, the calibration can be reviewed and/or printed at any time without having to perform any step other than loading the file.

Updating the Xponder File with the Calibration Results

Once you consider the calibration complete, the **Working Xponder** file can be updated directly from the **Calibration Results** dialog.

- 1 Click the **Update** button to display the dialog box shown in the next figure.



Each transponder present in the calibration copy of the Xponder file is listed by name, along with the corrections to be added to the respective Northing, Easting, and depth values in the **Working Xponder** file.

- 2 If a transponder is present in the calibration transponder list, but not in the **Working Xponder** file, instead of corrections “**(Not in Working File)**” is displayed opposite the respective transponder. To update the transponder, highlight the desired transponder, and click **Update**.

Once updated, the corrections for that transponder will change to 0 in the list.

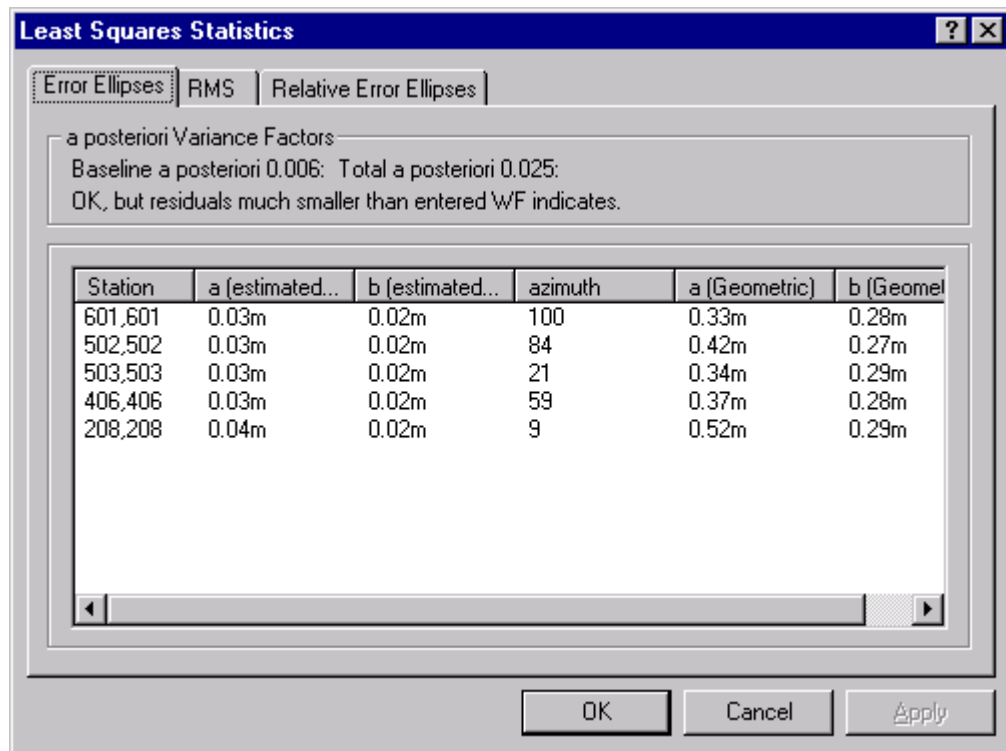
Viewing the LBL Solution Statistics

When a least squares adjustment of the station coordinates is performed the variance co-variance matrix of all the stations is also computed. These values are independent of the observations. They are dependent upon geometry and the weighting factors assigned to each observation.

WinFrog uses the variance co-variance matrix to produce basic statistic analysis tools, specifically **Error Ellipse**, **RMS** and **Relative Error Ellipse**.

To view the statistics for the LBL solution, click on the **Statistics** button in either the **Calibration** dialog or the **Calibration Results** dialog. This will access the **Least Squares Statistics** dialog. This dialog has three tabs to view the information in, **Error Ellipse**, **RMS** and **Relative Error Ellipse**.

Error Ellipse Tab



This tab presents the station error ellipse.

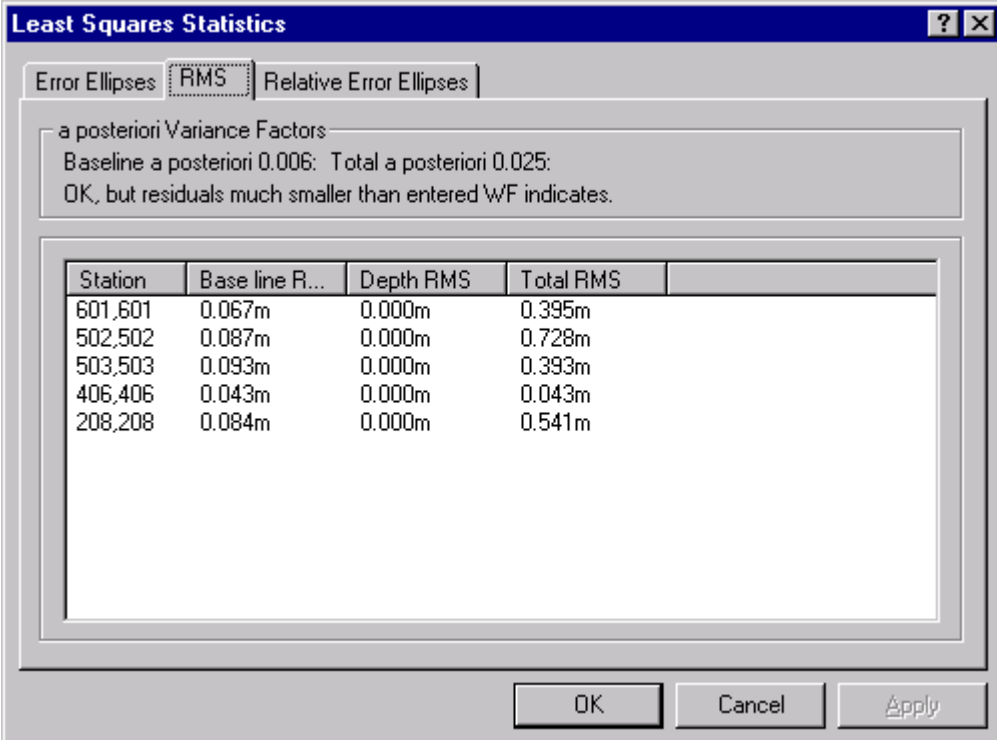
The first column gives the station name and the associated transponder address. If a station is occupied by more than one transponder, only the first transponder found is displayed.

The values **a Geometric** and **b Geometric** are the semi-major and semi-minor axes of the error ellipse determined directly from the variance co-variance matrix.

The values **a** (**Estimated using baseline a posteriori**) and **b** (**Estimated using baseline a posteriori**) are the **a Geometric** and **b Geometric** values scaled by the root of the baseline **a posteriori variance** factor. This is the estimate of the error ellipse of each transponder as if it were calculated using baselines only. It still involves the geometry of the whole system but reflects the more accurate baseline measurement.

The **azimuth** is the azimuth of the semi-major a axis.

RMS Tab



Station	Base line R...	Depth RMS	Total RMS
601,601	0.067m	0.000m	0.395m
502,502	0.087m	0.000m	0.728m
503,503	0.093m	0.000m	0.393m
406,406	0.043m	0.000m	0.043m
208,208	0.084m	0.000m	0.541m

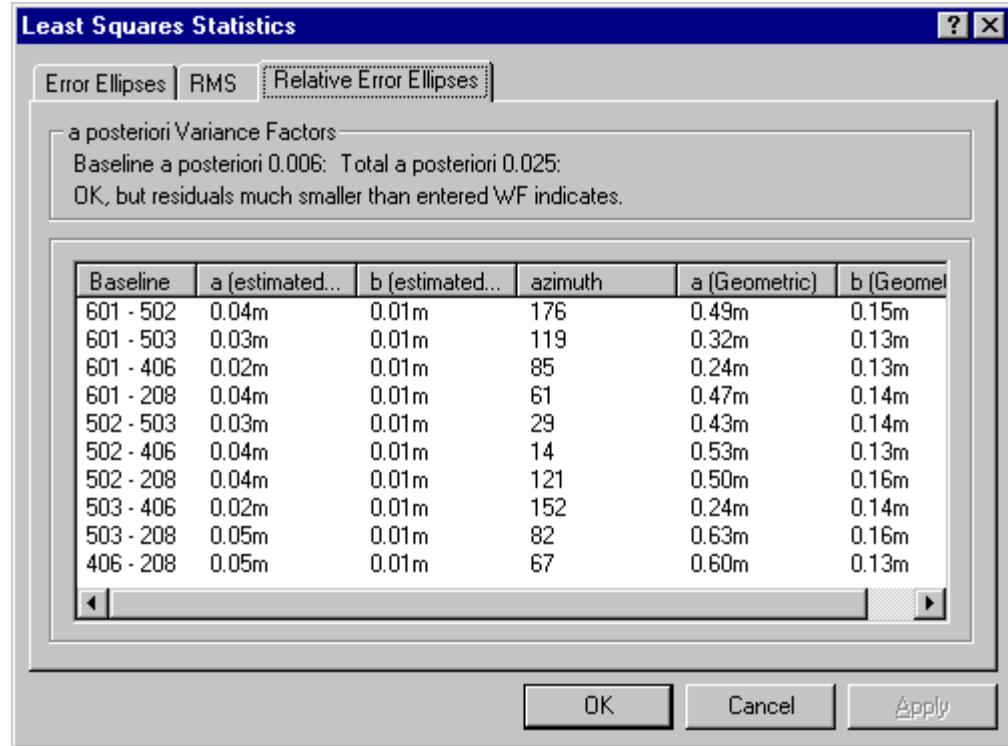
This tab presents the solution RMS values.

The first column gives the station name and the associated transponder address. If a station is occupied by more than one transponder, only the first transponder found is displayed.

The **Total RMS** values are the square root of the mean of the sum of squares of all residuals associated with the indicated station. The **Base line RMS** involves only baseline observation residuals. The **Depth RMS** only pertains only to the depth observations.

These values are a good indicator to the quality of the data used. They can also assist detecting where a bad observation may be.

Relative Error Ellipse Tab



This tab presents the relative error ellipse. A relative error ellipse calculated from the variance and co-variance of two stations. It involves the geometry and correlation between the two stations. If one had measured the base line between two stations then the correlation between these two would be some finite positive number. If the baseline had not been measured the correlation would most likely be smaller. But the proximity of the surrounding stations and number of other measured baselines also plays a factor.

If the baseline between two stations is measured the resulting relative error ellipse would be smaller than if the baseline was not measured. However the relative error ellipse still may be larger than either of the original station error ellipses. The relative error ellipses are a good indicator of the geometric strength or weakness between two stations. Smaller ellipse indicate strong geometry, larger ellipse indicate weaker geometry.

The first column gives the station name and the associated transponder address. If a station is occupied by more than one transponder, only the first transponder found is displayed.

The values **a Geometric** and **b Geometric** are the semi-major and semi-minor axes of the error ellipse determined directly from the variance co-variance matrix.

The values **a (Estimated using baseline a posteriori)** and **b (Estimated using baseline a posteriori)** are the **a Geometric** and **b Geometric** values scaled by the root of the **baseline a posteriori variance** factor. This is the estimate of the error ellipse of each transponder as if it were calculated using baselines only. It still involves the geometry of the whole system but reflects the more accurate baseline measurement.

The **azimuth** is the azimuth of the semi-major a axis.

Editing Calibration Station Information

The station information contained in the Calibration data set is essentially a copy of the **Working Xponders** file that was active when the calibration dialog was first opened to start a calibration data collection.

This Calibration data set station information is checked against the current **Working Xponders** file every time the Calibration dialog is re-opened or a Calibration data file is loaded. At these times you are informed of differences detected between the coordinates for the same station in both the **Working Xponders** file and the Calibration data set. In addition, stations that are in the **Working Xponders** file but not in the Calibration data set are detected and you are so informed of the discrepancy. You can choose to update the Calibration data set from the **Working Xponders** file or ignore the **Working Xponders** file and continue only with the station information in the Calibration data set.

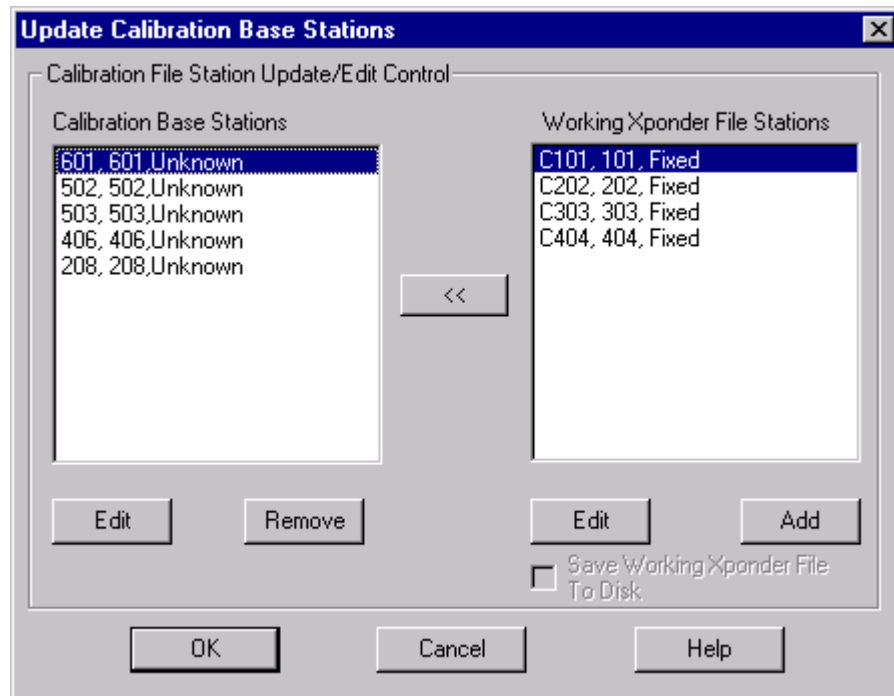
In addition to the aforementioned checks and options, when loading a Calibration file, you are prompted to either purge the existing Calibration data set station information before loading in new information or leave it and add the station data from the new Calibration data set to it.

Ultimately, the chance exists that the station information contained in the Calibration data set requires editing and/or cleaning out.

The editing of the Calibration data set station information may also be required to configure settings not supported in previous WinFrog versions and therefore not optimally configured when an old Calibration file is loaded for review or re-processing.

And finally, the editing of the Calibration data set station information may be required due to a calibration processing that due to bad data that was not edited out first, corrupting the solution to the point where the coordinates for the stations are in error to the magnitude that a solution with properly edited data is not possible without re-initializing the starting station coordinates.

To edit the Calibration data set station information, click the **Edit Xponder** button in the **Calibration** dialog. This accesses the **Update Calibration Base Stations** dialog.



The **Calibration Base Station** list box lists the stations currently in the Calibration data set by station name, transponder address and type. Note that if a station is occupied by more than one transponder, all instances are listed here. You must take care not to corrupt the coordinates. They are all available because the **Height Above Monument** setting can be configured from here. If the coordinate for one changes, you must also change the other from here.

The **Working Xponder File Stations** list box lists the stations contained in the current **Working Xponder** file. Note that if there is currently no **Working Xponder** file, this list box states this and no editing or adding of **Working Xponder** file stations can be performed.

The options available are as follows:

- Edit a Calibration Base station
- Remove a Calibration Base station
- Copy a new station from the **Working Xponder** file to the Calibration data
- Update an existing station in the Calibration data from the **Working Xponder** file
- Edit a **Working Xponder** file station
- Add a **Working Xponder** file station
- Force the **Working Xponder** file to write out to the disk when exiting this dialog.

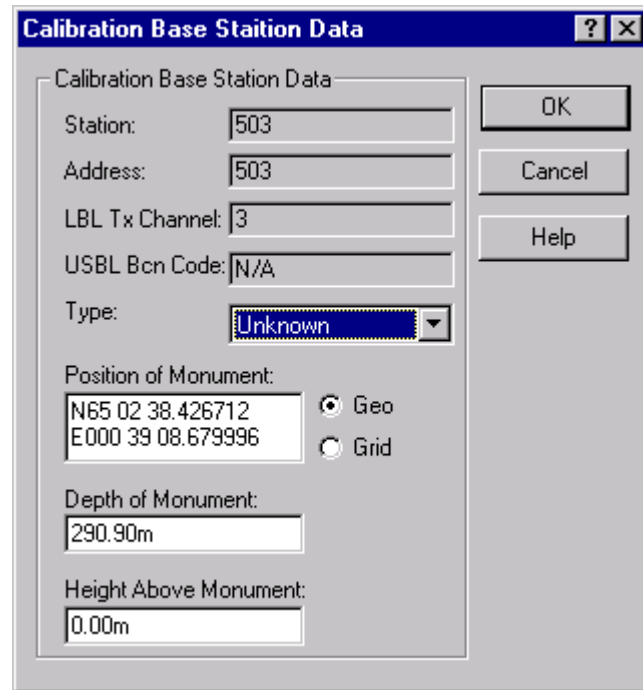
To Edit a Calibration Base Station

- 1 Highlight a station in the **Calibration Base Station** list.

- 2 Click the **Edit** button directly below this list box.

Or

- 3 Double click on the station in the **Calibration Base Station** list that is to be edited.



Calibration Base Station Data

Calibration Base Station Data

Station: 503

Address: 503

LBL Tx Channel: 3

USBL Bcn Code: N/A

Type: Unknown

Position of Monument:
N65 02 38.426712
E000 39 08.679996

Depth of Monument:
290.90m

Height Above Monument:
0.00m

☒ Geo
☐ Grid

OK
Cancel
Help

- 4 This dialog displays the station name, address of an LBL transponder, the transmit channel or frequency of an LBL transponder and the beacon code of a USBL transponder. These are not configurable from this dialog. To change any of these settings, the same station in the **Working Xponder** file must be edited (see **To Edit a Working Xponder File Transponder**) and then used to update the Calibration data set version (see **To Update the Calibration Data Set Station Information**).

You can edit the following items:

- **Type**
- **Position of Monument**
- **Depth of Monument**
- **Height Above Monument**

- 5 Edit the station information as required.
- 6 Click **OK** to exit and apply the station information changes, or **Cancel** to exit and discard any changes made.

To Remove a Calibration Base Station

- 1 Highlight a station in the **Calibration Base Station** list.
- 2 Click the **Remove** button directly below this list box.
- 3 Respond to the confirmation prompt accordingly, **Yes** to continue with the remove process or **No** to cancel the operation.

To Edit a Working Xponder File Station

- 1 Highlight a station in the **Working Xponder File Stations** list.
 - 2 Click the **Edit** button directly below this list box.
- Or
- 3 Double click on the station in the **Working Xponder File Stations** list that is to be edited.

The screenshot shows the 'Transponder/Beacon' configuration window. It contains several sections: 'Name/Position' with fields for Name (C303), Depth of Monument (125.0m), Height of transducer above monument (0.00m), and Position (N44 42 11.534100, W065 34 40.654000); 'Type' with a 'Depth Sensor' button and radio buttons for LBL Mode/Type (Fixed, Relay, Responder, Simultaneous, Cyclic, Sequential, Static Transceiver, Static Simultaneous, Dynamic Array); 'USBL Mode' with radio buttons for Fixed, Tracking; 'USBL Type' with radio buttons for Finger, Transponder, Responder; 'Control Parameters' with fields for Transmit (3), Receive (CIF), Address (303), Range correction to be subtracted by WinFrog (0.0 ms), and USBL Code; and buttons for Sensor Setup, Cyclic Setup, Save, Extended Status, OK, Cancel, Print, and Help.

- 4 See the **Working Xponders File** section in the **Working Files** chapter for information on editing the Xponder station. Edit the station information as required.
- 5 Click **OK** to exit and apply the xponder station changes, or **Cancel** to exit and discard any changes made.

To Add a Working Xponder File Station

- 1 Click the **Add** button directly below the **Working Xponder File Stations** list.

The screenshot shows the 'Transponder/Beacon' dialog box. The 'Name' field is 'C303'. The 'Depth of Monument' is '125.0m'. The 'Height of transducer above monument' is '0.00m'. The 'Position' is 'N44 42 11.534100' and 'W065 34 40.654000'. The 'Type' section has 'Depth Sensor' selected. The 'LBL Mode/Type' section has 'Fixed' selected. The 'USBL Mode' section has 'Fixed' selected. The 'USBL Type' section has 'Transponder' selected. The 'Control Parameters' section has 'Transmit' set to 3, 'Receive' set to CIF, 'Address' set to 303, 'Range correction to be subtracted by WinFrog' set to 0.0 ms, and 'USBL Code' is empty. Buttons at the bottom include OK, Cancel, Print, and Help.

- 2 See the **Working Xponders File** section in the **Working Files** chapter for information on editing the Xponder station. Edit the station information as required.
- 3 Click **OK** to exit and add the new xponder station, or **Cancel** to exit and discard the new Xponder.

To Update a Calibration Base Station

- 1 Highlight a station in the **Working Xponder File Stations** list.
- 2 Click the arrow button located between the two list boxes.
- 3 The calibration data set station information is checked for the existence of a selected station. The match is based first on matching the Station name. Then, in the case of the calibration data set station being an LBL transponder, a match of the address is checked for, or in the case of those transponders that do not use addresses, the transmit code. If the calibration data set station is a USBL beacon, the beacon code is checked for a match. If a match is found, the Calibration copy is updated with the **Working Xponder** file version.
- 4 If the station does not already exist in the Calibration data set station information, the station is added.

Note: If a calibration data set station requires an update of the address, transmit code or beacon code, you must first remove the calibration data set copy, then select the required **Xponder File** station and then follow the steps above.

To Complete the Base Station Editing

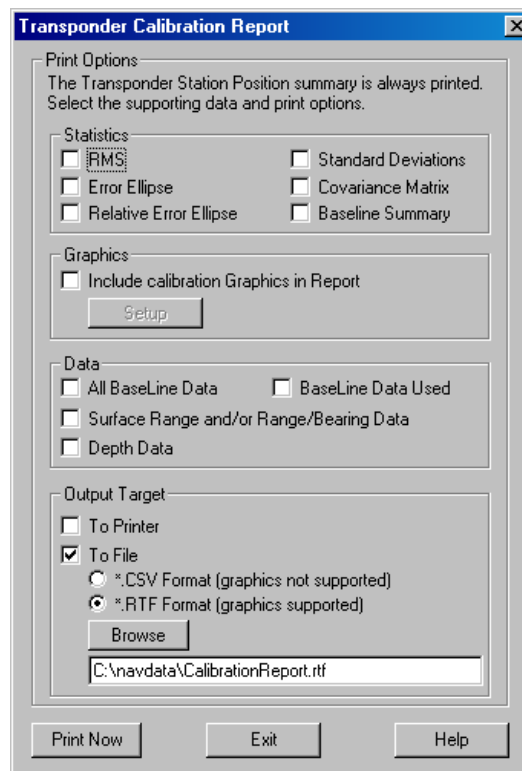
- 1 If any changes to the **Working Xponder** file have been detected, the **Save Working Xponder File to Disk** checkbox is activated. If the modified **Working Xponder** file is to be immediately saved to disk, check this box.
- 2 Click **OK** to exit the **Update Calibration Base Stations** dialog and apply the changes made, or click **Cancel** to exit discarding all changes made.

LBL Calibration Report

You can print an **LBL Calibration Report** at any time during the LBL calibration processing. The report can be printed directly to the default Windows printer or to an rtf format file.

To Print an LBL Calibration Report

- 1 From the **Calibration** dialog box, click the **Xpdr Report** button to access the **Transponder Calibration Report** dialog.



2 The report always includes the following items:

- Calibration Overview
 - Date report printed
 - Date/time calibration data collection was started
 - Date/time calibration data collection was completed
 - Total number of surface ranges observed/used (percentage)
 - Total number of baselines observed/used (percentage)
 - Total number of depths observed/used (percentage)
- Files
 - Name of current calibration file and dated/time saved
 - Current Working Xponder file (not necessarily the one used for the calibration)
 - Current Working Velocities file (not necessarily the one used for the calibration)
- Geodetics
 - Datum name
 - Ellipsoid name
 - Map Projection
- Calibration Configuration and Constraints
 - Station solution configuration (what was solved for, what was held fixed, what was not used)
 - Constraints used
- Basic Statistical Analysis
 - a posteriori variance factor for complete adjustment
 - a posteriori variance factor for baselines only
 - Chi Squared test results
- Transponder Station Position Summary Table
 - Station name
 - Geographic coordinates
 - Map Projection coordinates
 - Depth

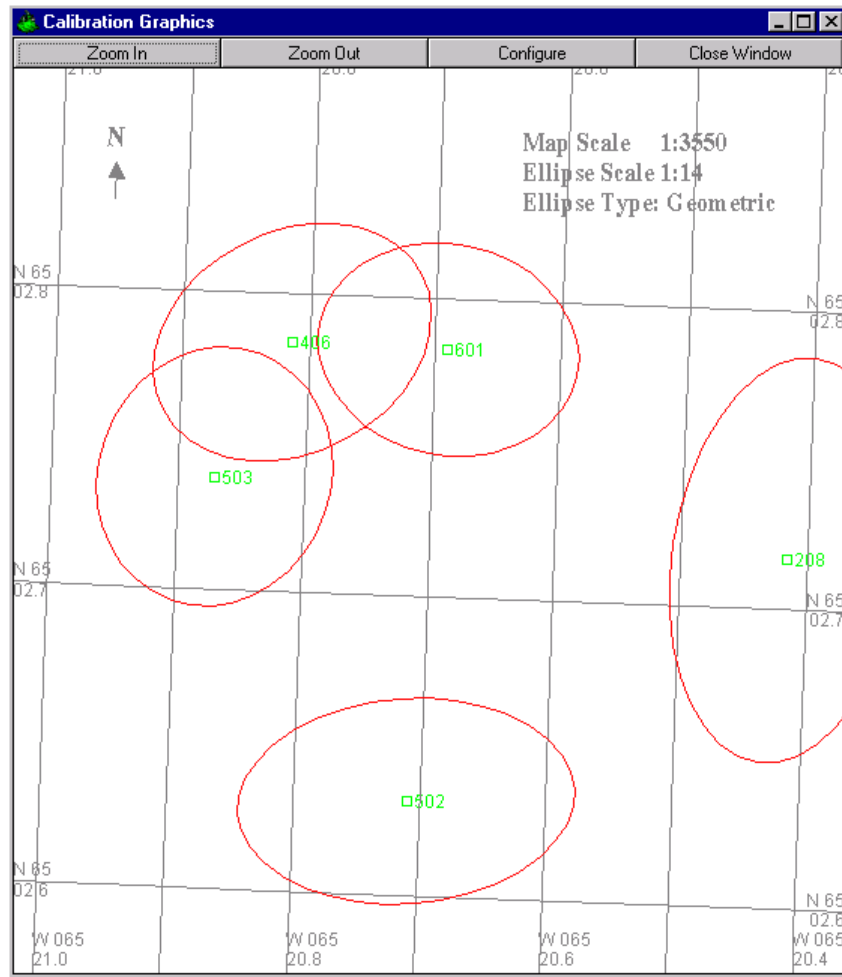
3 The supporting data options to include with the report are selected. The options are as follows:

- Statistics
 - RMS for each station
 - Based upon baselines only
 - Based upon depths only
 - All associated observations

- Absolute error ellipse for each station
 - Semi-major and minor axis scaled by the a posteriori variance factor (for the baseline component only) representing both the geometry and the quality of the baselines.
 - Orientation of the semi-major axis
 - Semi-major and minor axis not scaled by the any a posteriori variance factor and therefore representing the geometry only
- Relative error ellipse for all stations
 - Semi-major and minor axis scaled by the a posteriori variance factor (for the baseline component only) representing both the geometry and the quality of the baselines.
 - Orientation of the semi-major axis
 - Semi-major and minor axis not scaled by the any a posteriori variance factor and therefore representing the geometry only
- Standard Deviations
- Covariance Matrix
- Baseline Summary
 - For every baseline pair the following information is presented for all observations made *Forward* and *Reverse* (note that observations are displayed as slant ranges reduced to the Map Grid):
 - Number of observations made
 - Number of observations weighted in the solution (used)
 - Percentage of observations weighted in the solution (used)
 - Mean of the weighted observation
 - Standard deviation of the weighted observations.
 - Minimum weighted observation
 - Maximum weighted observation
 - RMS of residuals of the weighted observations
- Graphics
 - Graphic representation of the transponder array and supporting data (see step 4)
- Data
 - All Baseline Data
 - The data set is searched and all baseline observations are grouped by their to/from stations and presented in separate tables, with each pair being presented in two tables – one each for observations in each direction.
 - The data includes the raw TWTT observations, scaled LOPs (slant range distances reduced to the Map Grid), weighting factor and residuals.
 - The mean raw baseline (TWTT in ms), mean reduced baseline (grid slope range) and the RMS for the residuals are included in the

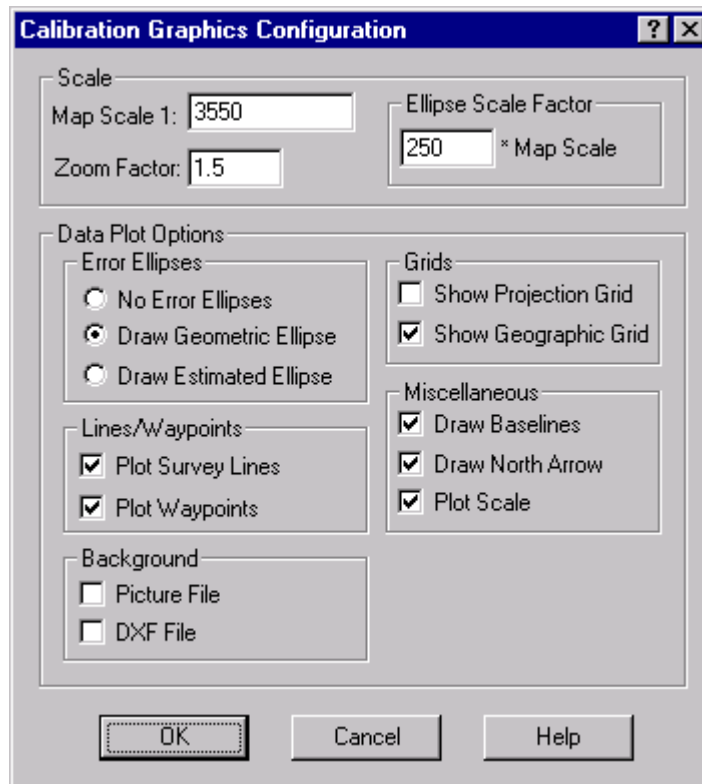
table, though it should be noted that the mean values are not used directly in the calibration solution and are included for evaluation only.

- The data is presented in tabular form.
 - Baseline Data Used
 - Same as the **All Baseline Data** option except only those baseline observations weighted in the solution are presented.
 - Depth Data
 - The data set is searched and all depths for each station are grouped and presented in separate tables.
 - The data includes the raw data, scaled data, weighting factor and residuals.
 - The mean raw data, mean scaled data and the RMS for the residuals are included in the table, though it should be noted that the mean values are not used directly in the calibration solution and are included for evaluation only.
 - Surface Range or Range/Bearing Data
 - For each data collection epoch the following is printed:
 - The data point number, epoch date/time and data item
 - Vehicle geographic and grid position at this epoch
 - Vehicle heading, course made good and speed at this epoch
 - The LOP data is then presented in a table listing the following:
 - LOP ID
 - Base Stn Name
 - Raw LOP
 - Reduced LOP
 - Weight Factor
 - Residual
 - Deskew value
- 4 If selected to include in the report, configure Graphic options. Click the Setup button in the Graphics panel.
- The **Calibration Graphics** window pops up.



The Zoom In and Out buttons can be used to examine the graphics window in detail. However, the printing of the graphics has been normalized to always plot the same size on paper.

- Click the **Configure** button.



- Select the options:
 - Scale
 - Map Scale
 - Zoom Factor (only affects viewing the Calibration Graphics window, the print out is normalized to always print the same size and area.
 - Ellipse Scale Factor
 - In order to better see the error ellipse, they can be scaled relative to the map scale used to draw the rest of the graphics.
 - Data Plot Options
 - Error Ellipses
 - No error ellipses drawn
 - Draw the Geometric ellipse (non-scaled ellipse)
 - Draw the Estimated Ellipse (scaled by the baseline a posteriori variance factor)
 - Lines/Waypoints
 - Plot current Survey Lines file
 - Plot current Waypoint file
 - Background
 - Plot current Picture file
 - Plot current DXF file
 - Grids

- Plot the Map Projection grid
- Plot the Geographic grid
- Miscellaneous
 - Draw the baselines observed
 - Draw a North Arrow
 - Draw the scale used
- Click the **OK** button to exit and apply the settings or **Cancel** to exit discarding the settings.

5 Select the output options from the following:

- To Printer

The data is formatted and printed directly to the printer in a report ready format utilizing *.rtf file formatting features using a temporary rtf file.

- To File

The report is written to the selected file.

- *.csv Format

The data mimics the printed report except that all data is comma delimited, including the tables. It ports directly into Excel. This format does not support graphics and therefore, even if selected, are not printed to this file.

- *.rtf Format

This file report is the same as the printed report. The temporary rtf file used to generate the printed report is copied to the selected file. This format supports the graphics option.

- Browse to select/set destination file

- Enables you to browse and select/set the destination file

- Display/edit destination file directly

- Displays the name and path of the destination file as well as allowing for direct entry of the destination file.

6 Click **Print Now** to exit the dialog and generate the printout or file as set. When printing the report to a file, WinFrog checks for duplicate file names. If a duplicate file name is found, you are asked if you wish to select a new file, in which case you can browse to select/set the new destination file. If this option is refused, you are asked if you wish to over-write the existing file or not. If it is decided not to over-write the file, the output to the file is aborted.

Or

7 Click **Exit** to exit without generating a report.

Recalculate LBL Data

Due to the configuration of WinFrog at the time of observation, it may be necessary to recalculate the reduced LOPs.

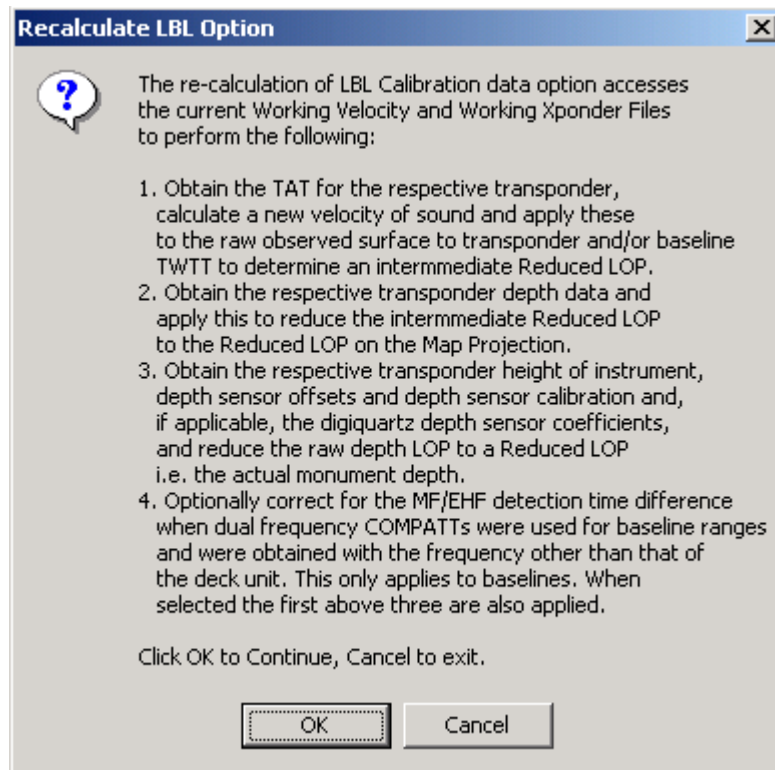
Examples of such situations are as follows:

- Invalid Working Velocities file used or a better one is now available.
- Incorrect turn-around-time (TAT) used for a transponder(s).
- Initial depth values used for the stations in error by tens of meters or more and thus potentially impacting the realtime projection of the observed range and baseline data to the map projection.
- Incorrect HI used for a transponder(s), depth sensor offset or calibration value.
- Incorrect digiquartz depth sensor coefficients used.
- Dual frequency COMPATT detection time correction was not applied when data was collected. (Sonardyne COMPATTs only)

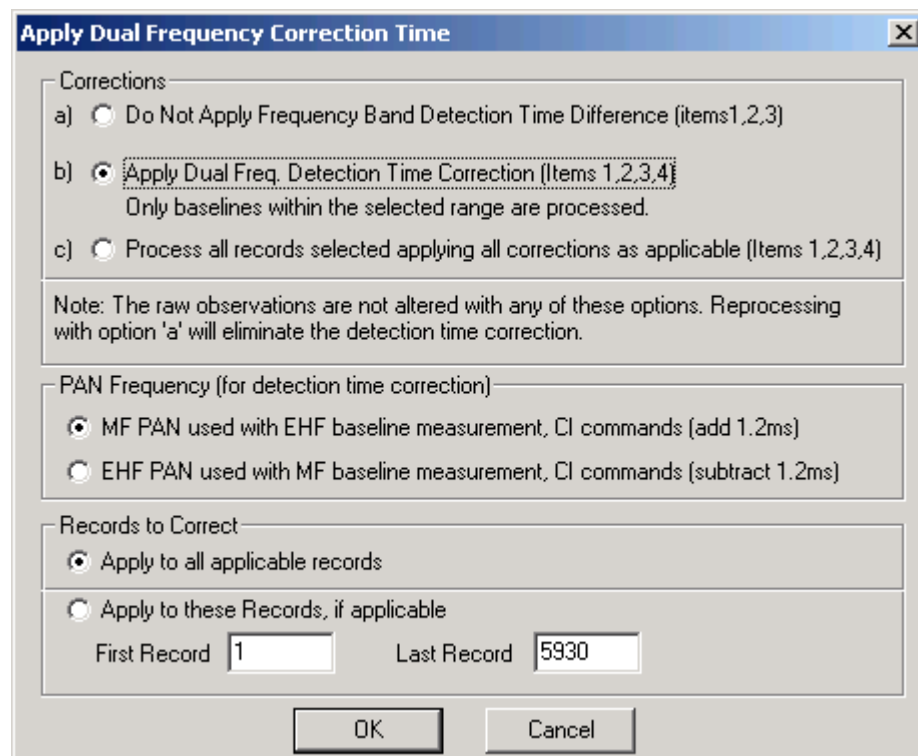
WinFrog allows for the recalculation of the reduced data from the raw data provided that correct Working Velocities and Working Xponders files are present when this is executed.

Note: The calibration file base station data is not automatically updated from the Working Xponder file data when the recalculate option is executed. The exception is any base station that has a depth observation associated with it. You must use the **Edit Xponder** feature to do this (see **Editing Calibration Station Information**).

Click the **Recalc LBL** button in the Calibration dialog. The following message box appears to inform you of exactly which recalculations will be performed.



Click **OK** to continue with the recalculation process or **Cancel** to abort. Clicking **OK** results in the display of the **Apply Dual Frequency Correction Time** dialog box.



Corrections

The top choice 'a' is for all but Sonardyne transponders. It is also the choice if the Sonardyne transponders were not dual frequency.

The second choice 'b' will allow one to correct baseline measurements if dual frequency Sonardyne transponders were used to collect the baselines and the frequency correction was not applied. This situation arises when the PAN or MK5 RovNav is one frequency, say MF, but the baselines were measured with the other frequency of the COMPATTS, in this case EHF. Because the PAN in this example is MF it will remove the MF detection time so the baselines need to be corrected by the difference between the EHF and MF detection times. Choose whether to add or subtract the correction from the group box **PAN frequency** below. Since the correction is applied to the raw data, all the computations listed (e.g. sound velocity, TAT, etc.) need to be performed. In this selection only baselines are recomputed.

The third choice 'c' will reprocess all observations and will apply the detection time correction mentioned above to the baselines.

Records to Correct

The Records to Correct group allows you to select specific records to process or all of them. The reference to 'those applicable' means that if option b above is selected only baselines will be recomputed.

If the re-calculation of the scaled LBL LOP is **successful**, you will see an information message box stating:

Re-calculation of Scaled LBL LOPs successfully completed

If the re-calculation was **unsuccessful**, a warning message box appears and provides information concerning the problem encountered. The warning messages are listed below:

General

- No Working Xponder File, unable to re-process LOPs
- No Working Velocity File, unable to re-process LOPs
- Continued un-reported errors...

The message 'Continued un-reported errors' only appears if the number of warnings results in a message that exceeds the allowed length.

Baselines

- Record 278, Transponder T106 to T110 (BL 4) depth(s) outside Velocity File extents.
- Record 281, Transponder Address 106 baseline to Tx code 13, To Transponder not in Xponder File.
- Record 276, Transponder Address 113 not in Xponder File.

Ranges

- Record 23, Transponder T106 depth outside Velocity File extents.
- Record 56, Transponder Address 107, Tx Code7, not in Xponder File.

Depths

- Record 23, Station T106, Transponder Address not in Xponder File.

Note: the appearance of any warning at all indicates the need to review the associated files to ensure the processing is being correctly applied.

Summary of the LBL Calibration Process

- 1 Evaluate the requirements and design the network array to provide the required coverage and geometry. Prepare the route that the vessel will follow to perform the data collection.
- 2 Deploy the array ensuring that reasonable estimates of the transponder positions are logged.
- 3 Review the directory on the WinFrog computer, to ensure that there is an appropriate directory in which to store the calibration file(s). Prepare the naming procedure for the calibration files. It is recommended that the name reflect the transponder array, calibration number, and the date.
- 4 Ensure that the correct **Velocity** file is opened and set to be the **Working Velocity** file (first toggle any existing **Working Velocity** files to **not working**). Configure the **Vehicle Text** window to display the **Working Velocity** file name.
- 5 Create a new Xponder file, open it, and set it to be the **Working Transponder** file. Add the relevant stations and transponder information with the correct parameters, including the best estimates for the positions. Address any double occupancy issues. The **Vehicle Text** window should be configured to display the **Working Xponder** file name.
- 6 Determine the depths of the deployed transponders as accurately as possible and enter these depths for the respective stations in the Xponder file.
- 7 Review the devices (as added to WinFrog) and the data items (as attached to the calibration vehicle).
 - Ensure that all devices are valid. Remove any from the vehicle that are not currently operational.
 - Check the configurations for the data items. Pay specific attention to the offsets and accuracy settings.
- 8 Finalize the data collection procedure and collect the data. Monitor the process to ensure any problems are detected quickly and addressed

immediately. Save the data regularly to disk.

- 9 Upon completion of the data collection process, make sure the data are saved to disk. Using Windows Explorer™ or a similar application, copy the file to an archive directory, and set it to **read only**. This will secure the data prior to proceeding with the calibration processing.
- 10 Review the data, editing out (de-weighting) the obvious outliers. Use the graphical editor, to view the LOPs, not the residuals.
- 11 Setup the calibration and solve. If the solution does not converge, review this manual for potential reasons and address them. If the solution does converge, review the data using both the LOP and residual graphical editors. Refine the editing by removing any questionable data.
- 12 Repeat Step 11 until the calibration solution is optimized, indicated by the transponder coordinates remaining unchanged between iterations, the correction values remaining unchanged between iterations, residuals for the used LOPs consistent with the expected accuracy of the systems used, an acceptable a posteriori variance, and passing of the χ^2 test.
- 13 Save the calibration data to a final calibration file and print a report. Remove any unwanted, intermediate calibration files from the directory.

USBL Calibrations

The purpose of the USBL calibration is to determine the errors associated with the mounting orientation of the USBL hydrophone with respect to pitch, roll, and heading and the velocity errors associated with the velocity of sound data used in the USBL system. This is required in order to eliminate these sources of errors when using the USBL system to either position a remote vehicle with a beacon attached or the vehicle with the hydrophone attached from a fixed beacon.

The USBL calibration, as performed by WinFrog, uses a rigorous least squares adjustment to first determine the position of the beacon used for the calibration, and then to simultaneously solve for the four unknowns, pitch correction, roll correction, heading correction, and velocity (scale) correction.

When WinFrog performs the least squares adjustments it uses the USBL observations as ranges from the hydrophone to the beacon. If the data is collected in a symmetric pattern about the beacon, the use of ranges in the least squares adjustment will eliminate most of the effects of ray bending. This is because the ray bending mostly affects the direction of the ray with only a small effect on its length. And the length effect will mostly be eliminated with symmetrically collected data. WinFrog also allows you to calculate the effect of

ray bending. This requires that the data come from a Sonardyne USBL system outputting the CSV Surveyor's Acoustic message.

This section details the steps to follow to perform the USBL calibration, including the following:

- Preparation of WinFrog for performing the calibration data collection and processing.
- Vessel track for data collection.
- Collecting the data.
- Reviewing and editing the data.
- Processing the calibration.
- Application of the results.
- Troubleshooting the process.

Reviewing and editing of the data and the processing is an iterative process.

Note: You can also use this technique to simply calculate the position of USBL beacons. In this case, the differences between what is discussed in the remaining part of this chapter and what would be required are the data collection pattern, the design of which would follow the guidelines discussed in the preceding **LBL Calibration** section, and the processing, which would stop once the beacon positions were determined.

USBL Calibration Preparation

In preparation for performing a USBL Calibration, WinFrog must be properly configured. Although WinFrog provides recourse during processing to correct for omissions and errors in the setup for the calibration, it is always better (and easier) to perform the setup correctly and eliminate the need to use these features.

Key Points to Review Prior to USBL Calibration

- 1 It is important that the correct **Working Transponder** file is loaded and available prior to the configuration for data collection. Check that there is a working file and it is the correct one.

When performing the calibration and when operating the USBL for positioning (if fixed beacons are being used), configure the **Vehicle** window to display the name of the **Working Transponder** file.

- 2 The **Transponder** file must contain, at a minimum, the beacon that is to be used for the calibration, the initial approximate position and depth for this beacon, and if the Sonardyne CSV acoustic message is used then the beacon turn around time must be entered. The depth is important because it is involved in the reduction of the observations to the map grid. Depths for the beacon can be determined using depth interrogations, if it is equipped with a depth sensor. Alternatively, the ship can pass directly over the deployment

position while ranging to the beacon and the shortest range can be used for the depth. Other options include using a sounder or from a chart.

Note: A working velocity file is only required if the travel time from the USBL system is to be used, such as the Sonardyne CSV acoustic message or Simrad SSB telegrams. Otherwise, the velocity is entered into the USBL system itself.

- 3 Ensure that all positioning and related devices are correctly configured, including operational settings and sensor offsets. These devices must be active and receiving data. If new data are not present for any POSITION or USBL device that is attached to the calibration vehicle, no calibration data will be collected. The USBL HYDROPHONE data item must be attached to the vehicle being used for the calibration.

If an attitude sensor is present it must be injected directly into the USBL system. WinFrog does not currently support application of attitude data to USBL data or sensor offsets. Note that this is the only device for which this is true, all other devices and offsets support application of attitude data.

Offsets from the USBL system's hydrophone to a reference point on the vessel must be entered into the USBL system. In most cases, these are already present because they are required to reference the data to the **Center of Gravity (COG)** of the vessel for output to a **Dynamic Positioning (DP)** system. If this is not the case, offsets to the same **Common Reference Point (CRP)** that will be used by WinFrog are to be entered, making sure that the vertical reference is the waterline. This is done so that the lever arm to the transceiver is corrected for attitude, as well as the observations from the transceiver to the beacon.

NOTE: The USBL system must not be configured to operate in **Fixed Beacon Depth** or **Telemetered Beacon Depth** mode, or similar. The Z component as determined from the analysis of the return signal at the hydrophone head is critical for the USBL Corrections Calibration process, in particular for the resolution for pitch and roll correction determinations. The use of an operating mode that uses some other means of determining the Z component will result in un-usable calibration data. It should be noted that once observed and recorded, the data cannot be re-engineered to make it usable.

- 4 It is strongly recommended that the USBL HYDROPHONE data item always be configured to **Positioning - Secondary**. While it can, in most cases, be configured to **Positioning - Primary** without affecting the data collection and subsequent processing, there are situations (discussed later) that require it be set to **Secondary**. Another consideration is that when set to **Positioning - Primary**, WinFrog will use the USBL to compute the position of the vessel. Since this determination will be based upon an estimated position for the

fixed beacon, and USBL is less accurate than the DGPS likely used, it will result in a jump in the vehicle's position. This situation may cause alarm among personnel, such as the helmsman, who are using the WinFrog screens.

- 5 The computer directories should be setup such that the calibration data have a specific location to which they are saved. The saving and archival process for the files should be decided upon to ensure that the necessary steps are followed to ensure safe file saving and archiving.
- 6 The USBL beacon used for the calibration should be deployed in an area that will permit adequate maneuverability to perform the data collection pattern.

The Acoustic Calibration Dialog for Data Collection

The **Acoustic Calibration** dialog, from which all data collection, saving, loading, editing, processing, and reporting is performed, can be accessed in several ways.

To Access the Acoustic Calibration Dialog

- 1 Set the **Vehicle Text** window to display the information for the vehicle to which the USBL Hydrophone is attached.
- 2 With the cursor in the **Vehicle Text** window, right-click to access the pop-up menu.
- 3 Select **Acoustic Calibration**.

Or

- 4 From the Main Menu, select **Configure > Vehicles**.
- 5 Highlight the vehicle to which the USBL Hydrophone is attached, and click the **Acoustic Calibration** button.

Or

- 6 From the **Acoustic Window**, click on **Configure > Select Vehicle for Calibration**, then click on the vehicle to which the USBL Hydrophone is attached.
- 7 Then click on **Configure > Calibration**.

Note: WinFrog is a multi-vehicle system. Ensure the vehicle that has the **USBL HYDROPHONE** data item added to it is the one selected/displayed before clicking the **Cal** button or using the right mouse button to access the pop-up menu. Normally this is not a problem as the button is disabled or the menu item isn't available, however, it may be enabled if another acoustic data item is present,

such as LBL HYDROPHONE. If the incorrect vehicle is selected and the **Calibration** dialog is accessed, you will still be permitted to setup the calibration data collection, but no data will be collected because no USBL data items are associated with that vehicle. If it appears that no data are being collected, check for this problem.

The **Calibration** dialog box is shown in the next figure. This dialog box is modeless and does not restrict access to other WinFrog windows while open. It is recommended that this be left open during the data collection process.

The following details those controls associated with the USBL Calibration data collection process.

Note: The first time this dialog is opened for a vehicle, it creates a calibration data set including a copy of the information from the working transponder file. Each subsequent time the Calibration dialog is opened, WinFrog compares the current Working Transponder file against the transponder station information contained in the Calibration data set and informs you of

differences between the Working Transponder file and the Calibration Transponder station data (coordinate variations and discrepancies in stations). You can then decide whether to overwrite the Calibration data set station information with that from the Working Transponder file, or ignore the differences and keep the Calibration data set station information untouched.

Data Collection Control

You control the type of data to collect with the controls in this section. Once selected, the **Apply...** button will change to reflect the changes that will be applied if it is clicked. Alternatively, selecting the data collection type and exiting the dialog with **OK** will also apply the settings.

Off	Stops data collection
LBL Ranges	Not applicable to USBL.
II Ranges	Not applicable to USBL.
USBL Data	Turns on the collection of USBL data. This is applicable for all USBL systems.
Min Interval	This controls the minimum data collection interval, in seconds, for the USBL data. During data collection, WinFrog checks for the presence of new data from the associated devices and then checks to see if the minimum interval has been reached or exceeded, and if so, logs the data. If either of the preceding checks fails, no data are logged.
LBL Baselines	Not applicable to USBL.
Depths	Not applicable to USBL.
Apply... button	The text of this button displays the collection setup that will be applied when clicked. Click this button to cause the current Data Collection setting(s) to be applied without having to close the dialog.
Points In Memory	The total number of points currently loaded/present in WinFrog memory. It is very important to note that when collecting calibration data, WinFrog logs the data to memory and not directly to disk. It is only written to disk when specifically directed by the operator.
Clear	This will clear the current calibration data in memory. Note: if these data have not been saved to disk, they are not recoverable after

Graphics On/Off

this is executed. A confirmation prompt appears when the **Clear** button is clicked. Controls the display of the data collection positions in the **Graphics** and **Bird's Eye** windows. Thus, the **Graphics** display provides both a means for monitoring the progress of the data collection and clear illustration of the geometry. After setting this option, the **Apply...** button must be clicked or the dialog exited with **OK** in order for the changes to take affect. You may also have to refresh the graphics window by resizing.

Data Load/Save

Current File

This is a read only control giving the path and name of the currently loaded calibration file or the last one that had been in WinFrog memory.

Load

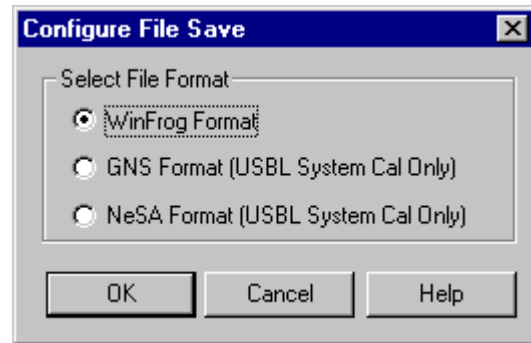
Enables the browsing of available storage media to select a calibration file (*.cal) and load it into memory. **Note:** this action automatically clears all calibration data currently in memory. You are warned of this and are given the option to cancel the action. You are also prompted as to whether or not you wish to purge the current Calibration data set transponder information. If there is a difference between the station information of the Calibration data being loaded and the current Working Transponder file, you are informed of this and given the option to overwrite the Calibration data set station information from the Working Transponder file or ignore the difference.

Save

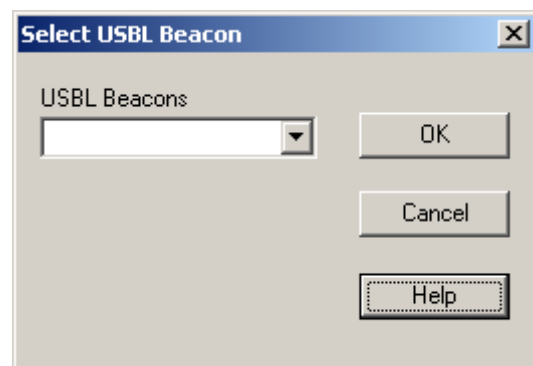
This is only available if there are calibration data in memory.

Enables browsing of available storage media to select an existing file or enter a new file name to save all the data currently in memory to disk. **Note:** when data are saved to an existing file, that file's contents are replaced with the contents of the memory. When this option is accessed and USBL data is present, you are prompted for the file

format to use. The next figure shows the available options.



The WinFrog format supports both LBL and USBL calibration data; the GNS and NeSA formats support only USBL calibration data. In all cases, the data should first be saved using the WinFrog format and if desired, resaved in the other formats. If only saved in either GNS or NeSA formats, some data will be un-recoverable and the file will not be able to be processed by WinFrog to the fullest capability of the software. If the radio button for either the GNS or NeSA format is clicked, you will immediately be prompted to select the USBL beacon whose data you want to save.



Select the beacon from the drop down list and click OK to exit. Upon exiting the **Configure File Save** dialog box with OK, you are then able to browse the directories. If there are no USBL data present, the WinFrog format is defaulted to and WinFrog goes directly to the browse. Future development.

AutoSave

USBL Calibration Data Collection

This section addresses the preparation for data collection and the data collection and saving itself. It includes the design of the pattern the vessel will take to collect the data and the configuring of WinFrog to collect and log the data.

There is no limit to the number of data points collected and used for the calibration, other than the constraints placed by the available RAM and disk space.

USBL Calibration Vessel Track for Data Collection

The objective of the vessel track, or data collection pattern, for the calibration data collection process is to present all sides of the ship to the beacon in a uniform and controlled manner. To be more specific, the objective is to collect data while orienting the USBL hydrophone relative to the deployed beacon such that the direction from the hydrophone to the beacon is (at a minimum) as follows:

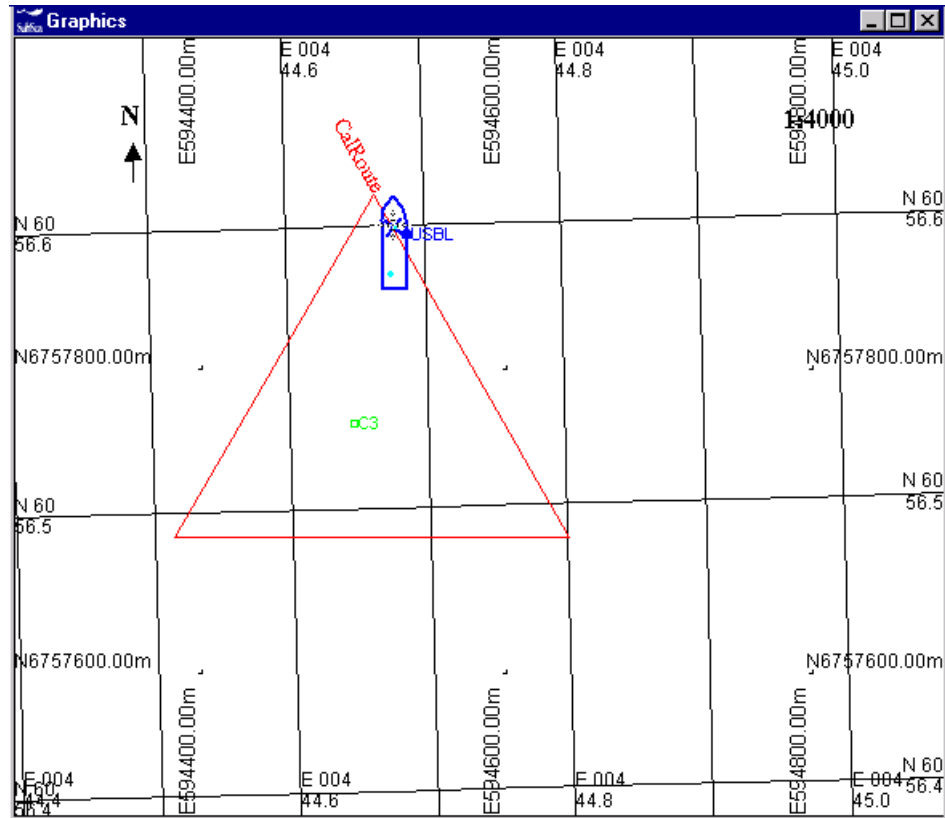
- Along the fore/aft alignment with presentation to the beacon in both the forward and aft direction.
- Along the port/starboard alignment with presentation to the beacon in both the port and starboard direction.

Though the WinFrog calibration processing will process data collected in any manner, there are industry-standard patterns that are recommended. These are the **triangle** and **cardinal points** patterns.

Note: It is important that the manufacturers specifications, recommendations and guidelines are followed to ensure the optimum performance of the USBL system is achieved, both for calibrating and real time operations. Of particular importance is the horizontal distance from the beacon that the vessel should use when designing the collection pattern. The following documentation states 1.5 times the water depth, but this should be adjusted as required in order to achieve the optimum performance from the USBL system.

Triangle Pattern

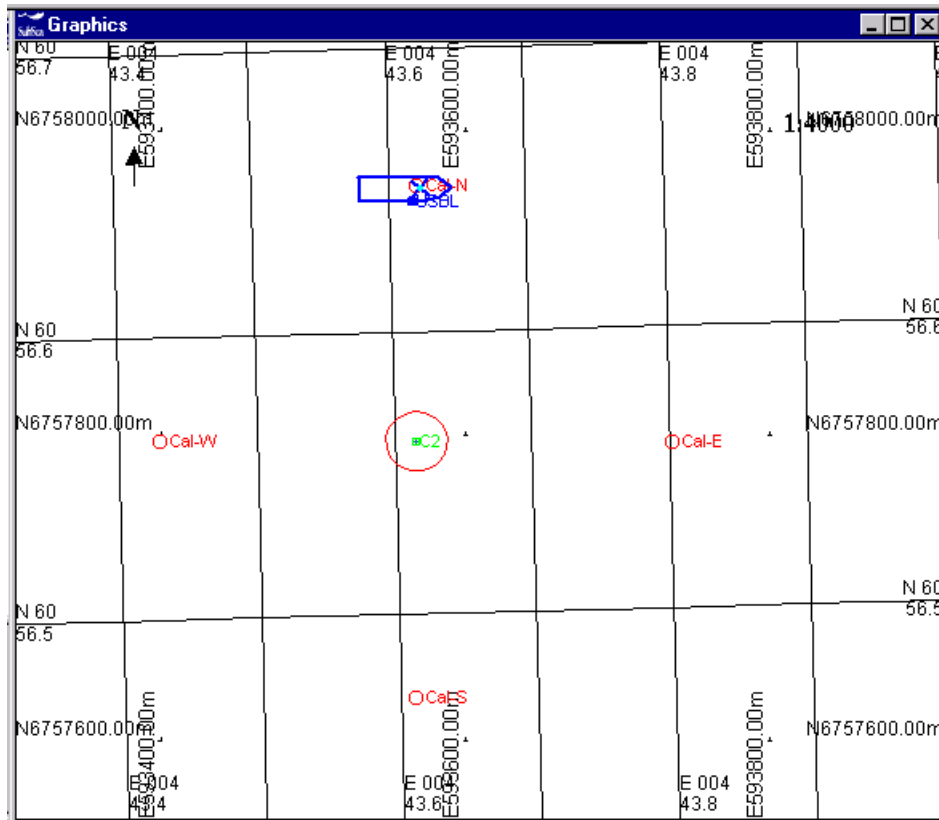
The triangle pattern consists of an equilateral triangle with apices approximately 1.5 times the water depth from the beacon (horizontally distant). The vessel travels along the track maintaining a constant heading, the heading being determined as perpendicular to one of the sides of the triangle. Data collection is continuous while traveling along the route. The next figure is an example of a triangle pattern vessel track. Data should also be collected directly over the beacon.



Cardinal Points

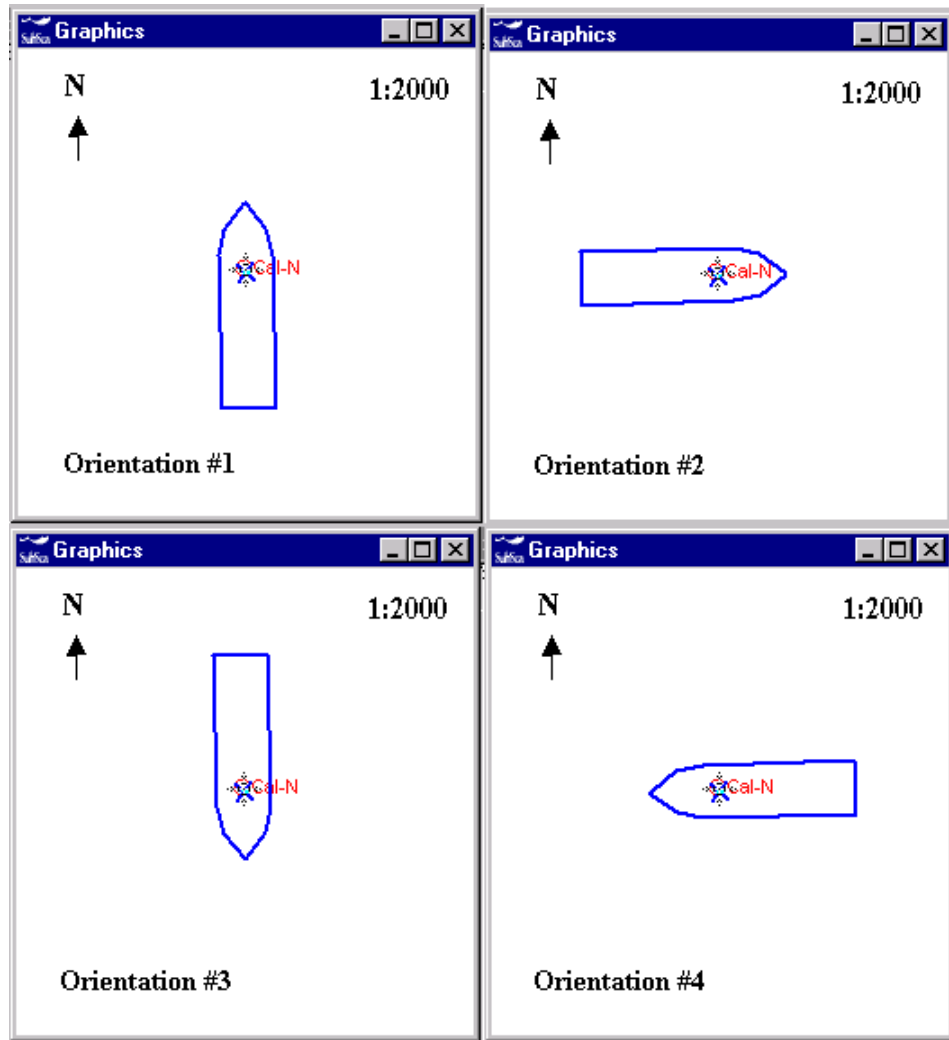
The term **Cardinal Points** pattern comes from the four main points of the compass. Designing the pattern involves assessing the current environmental conditions and determining the optimum heading that the vessel can maintain while holding station. Then using this heading as a reference, determine four points that are at a distance of approximately 1.5 times the water depth of the beacon from the beacon (horizontally distant) such that the azimuth from the beacon to the first point is equal to the aforementioned vessel heading, the azimuth to the second point is this same vessel heading plus 90° , the azimuth to the third is this heading same vessel heading plus 180° and the azimuth to the fourth is this same vessel heading plus 270° . A fifth point directly over the beacon is also usually included.

The following figure illustrates the location of the four **cardinal** points determined for a vessel heading of 0° . Note that the same points would be used if the vessel heading was determined to be 90° , 180° or 270° . They are labeled Cal-N (where the vessel is shown to be), Cal-E, Cal-S and Cal-W respectively. The beacon is shown as C2.



At each of the four cardinal points and the point directly over the beacon, the vessel collects data while holding station at four different headings. These headings are equal to the azimuths from the beacon to the four cardinal points as described above. In the above example, these headings would therefore be 0° , 90° , 180° and 270° .

The following figures illustrate the orientation of the vessel for the five data collection positions (each cardinal point and one over the beacon) based upon the above example.



The data collection is not continuous, but is started and stopped such that data is only collected when the vessel is at a cardinal point and is maintaining one of the four required headings. It is stopped while the vessel changes from one heading to the next and while transiting between the cardinal points.

Alternatives

The first pattern is only suited to vessels equipped with a dynamic positioning (DP) system. WinFrog employs a least squares adjustment to simultaneously solve for the four unknowns of the USBL calibration or the beacon coordinates that is not constrained by the pattern employed. Therefore, alternatives to these patterns are possible. To eliminate biases the pattern should have observation on opposite sides of the beacon.

Note: it is very important to note that the use of an alternative data collection pattern may influence the calibration setup, processing and results. (See the **WinFrog Setup for USBL Calibration Data Collection** and the **Transponder Position Calibration** sections for more details.)

General

It should be noted that in the case of the triangle and cardinal points patterns, it is the relative relationship and orientation between the vessel and the beacon that is important, not the absolute. Thus, in the case of the triangle pattern, the triangle can be rotated to any orientation as long as the vessel maintains the same heading (perpendicular to one leg of the triangle). Similarly, in the case of the cardinal points pattern, the actual pattern could be rotated to any orientation as long as the vessel's headings at each collection point matched the azimuths from the beacon to each of the points. This would hold true for an alternative pattern too.

WinFrog Setup for USBL Calibration Data Collection

This section explains the setup of WinFrog for the purpose of collecting data for a USBL calibration. The assumption is made that the USBL device and other required devices have been added to WinFrog and that the associated data items (USBL HYDROPHONE, POSITION, HEADING, etc.) have been attached to the calibration vehicle.

USBL Hardware

The setup of the USBL system is important in order to obtain optimum results from the calibration. The following steps must be followed.

- 1 If an attitude sensor is present, it must be injected directly into the USBL system. WinFrog does not currently support application of attitude data to USBL data or USBL sensor offsets. **Note:** this is the only device for which this is true, all other devices and offsets support application of attitude data.
- 2 Offsets from the USBL system's hydrophone to a reference point on the vessel must be entered into the USBL system. In most cases, these are already present because they are required to reference the data to the **Center of Gravity (COG)** of the vessel for output to a **Dynamic Positioning (DP)** system. If this is not the case, offsets to the same **Common Reference Point (CRP)** that will be used by WinFrog are to be entered, making sure that the vertical reference is the waterline. This is done so that the lever arm to the transceiver is corrected for attitude, as well as the observations from the transceiver to the beacon.
- 3 The USBL system must not be configured to operate in **Fixed Beacon Depth** or **Telemetered Beacon Depth** mode, or similar. The Z component as determined from the analysis of the return signal at the hydrophone head is critical for the USBL Corrections Calibration process, in particular for the resolution for pitch and roll correction determinations. The use of an operating mode that uses some other means of determining the Z

component will result in un-usable calibration data. It should be noted that the data cannot be re-engineered to make it usable.

- 4 The USBL systems may support the direct entry of USBL corrections. Since these are used to correct the data prior to output to peripheral hardware, they can be left in the system and the WinFrog calibration is then used to refine the corrections. This is particularly true for corrections entered to correct for gross USBL installation errors, such as the mis-alignment of the transducer head by 180°. WinFrog applies a rigorous least squares adjustment and makes no assumptions that the corrections are small angles. However, it is unable to resolve a heading error of 180°.

Note: due to the possibility of confusing sign conventions, it is recommended that the results of the WinFrog USBL Calibration not be entered directly into a USBL system. Rather, they should be entered and applied within WinFrog. The sign conventions used by WinFrog and presented to you are provided in such a manner that the sign conventions are easily followed. The WinFrog results of the calibration are entered into the WinFrog USBL hydrophone configuration exactly as shown and printed.

Vehicle Configuration

The vehicle configuration consists of editing the data item's associated with the calibration vehicle. This is accomplished using that vehicle's **Configure Vehicle-Devices** dialog.

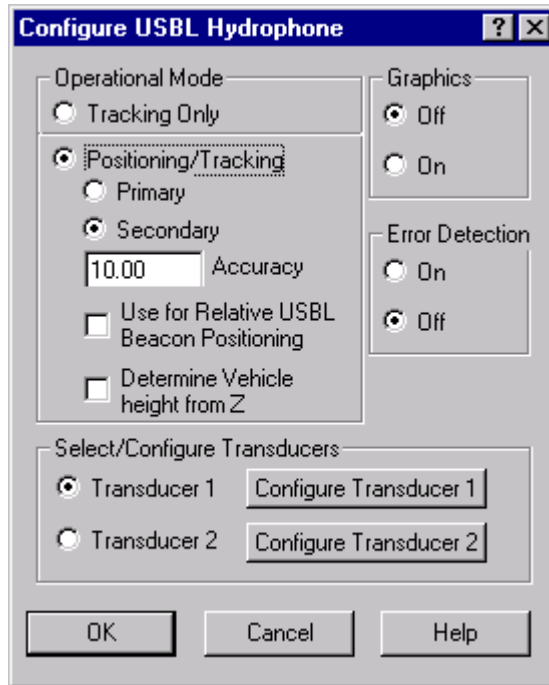
It is recommended that the **Kalman Filter** be turned on **and Dead Reckoning** enabled for the USBL Hydrophone vehicle.

Note: all POSITION and USBL HYDROPHONE data associated with the calibration vehicle will be logged to the calibration file, along with general vehicle data. In addition, a standard deviation is logged for each data item. This is used to determine the initial weighting for that data item in the calibration processing (inverse of the standard deviation squared).

If a **POSITION** data item is configured as **Primary** its standard deviation is logged in the calibration file. If a **POSITION** data item is configured as **Secondary**, the standard deviation logged for that data item is 0 or Off. The standard deviation logged for the USBL HYDROPHONE is the accuracy entered for this data item.

Note: it is recommended that the accuracy settings be “pessimistic” and relative with respect to the different systems involved. Reasonable settings for a DGPS are 3 to 5 meters and 7 to 10 meters for a USBL system (HYDROPHONE and BEACON). The same relative relationship should be maintained in real-time and calibration processing.

The following figure illustrates a typical USBL HYDROPHONE configuration as attached to a vehicle.



Note: it is set to **Secondary**. As previously mentioned, while setting this to **Primary** may not affect the calibration processing (see note below), it will affect the real-time positioning. If set to **Primary** WinFrog will use the fixed beacon and USBL data to position the vessel. This will likely produce inaccurate positioning with respect to DGPS and thus position jumps that may result.

Note: a general procedural recommendation is that the USBL HYDROPHONE data item always be set to **Positioning - Secondary**. If an alternative data collection pattern is used, it is critical that the USBL HYDROPHONE data item be set to **Secondary**. If set to Secondary, you are not constrained during the processing by an incorrect decision made at the data collection.

Though it will not affect the data collection, it is recommended that the **Use for Relative USBL Beacon Positioning** and **Determine Vehicle height from Z** check boxes be **unchecked**.

To Configure the Transducer Settings

- 1 Click the **Configure Transducer** button associated with the Transducer selected for use. The Configure USBL Transducer dialog is shown in the next figure.

Configure USBL Transducer

Calibration Corrections

Range Scale Factor	Head Rotation Correction
1.00000	000.0
Pitch Correction	Roll Correction
0.00	0.00

NOTE: Corrections sign conventions are
Roll=(+)Stbd down; Pitch=(+)Stern down

USBL System Internal Offsets

Offsets from the point the data is related to, to the transducer. These values will be subtracted from the USBL output data to get data related to the transducer.

Fore/Aft	Port/Stbd	Z (down +)
5.00m	1.00m	11.00m

WinFrog Offsets, from CRP to Transducer

Fore/Aft	Port/Stbd	Depth (down +)
5.00m	1.00m	11.00m

OK Cancel Help

Is the calibration a confirmation or initial calibration? If it is a confirmation calibration, the settings for the **Calibration Corrections** will probably already reflect the results of a previous calibration and should be left as they are. If the calibration is the initial determination of the correction values, the settings for the corrections must be reset to the following:

Range Scale Factor	1.
Head Rotation Correction	0.
Pitch Correction	0.
Roll Correction	0.

Note: during the calibration process you have recourse to reset the process, i.e., to revert to the original raw data unaffected by any calibration corrections applied either at the time of data collection or during the processing to that point. Therefore, an incorrect decision at this point is not irreversible.

The offsets must also be confirmed to be correct. There are two sets of offsets to enter for a USBL system. The first are the offsets currently entered into the USBL system itself to reference the data to a specified vessel reference point (i.e. COG). Note the sign convention of these offsets; the values are entered as measured from the said reference point to the transducer. A vertical offset is positive if the transducer is below the reference point.

The second set of offsets are the standard WinFrog sensor offsets with the respective sign convention, i.e. values are as measured from the CRP to the sensor and a vertical offset is positive if the sensor is below the CRP. Remember, the WinFrog CRP must be at water level and thus, the vertical offset is actually the draft of the transducer.

Note: there is no recourse to the entry of incorrect USBL system offsets within WinFrog once the data is logged, i.e. if the offsets from the USBL reference point back to the transducer (as entered directly into the USBL system) are incorrectly entered into WinFrog, the data can not be used for the calibration. If this happens, the calibration data file can only be recovered through manipulation using a spreadsheet program. There is however, recourse for the incorrect entry of the WinFrog sensor offsets.

The previous figure is an example of the WinFrog CRP and the USBL system's reference point being, in fact, the same point.

To Collect USBL Calibration Data

The collection of the calibration data is controlled directly from the **Acoustic Calibration** dialog.

- 1 Set the minimum data logging interval.

Since the only limit on the amount of data logged is the available computer memory and available storage media space, it is better to set this interval fairly small. If too long, any problems (i.e. acoustic noise) during the data collection may result in unacceptable gaps in the designed collection track. It is easier to edit out data than wish there was more data present.

- 2 Toggle the **USBL Data** radio button.
- 3 Click the **Apply** button.

As points are collected, the **Points in Memory** text will update and, if the **Graphics On** is selected, the data collection points will be displayed in the **Graphics** windows.

New data will not be collected until the minimum time has elapsed and then only when the next new data are received for all USBL HYDROPHONE and POSITION devices attached to the vehicle.

When the data collection is complete, or at any time the collection is to be suspended, toggle the **Off** radio button and click the **Apply** button. It is important to note that the data collection can be suspended and resumed at any time. This is particularly relevant when using the **cardinal points** pattern.

WinFrog does not support the writing of the calibration data directly to disk as it is collected. The saving of the calibration data to file is an operator-initiated action.

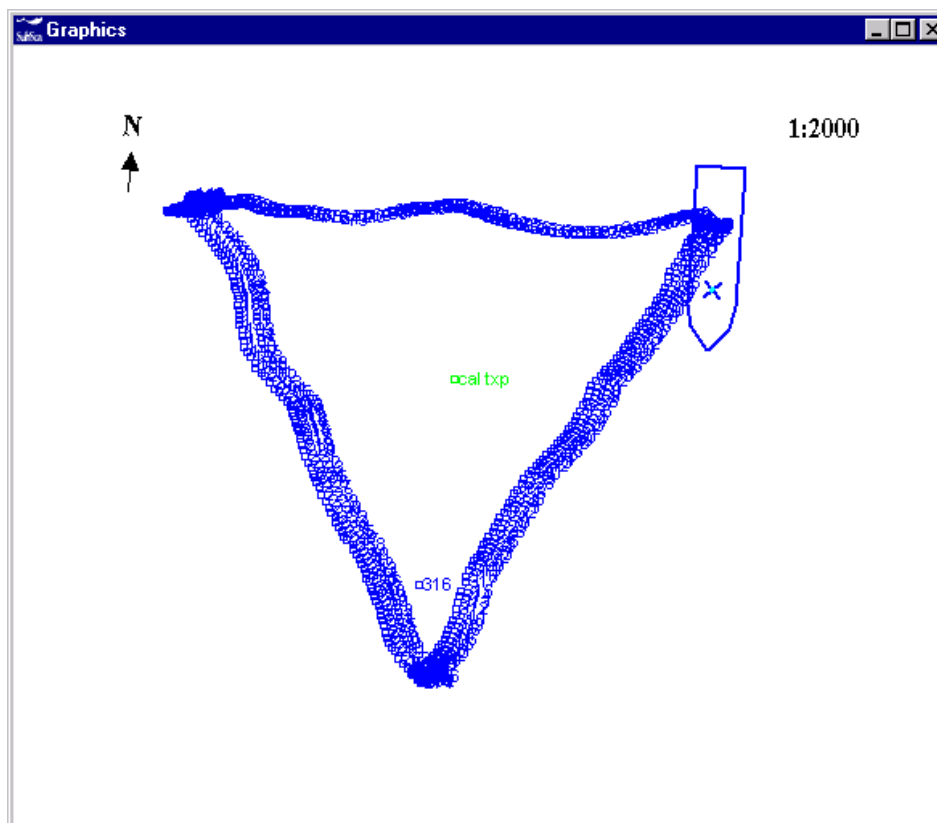
To Save Calibration Data to File

- 1 From the **Acoustic Calibration** dialog, click the **Save** button.

This can be performed at any time there are data present in memory. It is very strongly recommended that the data be saved regularly to a file during the collection process. Remember, as mentioned previously, when data are saved to an existing file, the contents of that file are replaced with the complete data currently in memory. Thus, though this provides an easy technique for repeatedly saving the data to the same file during the data collection process, care must be exercised to ensure that the correct file is selected.

In addition, an existing data file can be loaded and data collection turned **on** to add more calibration data.

The following figure illustrates a completed calibration collection based upon the **Triangle** pattern.



The calibration files (*.cal) are written to disk using ASCII text and as such are easily accessible and readable. The format for these files is given in the **WinFrog File Formats** appendix of this manual.

Note: once the data collection is complete, the original calibration data file should be archived and set to **read only**. Then, make a copy for actual use in WinFrog. In this way, you can always revert to the original data file if necessary.

USBL Data Collection - Monitoring

The number of points collected are displayed in the Calibration configuration dialog box. However, the data collection process is best monitored with the **Calibration Status** window in the **Acoustic Window** (see the **Operator Display Windows** section).

USBL Calibration Data Editing

The data editing can be performed any time there are data available in WinFrog memory, though it is generally done once the data collection process is complete.

The purpose of viewing and editing the data is to locate and remove those data that are considered to be invalid. WinFrog provides you with graphical editors that enable easy inspection of the data, detection of any trends, and direct editing capabilities. The graphical editors allow you to view the LOP data directly and the LOP residuals. The former is best used for investigating trends and visually detecting outliers, usually visible due to the associated break in a trend, and thus, is a very important pre-processing tool. The latter is valuable for refining the editing in subsequent iterations.

Note: the term editing the data consists of setting the weighting value for any given LOP and changing data item offsets. You do not have access to the actual data for the purpose of altering values.

An initial review of the data should be made prior to any calibration calculations. The purpose of this review is to find obvious flyers and bad data and remove them from the solution immediately. Then, after each calibration solution, the data should be viewed again for analysis and any further required editing.

To View USBL Calibration Data for Editing

- 1 From the **Calibration** dialog box, click the **Edit Data** button.

Calibration for Vehicle1

Data Collection/Control
☒ Off Apply Data Collection Setup Now

☐ LBL Ranges
☐ II Ranges 61 Points in Memory
Clear

☐ USBL Data
 Min Interval (seconds) 1
 Graphics ☐ On ☒ Off

☐ LBL Baselines Setup
☐ Depths Setup

Data Load/Save
 Current File C:\NAVDATA\USBLRayBent2.cal
Load Save AutoSave AutoSave Off

Calibration Calculations
Edit Data Recalc LBL Xpdr Report
Calculate Reset USBL USBL Report
Statistics Recalc USBL Edit Xponder

OK Cancel Help

(The **Edit Data** button is only accessible if there are data present in memory.)

WinFrog opens a **Calibration Station** dialog box, as shown in the next figure, which displays the vessel position, GPS position LOPs and USBL range, bearing, depth (and if available TWTT) LOPs.

Calibration Station

Records | Ranges | Baselines | Depths | Constraints

Record Information
 Data Point : 12 12-11-03 15:57:06.9
 S06 19.1430 E011 03.2229
 N9301569.55m E450637.95m
 Hdg: 30.91, Advc: 132.0038, Spd: 0.037

Base Stn	ID	Raw LOP	Scaled LOP	WF	Res	Deskew	Epoch
707	B31-R	1198.62	1198.604615m	0.0...	-1.515148m	0.000000m	15:57:06.9
707	B31-B	267 51.9980	267 49.0507	0.0...	223.6s	0.000000m	15:57:06.9
707	B31-D	-1170.87	1170.870014m	0.0...	1.808014m	0.000000m	15:57:06.9
707	B31-T	1605.528ms	1198.603308m	10....	-1.513841m	0.000000m	15:57:06.9
SimGps	N	S06 19.2330	N9301569.59m	5.0...	-0.034469m	-0.000260m	15:57:06.8
SimGps	E	E011 03.0443	E450637.96m	5.0...	-0.013753m	0.000280m	15:57:06.8

OK Cancel Help
Constraints Off On/Edit Wf Gating Plot Data Plot Res Sensor Offset

Note: the example shown above includes four USBL based LOPs, R, B, D and T. The T LOP is two-way-travel-time and is not available for all USBL devices. If it is not supported by the respective USBL driver in WinFrog, this LOP is not displayed.

The Calibration Station dialog box presents you with several options for viewing the calibration data. For a USBL Corrections calibration, generally only the **Records** and **Ranges** tab are relevant. The available editing options accessed via the buttons located on the right side of the dialog depend on the tab selected, and in the case of the **Records** tab, the type of LOP selected.

To edit an LOP, simply select it and click the appropriate button on the right. Make the editing changes as required and exit the editing dialog with **OK** to save the editing changes or **Cancel** to discard any changes made.

The following details the options available and the associated dialog boxes.

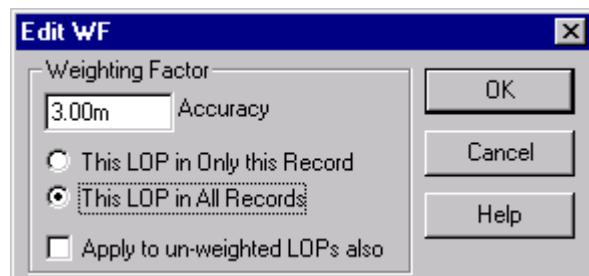
Off

This simply sets the weighting factor for the selected LOP to 0, which de-weights it from the solution. This option is only available with the **Records** and **Constraints** tabs.

When associated with a constraint, this toggles it between applied and not applied.

On/Edit Wf

This enables you to edit the actual weighting factor for the selected LOP. This control extends to applying the new weighting factor to the selected LOP in the displayed epoch only, or in all epochs in which this LOP is present. You can also control if the new weighting factor is to be applied to those LOPs already de-weighted. The next figure shows the associated dialog box.



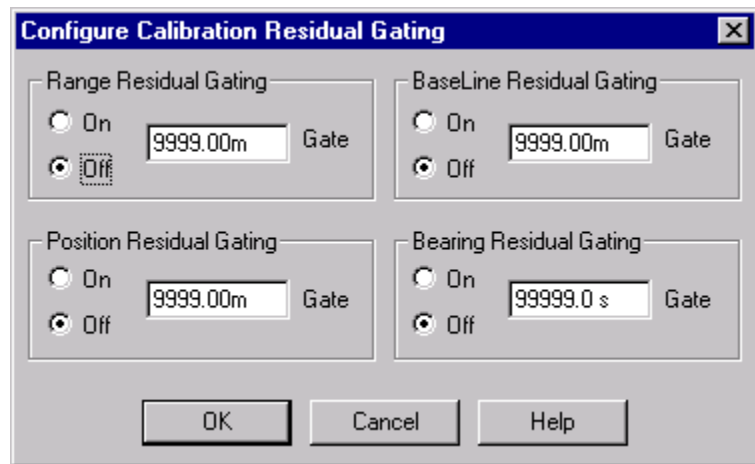
Note: When a tab other than the **Records** is selected, the **This LOP in Only this Record** option is not applicable and is disabled.

Gating

This enables you to apply **residual gating** to the **complete** data set based upon the

current results. This is a powerful tool for quickly editing out flyers, but it can also edit out good data and leave in bad if applied incorrectly. It is important to note the following points:

- The gating is only applied when this option is accessed and exited with **OK**.
- The gating is applied based upon the current residuals. If the gating is applied before any editing or any processing of solutions, the residuals will be based upon approximate transponder coordinates and as a result, the gating may have unexpected and erroneous results.
- If the gating is turned off for any LOP type and the dialog is exited with **OK**, all LOPs of that type will be re-weighted into the solution if they contain a non-zero value. The next figure shows the **Residual Gating** options.



This option is only available with the **Records** tab.

Plot Data button

Click this button to access a graphical editor for all of the instances of the selected LOP in the Calibration data set. See **Using the Plot Panel: LOPs** section later in this chapter for details on this editing window.

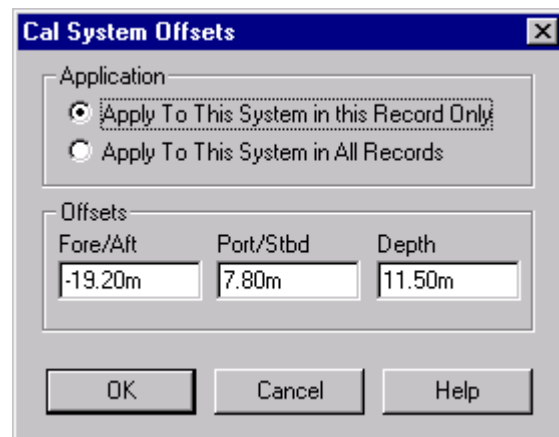
Plot Res(iduals) button

Click this button to access a graphical editor for the residuals for all instances of the selected LOP in the Calibration data set. See

Sensor Offset button

Using the Plot Panel: Residuals later in this section for details on this editing window. This button is only available for those data records involving sensor offsets, specifically Position and USBL Surface Range. It allows you to change the offsets for any sensor involved in the calibration. This provides for corrections in the case of incorrect configuration of the system prior to data collection. You can enter the new offsets and then select whether to apply them to the associated system for the current epoch only or for all epochs. This option is only available with the **Records** and **Ranges** tabs.

The following shows the **Cal System Offsets** dialog for those LOPs associated with surface observations, i.e. ranges and position LOPs.

The image shows a Windows-style dialog box titled "Cal System Offsets". It has a blue title bar with a close button (X) in the top right corner. The dialog is divided into two main sections. The first section, labeled "Application", contains two radio buttons: "Apply To This System in this Record Only" (which is selected) and "Apply To This System in All Records". The second section, labeled "Offsets", contains three text input fields: "Fore/Aft" with the value "-19.20m", "Port/Stbd" with the value "7.80m", and "Depth" with the value "11.50m". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

Note: In the case of USBL observations, this only affects the WinFrog offsets. The USBL system offsets entered as part of the **USBL HYDROPHONE** data item configuration cannot be edited. In addition, offsets applied when a USBL slant range LOP is selected are appropriately applied to all LOPs associated with the selected LOP's system.

After each major stage of data editing, it is recommended that you save the calibration file to disk. You should give each calibration file a unique name (i.e., the name can have a lettering or numbering code or even a short descriptive message appended indicating the processing stage represented by the file) so that

it does not write over a preceding copy of the same calibration set. When given a unique name, at any point in the processing you wish to return to a known point or state in the editing and calculation process, you can reload the appropriate file and resume the processing from that point.

The following detail the **Records** and **Ranges** tabs.

Records Tab

This tab is in two sections. A slider bar located in the top left allows the operator to go scroll through the complete data set essentially in chronological order. As you move the slider, the data for the respective calibration record displays. Also in the top left panel is the summary of the data record. This information varies depending upon the data item being viewed.

The second section is the data panel itself. The List View window presents the LOPs contained in the currently selected record.

Data Point Selection

This section is the top left panel and provides you with the option of scrolling through the complete data set using the slider bar. The position information for the vehicle used to collect the data for the selected epoch is displayed in this panel.

Line 1	The calibration point number and the date and time for the selected point.
Line 2	The geographic coordinate for vehicle's CRP on the working ellipsoid.
Line 3	The map grid coordinate for the vehicle's CRP.
Line 4	The vehicle's heading, CMG, and speed in knots.

Data Point Summary

This section is the lower, larger panel and presents the data (LOPs) collected at the selected epoch in a list window. **Note:** there are no sort capabilities available, the data are displayed in the order that the data items are added to the associated vehicle. It is also important to note that the selection of an LOP is only possible from the first column. The order does not affect the calibration processing. A single position data item provides two LOPs: a latitude and a longitude. A USBL data item provides three LOPs: slope range, bearing, and depth.

Base Stn	This lists the LOP's name. In the case of a position LOP, the name of the associated device is shown, in the case of the USBL

	LOPs, the name of the station is given.
ID	This lists the associated ID of the LOP. In the case of a position LOP, it is the denotation of either N(othing) or E(asting). In the case of a USBL range LOP, it is the beacon ID with a code identifying the LOP type: R = Range, B = Bearing, D = Depth and T = TWTT.
Raw LOP	This is the raw LOP, or actual data, logged for the LOP. For a position LOP it is the WGS 84 latitude and/or longitude. For USBL LOPs, they are the raw slope range, bearing, depth and TWTT as obtained from the USBL system (corrected for the USBL system offsets).
Scaled LOP	This is the scaled LOP, or data reduced to the map projection. In the case of a position data item, the WGS 84 position is transformed to the working ellipsoid and then projected onto the working map projection. For the USBL LOPs, the data are projected onto the map grid and corrected with the current USBL calibration corrections, either as they were applied in real-time (during data collection) or determined and applied as part of the current calibration processing.
WF	This is the weighting factor used for the LOP in the solution. Note: the lower the value, the greater affect the LOP will have on the solution.
Res	This is the residual for the LOP for the selected epoch.
Deskew	The individual LOPs collected for a given calibration epoch are actually valid for different times. The calibration point epoch is defined by the vessel position epoch. Position LOPs are deskewed to the vessel epoch using velocity vectors generated as part of the standard real-time positioning and processing and logged with the calibration data. In the case of USBL LOPs, the vessel position is dekedwed to the USBL

epoch and as a result the deskew value for USBL data is shown as 0 in this window. In fact, the data capture and logging is driven by the reception of the USBL data and as a result, if the vehicle positioning is set to use Kalman Filter and Dead Reckoning (recommended settings) the vessel epoch and USBL data epoch will be virtually the same.

Epoch

This is the time stamp for the LOP data.

Ranges Tab

This tab allows you to view a summary of all surface ranges observed and contained in the calibration file. The information presented is detailed here.

Station	Type	Tx	Add...	Total # Ran...	# Used Ran...
Test1	LBL	1	101	153	99
Test2	LBL	2	202	152	112
Test3	LBL	3	303	153	133
Test4	LBL	4	404	153	108
Test5	LBL	5	505	153	99
Test1	USBL (XYZ)	A25	A25	116	91
Test3	USBL (XYZ)	B26	B26	115	87
Test1	USBL (TWTT)	A25	A25	116	116
Test3	USBL (TWTT)	B26	B26	115	115

Station

The name of the **Xpounder** station observed to.

Type

The surface range may be a standard LBL TWTT (**LBL**) observation, a USBL XYZ based observation (**USBL (XYZ)**) or a USBL travel time observation (**USBL (TWTT)**).

Tx

The transmit channel (or frequency) or beacon ID of the **Xpounder** station observed to.

Address	The address of the Xponder station observed to, which in the case of a USBL beacon duplicates the ID.
Total # Ranges	The total number of observations made to the Xponder station.
# Used Ranges	The total number of observations made to the Xponder station that are weighted into the solution.

Using the Plot Panel: USBL LOPS

When you click the **Plot Data** button in the **Calibration Station** window with a Position or USBL LOP selected, the following graphical editor is opened.

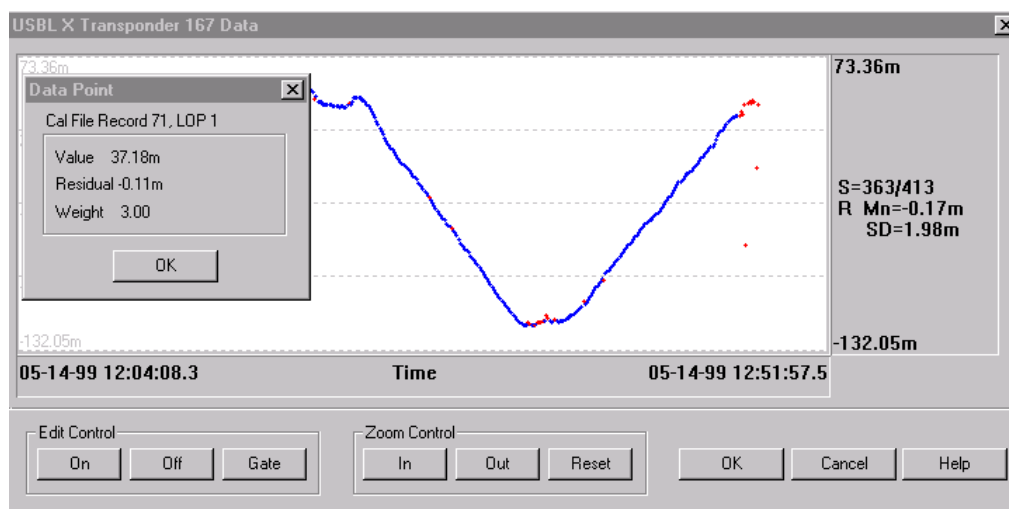
In the case of a USBL range or bearing LOP, a prompt pops up asking if you wish to plot X or Y data respectively.



Answering **Yes** to either of these prompts results in the graphical editor plotting the scaled X or Y data used to produce the scaled range and bearing LOPs. Answering **No** to results in the graphical editor plotting the scaled range and bearing LOPs respectively. The viewing of the X and Y data is representative of viewing the components of the bearing LOP in greater detail. This provides for comprehensive data viewing and editing options.

Note: it is recommended that for the initial viewing looking for trends and outliers, the actual range and bearing LOPs be viewed.

The LOP data are plotted as LOP (Y axis) versus epoch time (X axis). This provides a valuable visual editing tool as the data trends are clearly evident and breaks in trends indicating problems can easily be seen and examined. Outliers are also easily detected. Data which are weighted in the solution are drawn in blue, those which are de-weighted are drawn in red.



Time Axis

The time axis (horizontal) is labeled with the time/date for the left and right most extents of the window. When the panel is originally drawn and on a **Reset** (see below) this axis is extended 10% of the total time span before and after the actual data time span.

LOP Axis

The LOP axis (vertical) is labeled with the LOP value for the top and bottom, along with the summary of the LOPs. This summary includes the number of LOPs weighted in the solution and the total number of LOPs in the data set, and the mean residual and its standard deviation based upon those LOPs currently weighted in the solution. When the panel is originally drawn and on a **Reset** (see below) this axis is extended 10% of the total LOP values span at top and bottom.

Point Exam

Double-click the left mouse button in the plot panel to cause WinFrog to locate the closest data point and display the information for that point in a message dialog box, as shown in the above figure.

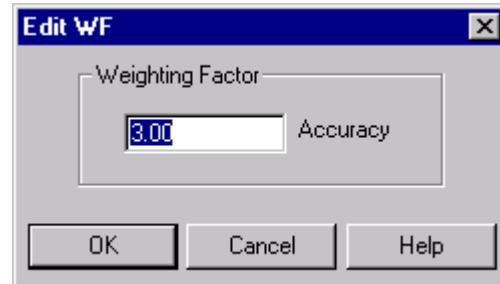
Windowing

Using the left mouse button (click and drag) you can draw a window in the plot panel. This provides WinFrog with the outline of the area in which to perform subsequent actions, as detailed below.

Edit Control

On

If an area of the plot panel has been selected, you are presented with the option to enter a weighting factor to be applied to all points in the selected area. The next figure shows the associated dialog box.

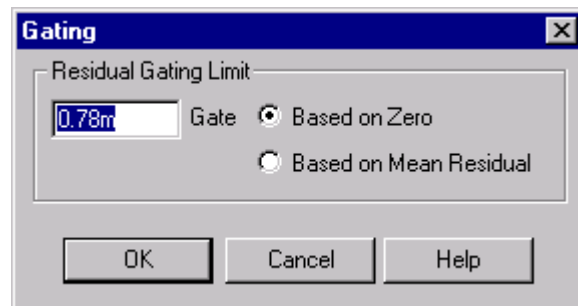


Off

If an area has been selected in the plot panel, all LOPs in that area will be de-weighted (weighting factor set to 0).

Gate

This allows you to apply gating to a specific LOP. This is preferred over blindly applying gating to the complete data set, as described above. The gating is applied to the data in a selected area or if an area in the plot panel has not been selected, to the complete LOP set. The next figure shows the options available for the gating.



You can enter the gating value and then select the application of the gate value. If **Based on Zero** is selected, any LOP whose residual is outside $\pm$ gate is de-weighted. If the **Based on Mean Residual** option is selected, any LOP whose residual is outside the mean residual $\pm$ gate is de-weighted. The default gate is the standard deviation for the residuals for the respective weighted LOPs.

Zoom Control

In	If an area has been selected in the plot panel, this area is drawn to the extents of the display. Otherwise the plot panel is zoomed in by a factor of 2 vertically. The horizontal time span remains the same.
Out	Regardless of whether an area is selected in the plot panel, this causes a zoom out of 10% vertically. The horizontal time span remains unchanged.
Reset	Re-draws the plot panel to the original coverage.

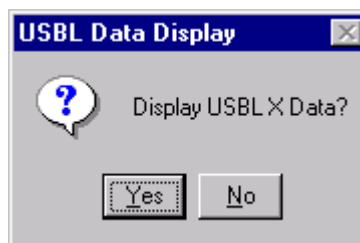
To close the window and apply all changes made with this editor, click **OK**. Clicking **Cancel** closes the window, discarding all changes made.

Note: If the data being viewed is a USBL XYZ based LOP (i.e., a calculated slant range, X, bearing, Y or depth LOP but not the TWT T LOP), and LOPs are de-weighted in the above process, the associated XYZ based LOPs are automatically de-weighted. This does not apply to the weighting in of LOPs.

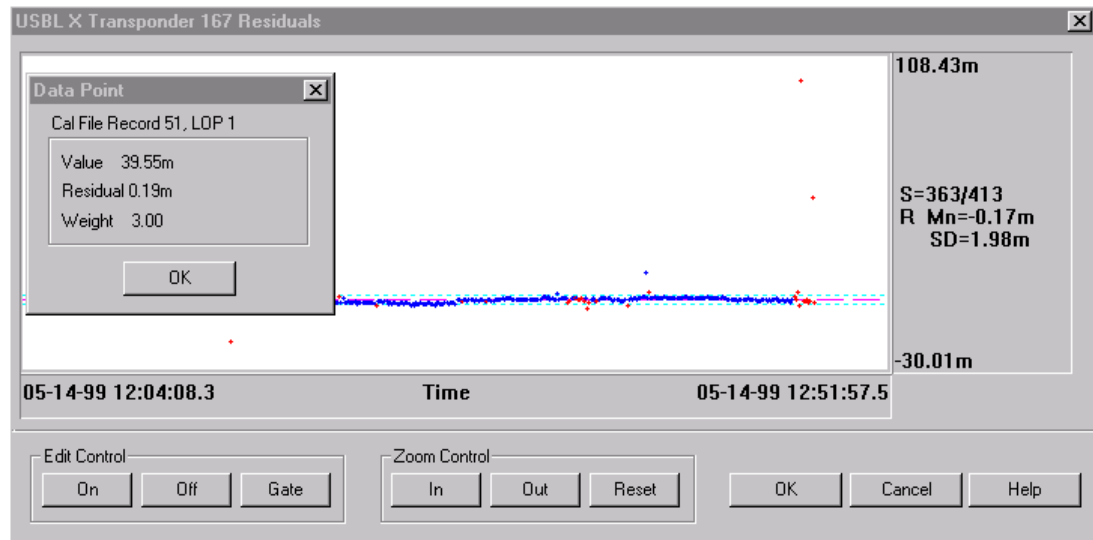
Using the Plot Panel: USBL Residuals

When you click the **Plot Res** button in the **Calibration Station** window with any LOP selected, the following window is presented.

In the case of a USBL range or bearing LOP, a prompt pops up asking if you wish to plot **X** or **Y** data respectively.



Answering **Yes** to either of these prompts results in the graphical editor plotting the residuals based upon the scaled X or Y data. Answering **No** results in the graphical editor plotting the residuals based upon the scaled range and bearing data.



The window title gives the LOP type and the name of the specific LOP. The capabilities and options are the same in this window as detailed in **Using the Plot Panel: USBL LOPS.**

The horizontal lines represent the following:

- Long dashed magenta line is 0.
- Short dashed magenta line is the mean of all the residuals.
- Short dashed light blue line is the mean residual $\pm$ standard deviation.

The residuals are plotted against time, that is the time stamp for the data reception. Data weighted in the solution is plotted in blue, that de-weighted is plotted in red.

Note: Though the graphically editing of Residuals is useful, it must be done carefully and always after the initial calibration processing. It is important to be aware that the least squares technique minimizes the residuals of all observations. Consequently, it distributes any errors throughout the whole array. The error from a single observation will appear in the residuals of all the observations. The amount that appears in each observation depends upon the geometry, number of observations, and the weight assigned to each observation. One cannot assume that the observation with the largest residual is necessarily the observation with the error (although this is where one generally begins to investigate). Consequently, do not eliminate large blocks of observations all at one time. Remove only a few of the largest then solve again.

Note: If the residuals being viewed are based upon a USBL XYZ based LOP (i.e., a calculated slant range, X, bearing, Y or depth LOP but not the TWTT LOP), and LOPs are de-weighted in the above process, the

associated XYZ based LOPs are automatically de-weighted. This does not apply to the weighting in of LOPs.

USBL Calibration Processing

The solution of the USBL calibration is a two-step process. The first step is to determine the position of the beacon used. The second step is to use this known beacon to determine the USBL calibration correction values. This process can be repeated to confirm the results. However, it is recommended that the cycle not be repeated more than twice as this has a tendency to bias the results and the solution of the calibration corrections may diverge from the correct results.

Each step of the process has different data requirements and, as a result, the editing of the data is approached differently for each.

The following sections detail the two steps.

Transponder Position Calibration

As mentioned, the USBL calibration requires that the position of the beacon used be determined.

Note: the USBL range and USBL Angles (bearing LOPs) can both be used for the determination of the beacon position (at present, the depth LOP is available only as an editing tool, not an observable for the solution of the beacon position). However, it is recommended that only the range LOPs be used. Experience has shown that the slope range, as extracted from the XYZ data, is more reliable than the range and bearing for many USBL systems. More importantly, with the use of the range LOPs only, the effects of any unapplied USBL corrections are minimal and appear to the least squares solution as noise. If a good data collection pattern has been employed (i.e. either the triangle or cardinal points patterns), this noise has a minimal affect on the solution of the position as it tends to be cancelled out.

Note: the USBL range data used to calibrate a beacon position can either be that calculated from the XYZ data or that calculated from the travel time, but not both. In the case of the latter, a **Working Velocity** file must be present.

Data Editing

The editing of the data requires an initial editing prior to performing any position calculations. This is followed by a review of the data once the first position solution has been successfully performed, to refine the selection of valid data.

Pre-Position Solution Editing

Using the **Plot Data** option, as detailed previously in the **USBL Calibration Data**

Editing section, the POSITION and USBL range LOPs collected for the calibration should be reviewed specifically for those points that appear to break a trend or are obvious outliers. These changes may be exaggerated, as in the case of a bad hit on the beacon, resulting in a jump in the range to the beacon of many meters. They may also be subtle, as in the case of the GPS losing the differential corrections and beginning to drift from a DGPS solution.

It is equally important to re-weight into the solution those points that for one reason or another were automatically de-weighted during the data collection process, but in review appear to be valid.

It is important to remember that at this point, the USBL corrections are “unaccounted for.” This may cause good data to appear to break a trend, especially in the case of the bearing and depth LOPs. It is for this reason that these LOPs are not examined at this stage in the processing.

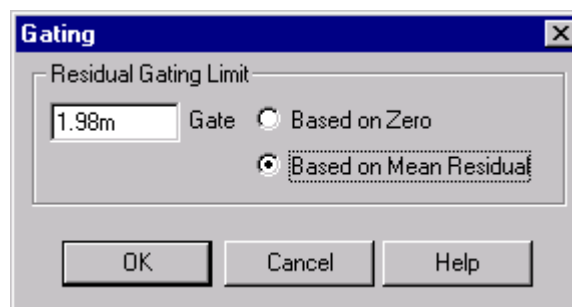
The graphical editor should be used to its full capability to zoom in on questionable areas of the data. If there is doubt as to whether the data are indeed breaking a trend, do not de-weight it at this stage.

Post-Position Solution Editing

Once a position has been solved for, the data should be reviewed again. The graphical editors are the best editing tools to use.

It is important to remember that, at this point, the USBL corrections are still “unaccounted for.”

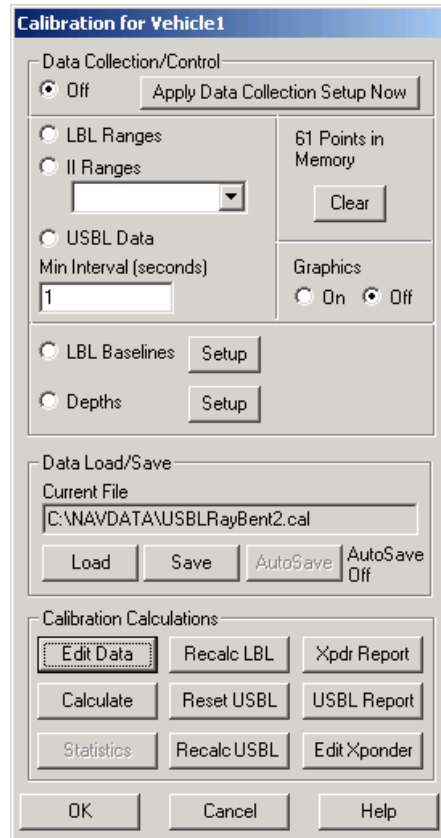
Review the data using the **Plot Data** to ensure no outliers or trend breakers were missed. Then use the **Plot Residual** option to view the residuals for the POSITION and range LOPs. At this stage, the residuals should be fairly consistent, in that they are not excessive, though in the case of the USBL LOPs, they will probably be offset from zero. The standard deviation will generally indicate the range of the errors due to the unaccounted for USBL corrections. Remove those points with large residuals. Depending upon the quality of the data, the gating feature may be used to apply further editing of the data, although very carefully. If used, it should be applied to the Mean Residual, **not** Zero, as illustrated in the following figure.



Setup

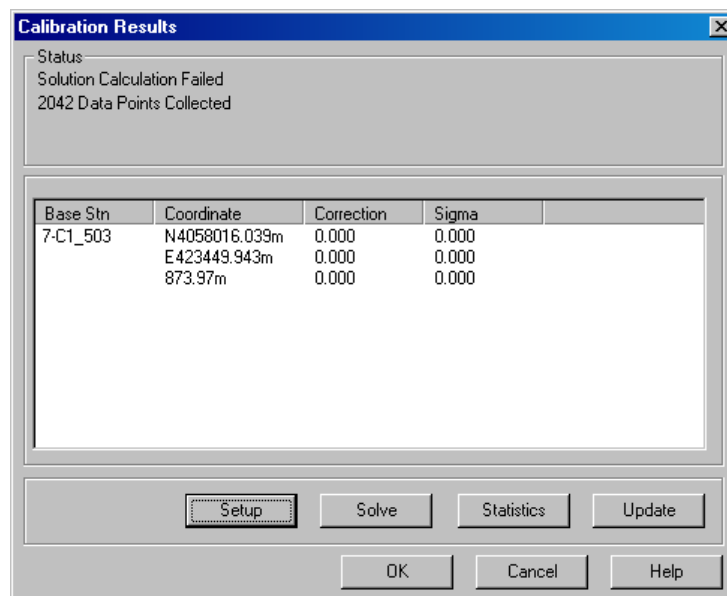
To Setup for the Determination of the Beacon Position

- 1 In the Calibration dialog, click the **Calculate** button.



The 'Calibration for Vehicle 1' dialog box contains several sections for configuring data collection and processing. The 'Data Collection/Control' section has radio buttons for 'Off' (selected), 'LBL Ranges', 'II Ranges', and 'USBL Data'. It includes a 'Min Interval (seconds)' field set to '1' and a 'Graphics' section with 'On' and 'Off' radio buttons. The 'Data Load/Save' section shows the 'Current File' as 'C:\NAVDATA\USBLRayBent2.cal' with 'Load', 'Save', and 'AutoSave' buttons. The 'Calibration Calculations' section features buttons for 'Edit Data', 'Recalc LBL', 'Xpdr Report', 'Calculate', 'Reset USBL', 'USBL Report', 'Statistics', 'Recalc USBL', and 'Edit Xponder'. At the bottom are 'OK', 'Cancel', and 'Help' buttons.

The **Calibration Results** dialog box opens.

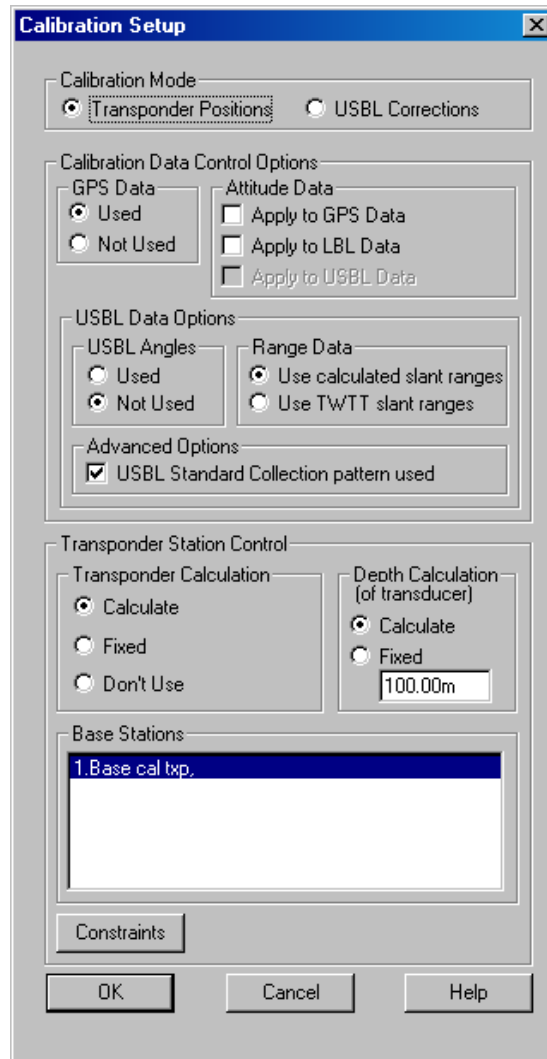


The 'Calibration Results' dialog box displays the status of the calibration process. It shows 'Solution Calculation Failed' and '2042 Data Points Collected'. Below this is a table with four columns: 'Base Stn', 'Coordinate', 'Correction', and 'Sigma'. The table contains three rows of data for base station 7-C1_503. At the bottom are buttons for 'Setup', 'Solve', 'Statistics', 'Update', 'OK', 'Cancel', and 'Help'.

Base Stn	Coordinate	Correction	Sigma
7-C1_503	N4058016.039m	0.000	0.000
	E423449.943m	0.000	0.000
	873.97m	0.000	0.000

- 2 Click the **Setup** button to configure the solution type and parameters.

This opens the **Calibration Setup** dialog, shown in the next figure. The sample shown reflects typical settings.



The calculation options are as follows:

Calibration Mode

Transponder Positions

WinFrog will solve for the positions of the transponders/beacons as configured. Select this option for this phase of the processing.

USBL Corrections

WinFrog will solve the USBL calibration corrections as configured.

Calibration Data Control Options

GPS Data

Controls the use of the logged GPS data.

Used	The GPS position data are used in the calibration solution. This must be selected for a USBL beacon position solution.
Not Used	The GPS position data are not used in the calibration solution. This is not applicable for a USBL beacon position solution.
Attitude Data	
Apply to GPS Data	If available during the data collection, the pitch and roll data logged with the GPS LOPs are applied to the GPS sensor offsets in the solution.
Apply to LBL Data	Not applicable to a USBL beacon position solution.
Apply to USBL Data	If available during the data collection, the pitch and roll data logged with the USBL TWTT LOP are applied to the USBL sensor offsets in the solution. Note that this is applicable to the transponder position portion of the calibration process when TWTT data is used and never for the actual USBL correction portion of the calibration process.
USBL Angles	This allows the use of USBL bearing LOPs to be used in the solution of a USBL beacon position. For the determination of a USBL beacon position for the purpose of then solving the USBL corrections, this is not to be used. However, it is a useful tool if the position of a beacon is required and data from a calibrated USBL system are used to collect data without actually circling the beacon.
Range Data	
Use calculated slant ranges	Note: The radio button labels change depending upon the data recorded.
Use TWTT slant ranges	Select this option if the slant range data to be used for the transponder beacon position determination is derived from the XYZ data (typical). Select this option if the slant range data to

be used for the transponder beacon position determination is derived from the observed signal travel time. Note that if this option is selected, the **Attitude Data** option **Use Apply to USBL Data** becomes available. This is because the travel time data is not corrected to a vertical datum and therefore the application of pitch and roll to the application of the sensor offsets can improve the solution. This will be disabled if the data does not contain two way travel time.

Use Travel Time

This radio button will be present if the data contains two way travel time with no XYZ data. This is the case with Sonardyne's surveyor's acoustic CSV telegram. When this button is present the other two will not be present.

Advanced Options

USBL Xponder Standard Cal

This is an important setting. A standard calibration is considered to be one that specifically meets the objective of the design of the data collection pattern.

To summarize the objective here, this is a collection pattern that evenly distributes the collection points about the beacon while presenting the hydrophone to the beacon such that observations fore and aft, port and starboard are equal. If the triangle or cardinal points pattern is used, this should be checked (default setting). If any other pattern is used, this should be unchecked in order to ensure that any non-symmetry of the pattern does not bias the results.

In a **Standard Cal**, the vessel's position is considered an observation and is adjusted using the data collected during the least squares adjustment. In a **non-Standard Cal**, the vessel's position is considered a known and is held unaltered during the processing from the original position logged during the data collection.

Note: If processed as **Standard Cal**, in order to revert back to the original data to try

processing as a **non-Standard Cal**, use the **Reset USBL** option in the main Calibration dialog (see **Using the Reset USBL Option**) Alternatively, reload the original data and repeat the processing as a **non-Standard Cal**.

Note: if the data were collected with the USBL HYDROPHONE data item configuration set to **Positioning-Primary**, it is recommended that the data be processed as a standard calibration. This is due to the real-time positioning of the vessel having been affected by the positioning from an uncalibrated beacon and, therefore, must be adjusted during the processing.

Transponder Station Control

Transponder Calculation	This controls the horizontal position solution for the beacon selected in the Base Stations list box.
Calculate	Solves for the Northing and Easting of the beacon.
Fixed	The beacon is held fixed (known) in the solution. This is not applicable in the processing of a USBL beacon for the purpose of performing a USBL calibration.
Don't Use	The beacon is not used at all in the solution. It is important that if a transponder appears in the list, but there are no data for it in the calibration data, this option is selected for that transponder. Otherwise, the solution will fail.

Depth Calculation

This is an important setting in any calibration, but especially in the case of a USBL calibration. The errors solved for in the USBL calibration include a scale factor, which (even if excessive) is largely accounted for in the least squares solution with respect to the horizontal position determination. It can however, influence the determination of the depth, which will subsequently greatly impact the solution of the USBL corrections. If at all possible, the depth of the beacon should be determined using a depth sensor in the actual beacon and then held fixed **for processing**. As a check, once calibrated, the same data can be used to solve for the depth to confirm the validity of the solution.

Note: Do not confuse the term **Fixed** as discussed here in the context of the data processing with the term **Fixed** in the configuration the actual USBL system itself. They are completely different aspects of the calibration process. You are reminded here that the USBL system itself **must not** be configured to use Fixed Depth or Telemetered Depth or similar during the collection of calibration data.

Calculate

Solves for the depth of the beacon.

Fixed

The depth for the beacon is held fixed in the solution. You may enter a value here to use as the fixed depth. The default is the value present in the **Working Xponder** file when the calibration is first started or the depth solved in subsequent processing.

Base Stations

This lists all the stations available for the calibration solution (set to **USBL Fixed** in the **Xponder** file at the start of the calibration setup process or edited with the **Calibration Edit Xponder** option) by station name and, if it has been entered at some point (e.g. if the beacon is a dual purpose Sonardyne Compatt), the transponder's address. It is important to note that when the **Calibration** dialog is first opened, the current **Working Xponder** file is copied to a calibration local copy of that file. It is this copy that is used throughout the calibration process, not the actual **Working Xponder** file. It is for this reason that it is very important to ensure that the **Xponder** file contains all transponders involved in the calibration and has their approximate starting coordinates entered prior to starting the calibration data collection, editing, and calculation process. If there are problems, the calibration data set station information can be edited using the **Edit Xponder** feature.

Select each transponder and configure appropriately using the options available in this panel. Once the configuration is complete, use the **OK** button to exit this dialog.

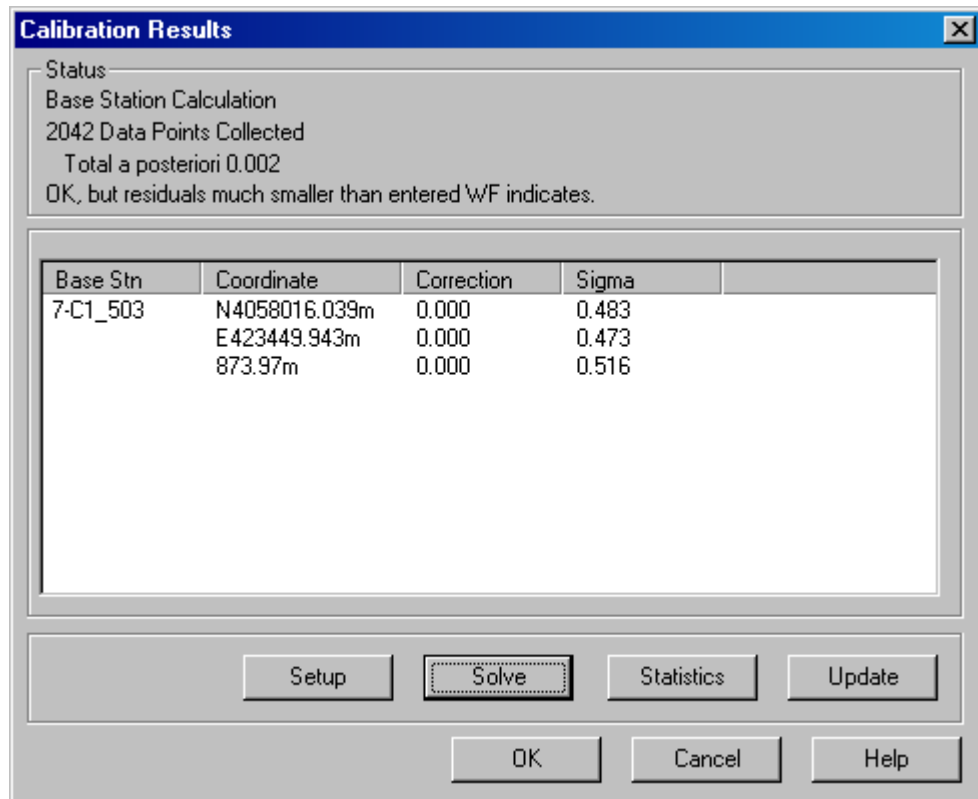
Additional Controls

Constraints

Clicking this button allows you to configure constraints for the Least Squares Adjustment (see **To Enter Constraints for the Least Squares Adjustment**).

Solving

Once the solution is configured, you can perform the iterative calibration calculation directly from the **Calibration Results** dialog box. Continue clicking the **Solve** button until the solution has converged.



The Calibration Results Dialog Box

The **Calibration Results** dialog box is shown in the previous figure. The following details the components.

Status Panel

Displays the current status of the solution (first line) and the number of points used in the solution (second line). The following are possible status messages:

No Calibration Solution Defined

The **Setup** has not been performed for the calibration. A solution is not possible.

Solution Re-Defined, should Re-Process

The **Setup** has been re-accessed and exited with the **OK** button. Therefore, the solution should be re-calculated.

Solution Must be Recalculated

The solution has been reset and it must be re-calculated.

Base Station Calculation Solution Calculation Failed

Solution for transponders was successful.
Solution failed. There are major problems with the data that must be investigated.

Processing...

WinFrog is executing the calibration processing.

Data Panel

Base Stn

The USBL beacon name of the station.

Coordinates

The Northing, Easting, and depth for the station. **Note:** the Units/Coordinates/Grid Coordinate Order controls the order of the Northing or Easting.

Corrections

The corrections determined and applied in the last adjustment iteration. If the associated coordinate component has been held **Fixed**, instead of the correction value, the term **Fixed** is displayed in brackets.

Note: the term **corrections** here refers to the adjustments to the unknowns determined by the least squares adjustment, not the USBL corrections. The unknowns in this processing are the beacon coordinates and depth, if it is to be solved.

Sigmas

The sigma of the associated coordinate component as determined from the last adjustment iteration.

To Perform the Adjustment

As mentioned previously, the least squares solution is an iterative one.

- 1 Click the **Solve** button to perform one adjustment. If the solution is successful (converges), the results of the adjustment are displayed.
- 2 Continue to click the **Solve** button until the value no longer changes with each click.

The correction values continue to converge (get smaller), eventually reaching a value that remains unchanged on subsequent clicks of the **Solve** button. This indicates that the calibration adjustment is complete based upon the currently weighted data.

Note: in a “perfect” solution, the correction values would converge to zero. However, in the actual calibration, they should converge to values consistent with the accuracy of the acoustic system being used.

Problems with the calibration data are indicated by the following:

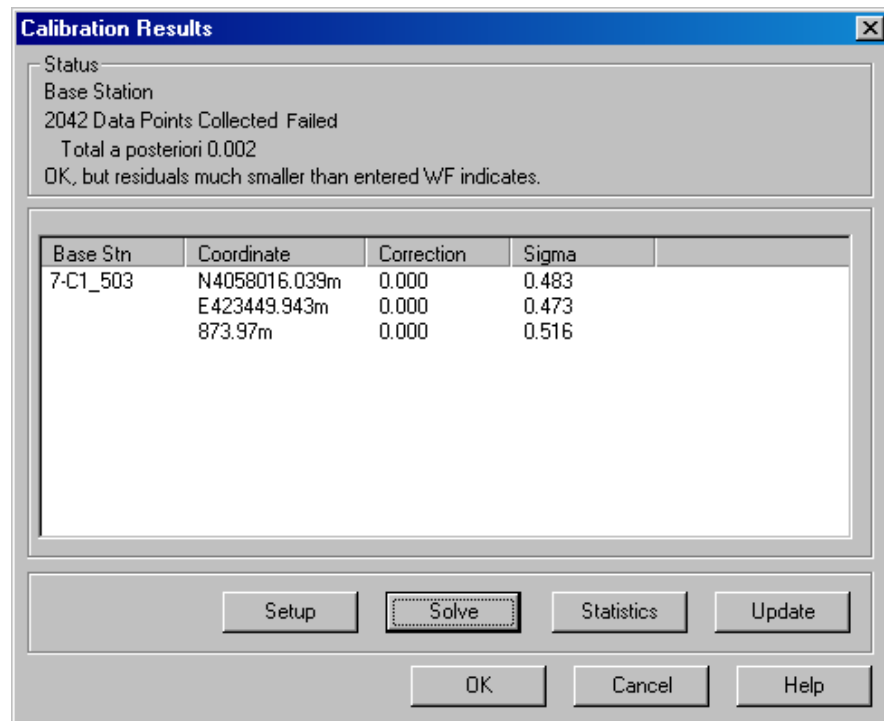
The solution fails. Probable causes are:

- A transponder has no data associated with it, but is not set to **Don't Use**.

- The initial transponder coordinates and/or depths are not sufficiently close to the actual locations. Also, check that the correct transponder was dropped or located at the correct location.
- There are flyers that have not been de-weighted from the solution.
- Incorrect beacons in file. To correct:
 - A** - Exit the calibration process
 - B** - Confirm the validity and completeness of the Working Xponder file
 - C** - Start a new calibration
 - D** - Save to a dummy file.
 - E** - Use a text editor to replace the 901 records in the real calibration file with those in the just created dummy file.
- GPS Data is set to Not Used
- The correction values converge, but not to a value consistent with the accuracy capabilities of the acoustic system being calibrated. This indicates that there are probably still bad data weighted in the solution. The LOPs should be re-examined using the graphical editor.
- The correction values jump about without converging, or appear to converge, but before reaching a static result start to increase again. This again indicates that there are probably still bad data weighted in the solution. The LOPs should be re-examined using the graphical editor.

Analyzing the Results: the Chi Squared Test and A Posteriori Variance factor

Once you click the **Solve** button, at least once, two more status lines display.



A **a posteriori** values display on the first new line and, on the second new line, the results of a statistical test performed on the total **a posteriori**. Before the **a posteriori** values can be used, the solution must reach convergence or it is no longer productive to click the **Solve** button.

The **a posteriori** is a variance and is the sum of the square of each residual multiplied by its weight all divided by the number of observations less the number of unknowns. This value can be used as an aid in assessing the quality of the least squares adjustment.

The **a posteriori** is compared statistically to the **a priori variance** using the statistical test termed the **Chi squared test**. This test is performed at a 95% confidence interval. The value of the **a priori variance** is 1 because the standard deviation of each observation is known and set by the operator.

Why could the Chi Squared Test Fail?

If the test fails and the **a posteriori** variance is large, the adjustment and consequently the calculated coordinates of the transponders are unreliable. A failure of this statistical test can occur for three reasons:

- bad mathematical model
- unmodeled biases in the data (some bad observations)
- incorrect initial weighting (wrong Weighting Factor)

The first possible cause of the failure can be discounted as the mathematical model has been proven sound by several authors over many years.

The second cause of the failure, **unmodeled biases in the data**, is usually the cause that requires investigation. This can be due to the following:

- There is one or more bad observation: a baseline, surface-to-transponder range, depth or GPS fix.
- Excessive pitch and roll of the vessel during recording of the transceiver-to-transponder ranges without an attitude sensor input to WinFrog and enabled for use in the Vehicle positioning. This could effect all surface-to-transponder ranges and GPS positions. In this case, the unmodeled bias in the data is the un-calculated change in range due to pitch and roll. (Actually the ship rocks so the offset between the GPS antenna and the transponder is not correct so the transponder coordinates are calculated incorrectly at the time the observation is made.) WinFrog can be configured to use an attitude sensor in realtime and log the data to the calibration data for use in the calibration processing, if an attitude sensor is available when the data is observed.

If an attitude sensor is not available and there is excessive ship pitch and roll the residuals will show a marked sinusoid pattern. The crests and troughs will usually straddle the mean, but not always evenly as the ship

may roll to one side more than the other. If there are a large number of observations and all the larger outliers are removed, the pitch or roll to one side will cancel the pitch or roll to the other and the adjustment should be good. However in this situation one should multiply the geometric error ellipses by the square root of the **total a posteriori variance** to obtain the actual absolute error ellipses. This will then reflect the uncertainty in the absolute accuracy of the transponders due to the un-modeled pitch and roll.

- Invalid velocity profile.

The size of the **a posteriori** is a qualitative indicator of how many bad observations there are. It usually only requires one bad observation to cause the failure. However, when this happens the **a posteriori** variance is usually smaller (say less than 10). The more bad observations there are, the larger the **a posteriori variance** can become. If it is greater than 999, it indicates that there are several bad observations. **Note:** one large error is roughly equivalent to a few smaller errors.

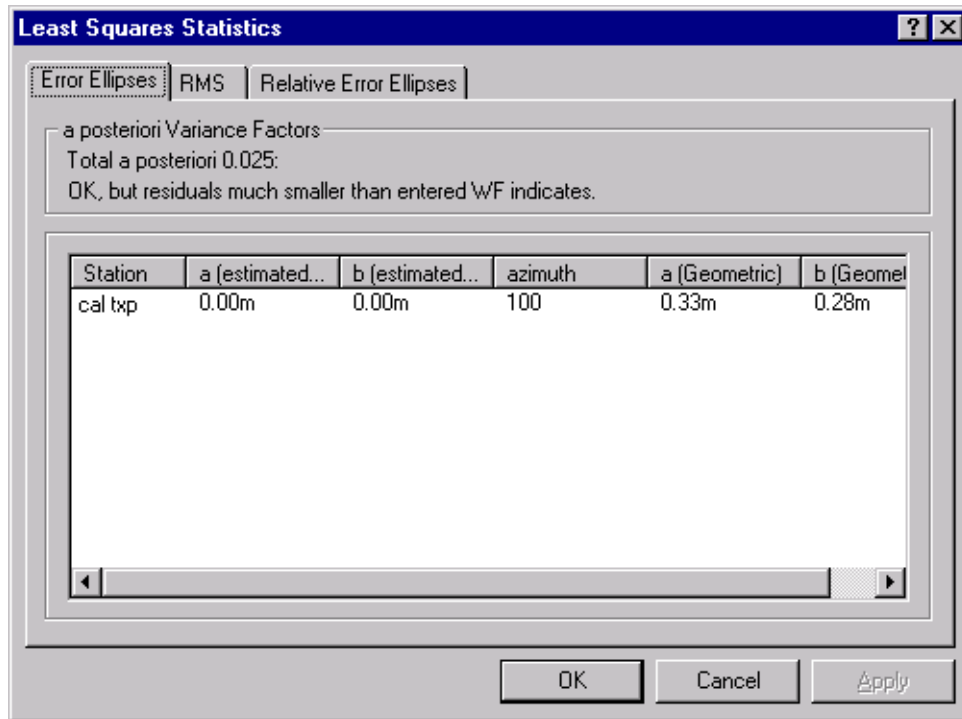
The third possible reason that the test on the **a posteriori variance** factor can fail is **incorrect initial weighting**. The initial weighting is the weighting factor value assigned to each observation. The status line may display the message, **OK, but residuals much smaller than initial WF indicates**. This means that the statistical test failed, but not due to bad data. This is caused by assigning weighting factor values that were too pessimistic to the observations, i.e. the standard error of each observation is better than that entered, as determined by the least squares adjustment. In this case, the solution is still good and the coordinates are reliable.

The weighting factors can be reduced and the solution re-processed to determine if this improves the a posteriori variances. However, it is important not to reduce them to unreasonably small values simply to achieve satisfactory **a posteriori variances**. If the weighting factors are reasonable, accept the results and use the geometric error ellipses for the absolute error ellipses and the error ellipses estimated from the Baseline a posteriori as the bottom relative error ellipses.

It should also be noted that there is a phenomenon with electronic instruments in that they produce precise results over short periods of time under steady environmental conditions. This can lead to the **a posteriori variances** indicating that the weighting factors are too pessimistic for the observations. Data collected over a short period of time when the seas are very calm and the water column has no discontinuity in velocity.

Analyzing the Results: the Error Ellipse and RMS

Clicking on the **Statistics** button in the **Calibration Results** dialog accesses the **Least Squares Statistics** dialog.



You can view the Station Error Ellipse, the Relative Error Ellipse and the solution RMS values.

For details, see **Viewing the LBL Solution Statistics** section in this chapter.

Examining the Results and Repeating the Process

The process of reviewing and editing the data and then performing an adjustment should be repeated several times. The actual number of cycles depends upon the quality of the data. The objective is to achieve a reliable solution while using most of the data.

When editing the data by looking at the residuals, be aware that the least squares technique minimizes the residuals of all of the observations. Consequently, it distributes any errors throughout the whole array. The error from a single observation will appear in the residuals of all observations. The amount that appears in each observation depends upon the geometry, number of observations, and the weight assigned to each observation. One cannot assume that the observation with the largest residual is necessarily the observation with the error (although this is where one generally begins to investigate). Therefore, do not eliminate large blocks of observations all at one time. Remove only a few of the largest, then solve again.

In addition, the USBL corrections are still un-accounted for and the residuals may not be centered around 0 as one might expect. In this stage, only those LOPs whose residuals are extreme and are obviously outside of the main grouping should be de-weighted.

Note: as previously mentioned, it is recommended that the calibration be saved after each cycle. In this way, you can return to a known point or resume processing at a later time, if required. Once the calibration is considered complete and the final calibration file is saved to a new file, the intermediate files can be removed, leaving the original untouched file and the final result file. By loading the final result file, the calibration can be reviewed and/or printed at any time without having to perform any step other than loading the file.

Note: when a calibration file is saved, all configuration settings are also saved.

Note: if the USBL calibration is being performed only to calibrate the position of USBL beacons, then the processing is completed after repeating the process as detailed above. A report can then be generated in the same manner as is done for a typical LBL calibration process. See the section **LBL Calibration Report** in this chapter.

USBL Calibration

With a known beacon position, the USBL system corrections can be determined. This process requires the same steps as followed for determining the beacon position.

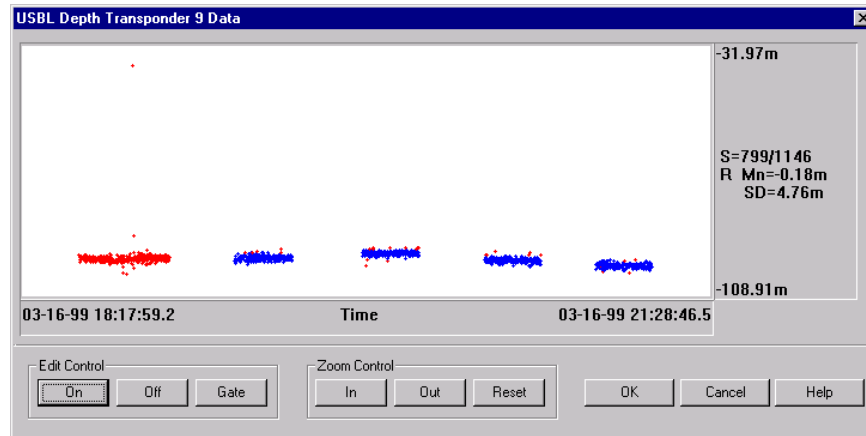
Data Editing

Similar to the editing of the data for the position determination, the editing of the data for the actual USBL corrections determination has a pre-first solution and post-first solution aspect to it.

In both cases, the data editing now focuses on the USBL data, specifically the bearing and depth LOPs. Whereas the range LOP is the least affected of the USBL LOPs by the corrections to be solved for (and thus the LOP to examine and use for the beacon position solution), the bearing and depth LOPs are greatly affected. Therefore, they are better indicators of the validity of the USBL data for use in the determination of the corrections and the results of subsequent correction determinations. The bearing can also be examined as the X and Y data (see **Using the Plot Panel: USBL LOPs**).

Pre-First Solution Editing

Once again, using first the **Plot Data** graphical editor, view the bearing (or X and Y) and depth LOPs for breaks in trends. **Note:** in this case, the trends may be dependent upon the orientation of the vessel at the time of the data collection and grouped as such. The following figure illustrates this point.



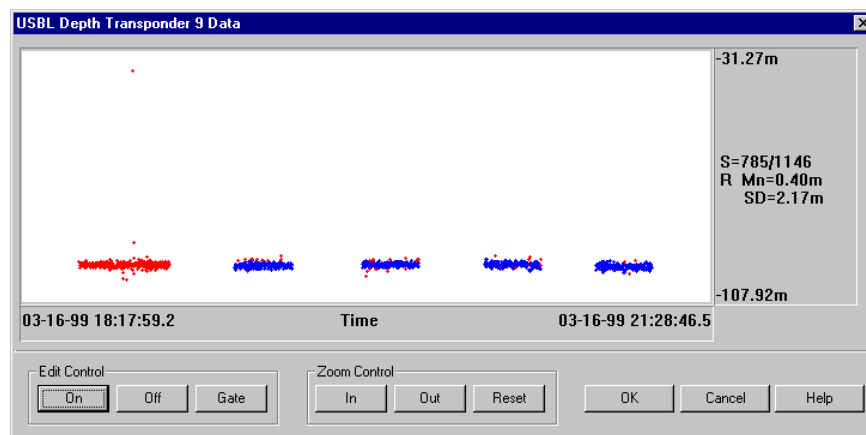
It shows the uncorrected depth LOP for a cardinal point collection pattern with five distinct groupings, all at slightly different values. Within each grouping there is very good agreement of the data. In this example, outliers and breaks in trends are illustrated by the two red points way above the first grouping and the red points in the subsequent four groupings, respectively.

The **Plot Residual** graphical editor can also be used for editing at this point, as long as you can focus on the trends and not the actual residual values.

Note: experience has shown that if the cardinal points pattern is used, at this point, all data collected while directly over the beacon (or nearly so) should be edited out of the solution. While it is valuable data for the determination of the beacon position, it degrades (rather than enhances) the determination of the USBL corrections themselves as processed with WinFrog.

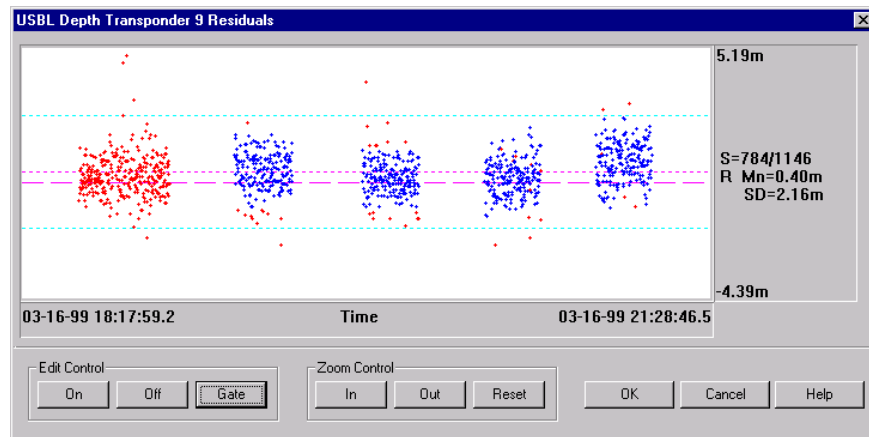
Post-First Solution Editing

After the first solution, the editing can focus on the **Plot Residual** editor and analyze the actual residual values. At this point, the initial USBL corrections have been determined and applied. As a result, the data should be more uniform. The following figure shows the same data as shown in the previous figure, but after an initial USBL correction solution/application.



Notice that the groupings are now more consistent with each other and that the standard deviation of the residuals has dropped from 4.76 to 2.17 even though the mean has actually shifted from -0.18 to 0.40.

The **Plot Residual** editor provides a good means to both view the data and edit out data at this point. The following figure shows the same data, but with the **Plot Residual** editor, after applying the **Gate** option using the default **Residual Gate Limit** and applying the gate based on the **Mean Residual**.



Setup

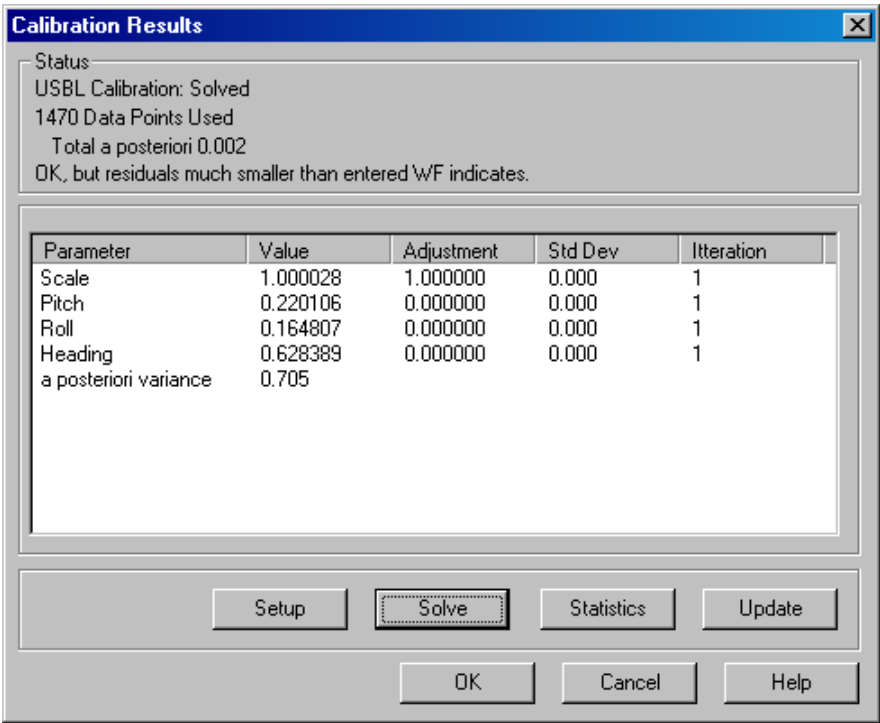
The setup for the USBL corrections determination is accomplished using the **Calibration Setup** dialog, as used for the beacon position configuration.

Note: by toggling the **USBL Corrections** option, all non-relevant options are disabled. In addition, the options for configuring the **Transponder Station Control** are altered to disable the **Fixed** option in the **Transponder Calculation** panel and all the **Depth Calculation** panel as non-relevant.

The only options available to you are the selection of the appropriate beacon and the **Transponder Calculation** settings of **Use For USBL Cal** and **Don't Use For USBL Cal**. Once you have chosen a beacon, set it to **Use for USBL Cal** and set all others to **Don't Use for USBL Cal**.

Solving

The process for the solving of this calibration varies somewhat from that of solving for the beacon position, with the exception that the process is still executed from the **Calibration Results** dialog by clicking the **Solve** button as shown in the next figure. The information displayed is also different.



For the sake of clarity, in this section and this section only, the USBL corrections will be referred to as the **unknowns** and the results of the least squares adjustment will be referred to as the **corrections**.

First, an explanation of the bottom panel as the top remains unchanged in content and information displayed.

First Column

This lists the current values for the unknowns, these being scale factor (S), pitch correction (P), roll correction (R), and

	heading correction (H). The scale factor has no units and the remaining parameters are displayed in decimal of degrees.
Second Column	This displays the corrections to the unknowns determined by the least squares adjustment.
Third Column	This displays the standard deviation of the corrections determined by the least squares adjustment.
Fourth Column	This displays the number of iterations the least squares adjustment took to converge.
a posteriori variance factor	Shown below the last row.

The solution process is an iterative one, as was the beacon position solution. First, click the **Solve** button to execute the least squares adjustment that will determine the corrections to be applied to the unknowns. These corrections are then applied to the unknowns by clicking the **Update** button. This process is repeated until the corrections reach zero (which in the case of the scale factor is indicated by a correction of 1.000000).

If the solution does not converge to zero, there is either insufficient data or there are bad points present in the weighted-in data. If this occurs, the data must be reviewed using the editors to determine the cause of the problem.

Analysis of the Results and Repeating

The results themselves are the primary tools for analysis. These provide a graphic presentation of the result of the determination of not just the beacon position, but of the data after determination and application of the USBL corrections. The **a posteriori variance** factor is also an indication of the quality of the data and the results. (Another important tool is the **USBL Calibration Report**, which will be discussed in a subsequent section.)

After completing a Solve/Update cycle, the data should be reviewed using the **Plot Residual** editor. Now that the USBL corrections have been determined and applied, the residuals should be reduced and match the expected accuracy of the systems involved. In addition, they should now be centered about or close to zero rather than offset, as is the case prior to this step. The **Gate** option can now be used to refine the data to be included in the calibration.

Unfortunately, there are no specific quantitative measures to compare the data against, to decide what data are acceptable and what data are to be removed. The data must be viewed by comparing any one LOP to the whole data set.

The prevailing environmental conditions at the time the data were collected have a very large impact on the results.

Another, but less reliable, analysis tool is the **a posteriori variance** factor. This should be equal to one (1.0). A value (much) lower than one is possible when a large quantity of data of high quality has been collected and/or the weights used are relatively high and pessimistic. A value greater than one does not necessarily indicate a bad solution, though if this value is greater than 10 the data should be reviewed for outliers.

It is recommended that the data be reviewed and edited once and then the Solve/Update cycle repeated again afterwards.

As a **confirmation**, the beacon position can be resolved for using the now corrected data. If the editing and processing have been correctly performed, the change in the position will be in the centimeter to decimeter range. If the change is greater, the solution must be suspect and restarted with greater attention paid to editing the data.

Note: it is recommended that the process of solving the beacon position after the determination of the USBL corrections be performed for the purpose of confirming the results of the whole USBL Calibration process only. Repeating the solution of the USBL corrections after resolving the beacon position can lead to a never-ending cycle that can actually cause the results to diverge from the correct results.

USBL Calibration Reporting

Reporting for the USBL Calibration is accessed from the **Acoustic Calibration** dialog by clicking the **USBL Report** button. The results of the calibration are printed along with some statistical values and graphs described below.

The data presented in the USBL calibration report is described below and is essentially derived by comparison of raw USBL data to the mean position derived from that raw data and comparison of corrected USBL data to the mean position derived from that corrected data.

The maximum and minimum values of each set are displayed along with a mean, standard deviation and root mean square (RMS). The main values to consider when assessing the calibration are the Range C-O of the corrected data, specifically the mean. This is because it's the range that is used as the observation for the calibration.

The other C-O quantities are derived, but their RMS should provide a better evaluation number than the standard deviation. See below for a description of each.

Transponder Coordinates

Summary of the results of the position determination of the beacon used for the calibration, specifically:

- the beacon code;
- Northing c/w standard deviation;
- Easting c/w standard deviation; and
- Depth c/w standard deviation (if solved for).

Calibration Results

Summary of the results of the determination of the USBL Corrections, specifically:

- the Scale Factor (no units),
- Pitch Correction (decimal of degrees);
- Roll Correction (decimal of degrees);
- Heading Correction (decimal of degrees);
- the a posteriori variance factor; and
- the total number of data available and used in the calibration.

Data Summary Table

The summary table presents the minimum, maximum, mean, and standard deviation based upon Calculated-Observed (C-O) for un-corrected and corrected USBL data. In addition, the RMS for the respective C-O data sets is given for the corrected data.

Note: to produce these values, the components of each calibration data record (XYZ) are subtracted from the corresponding calculated values derived from the calibrated beacon position and the USBL hydrophone position. In the case of the beacon position, range, and azimuth comparisons, these are derived from the XYZ data for each calibration data record. Note that only that data weighted in the USBL calibration solution are used.

Psns C-O

The distance between the mean beacon position and the position derived from each observation set (raw and corrected) is calculated. The statistical values of these two sets are calculated and displayed. **NOTE:** This data set is not *normally* distributed. In a *normally* distributed data set, whose expected mean is zero, adding more data should cause the mean to approach zero since some values will be positive and some negative. However, the distance between two points is always positive, thus the

expected mean is not zero. Consequently, the mean and standard deviation should only be looked at as an indication of the noise in the data. Larger values indicate noisier data. The RMS is the better quantity to look at here.

X, Y and Z C-O

This is related to the vessel, X port/starboard, Y fore/aft and Z up/down. The known transceiver position is compared to the mean beacon position (raw and corrected) to produce the computed X, Y or Z value. The difference between this value and each observed X, Y and Z value is determined to produce the data sets. One set for raw data and one for corrected data for each item. This data should be normally distributed and does give an indication of the error in these directions.

Range C-O

Similarly to above, the slant range between the known transceiver position and the mean beacon positions (raw and corrected) are calculated. From that is subtracted the slant range (derived from each USBL observation set) to produce the data sets, one for raw and one for corrected. This data should be normally distributed and does give an indication of the range error. This is the observation that is used to calculate the beacon position.

Note: Of all the USBL corrections the only one that affects the slant range is the scalar. Since the scalar is small there will be very little difference between the uncorrected and corrected data.

Bearing C-O

The azimuths from the USBL transceiver to the mean beacon positions (raw and corrected) are calculated. From these are subtracted the azimuth from the USBL transceiver to each observed beacon position (raw and corrected). This data should be normally distributed. Perhaps somewhat abstract, these values usually experience the greatest change between the raw and corrected data sets.

Plots and Histograms

The histograms based upon the data calculated to produce the **Data Summary Table**. Note that only that data weighted in the USBL calibration solution are used. The histograms include the mean value drawn as a vertical line at the appropriate position complete with annotation. The standard deviations are also drawn as vertical lines in the appropriate position.

Vehicle Position	This is a plot of the vehicle positions during the data collection, centered about the calculated beacon position.
Beacon Position, Uncorrected USBL	This is a scatter plot of the USBL beacon position calculated for each epoch using uncorrected USBL data, centered about the calculated beacon position. Note this is always uncorrected data. If the data was gathered with calibration corrections already in the Hydrophone Data Item configuration dialog they are not applied in this plot.
Beacon Position, Corrected USBL	This is a scatter plot of the USBL beacon position calculated for each epoch using corrected USBL data, centered about the calculated beacon position. Look for a tighter group about the center than the uncorrected.
Coor. Position C-O	Histogram of the distance from the solved for USBL beacon position to the position calculated for each epoch using corrected USBL data for each epoch. Since the values are distances they are always positive. This graph indicates how noisy the data is. The more spread out the graph, the noisier the data.

In the following histograms look for an improvement in the shape of the corrected data histograms. The shape should represent a normal distribution.

Raw Range Res, C-O	Histogram of the uncorrected USBL range residuals.
Corr'd Range Res, C-O	Histogram of the corrected USBL range residuals.

Raw Bearing Res, C-O	Histogram of the uncorrected USBL bearing residuals.
Corr'd Bearing Res, C-O	Histogram of the corrected USBL bearing residuals.
Raw X Res, C-O	Histogram of the uncorrected USBL X component residuals.
Corr'd X Res, C-O	Histogram of the corrected USBL X component residuals.
Raw Y Res, C-O	Histogram of the uncorrected USBL Y component residuals.
Corr'd Y Res, C-O	Histogram of the corrected USBL Y component residuals.
Raw Z Res, C-O	Histogram of the uncorrected USBL Z component residuals.
Corr'd Z Res, C-O	Histogram of the corrected USBL Z component residuals.

This window is a valuable analysis tool for the USBL calibration. The scatter plots clearly illustrate the quality of the data collected and the processing, supported by the histograms. As an analysis tool, this report provides you with the best summary of all aspects of calibration one place and should be utilized as such.

Clicking the right mouse button with the cursor in this window gives a pop-up menu with the following options:

- **Save to a metafile**

This allows you to save the window as an enhanced metafile, which can, subsequently, be inserted into a document. The example in this manual has been created and inserted in this way. This provides a report quality presentation of the USBL calibration suitable for presentation to clients.

- **Save to CSV file**

Saves the data to a file using comma-delimited fields to enable easy loading into another software package.

- **Change Vehicle Pos. Scale**

Allows you to manipulate the scale of the panel containing the plot of the calibration data collection points.

- **Change USBL data Scale**

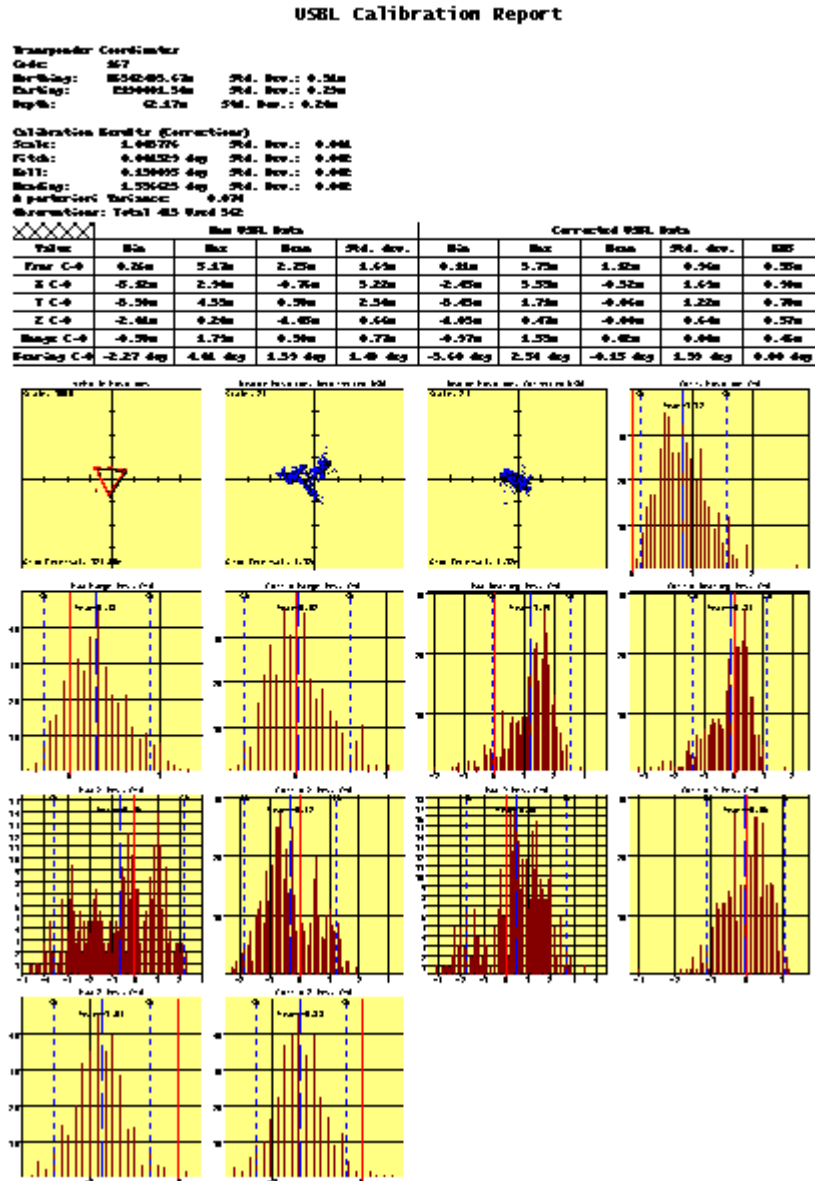
Allows you to manipulate the scale of the panels containing the calculated beacon positions based upon the raw and corrected USBL data. Note that both panels are plotted with the same scale.

- **Change color Graphics**

Allows you to manipulate the background color of all panels.

- **Change color Data**

Allows you to manipulate the color used to plot the histogram data.



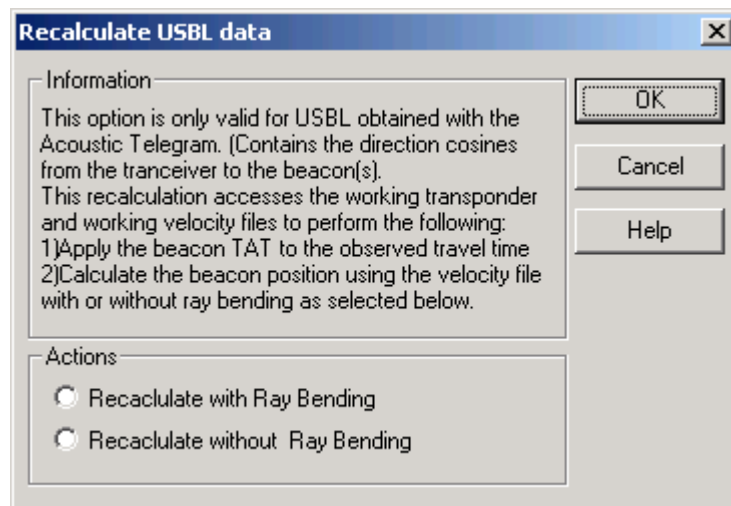
Recalculation of the USBL Data

This option is only applicable for data from the Sonardyne CSV Surveyor's Acoustic telegram and the TWT'T component of the Simrad HPR400 telegram with travel time included. It does not apply to standard X, Y, Z USBL data, even that included in the Simrad HPR400 telegram. For those cases where it is applicable, the data can be reprocessed with a new transponder file and/or a new

velocity file to correct errors in the initial settings for turnaround time and estimates of transponder depths and changes to the velocity profile. As well, in the case of the Sonardyne data, the data can be recomputed with or without ray bending. If the Sonardyne data is loaded from a file and it isn't known if ray bending was applied when collected, use this button to recompute it. After recomputing the data, you must reset the USBL calibration values using the button described below.

The application of ray bending uses the direction cosines, travel time, and the velocity profile to compute a new X, Y, Z and a reduced range of the beacon for display and eventual use in the calculation of the beacon coordinates and USBL calibration values.

If any USBL data from the Sonardyne telegram is detected in the calibration data, the following dialog opens when this button is clicked. Select the Ray Bending option desired and click OK to re-process. It should be noted that in the case of the calibration data containing both Sonardyne and Simrad-based data, ray bending is only applied to the Sonardyne data.



If only USBL data from the HPR400 telegram is detected, the processing launches upon clicking the Recalc USBL button.

Reset the USBL Calibration Data

At any time during the USBL processing, you have the option to reset the USBL data to its uncorrected state with respect to the USBL calibration corrections. This is sometimes required when during the processing you feel incorrect editing has biased the solution and that the best action is to start over. In addition, the reset can also be used to correct for the situation of logging the data with the wrong map projection settings.

Note: For any resetting of the USBL data and/or map projection, it is **critical** that

the current WinFrog geodetic and map projection configuration is the correct one to use for the USBL calibration.

To execute this option, click the **Reset USBL** button from the main **Calibration** dialog.

When the button is clicked, you are prompted with a message box informing you of the reset options. These are as follows:

- Change the Map Projection and reset the USBL Calibration Corrections (click **Yes**); or
- Reset the USBL Calibration Corrections only (click **No**); or
- Abort the process (click **Cancel**).

Click the appropriate option. If Yes or No were selected, when the change and/or resetting process is completed, you are informed with an appropriate message box. For both of these options, any travel time data will be reprocessed using the current velocity profile. If none exists, then a default sound velocity of 1485 m/s is used.

The Transformation to a new Map Projection

The change of the map projection involves the following:

- Transforms the geographic coordinates for all base stations in the calibration data set to the current Working Map Projection.
- Transforms the geographic vessel positions to the current Working Map Projection.
- Transforms the raw position LOPs (WGS84 ellipsoid latitude and longitude) to the current Working Ellipsoid and then to the current Working Map Projection.

The Resetting of the USBL Data

The resetting of the USBL data involves the following:

- The current USBL corrections are reset to default values, that is scale = 1, pitch = 0, roll = 0 and heading = 0.
- The raw XYZ data are reprocessed with the reset calibration corrections and are projected to the current Working Map Projection to derive new scaled LOPs.
- If TWTT data are available, the current Working Velocity file is accessed and the raw TWTT LOP are reprocessed to determine new Reduced LOPs, i.e., slant ranges relative to the potentially new map projection.
- If direction cosine data are available, they are reprocessed with the current Working Xponder and Velocity files and the reset calibration corrections and projected to the current Working Map Projection.

This step also removes the affect of the USBL corrections that were present in WinFrog and applied during the data collection process.

Note: This option is the only method available for correcting the projection of standard USBL X, Y, Z data to the map projection if a bad depth was entered in the **Working Xponder** file prior to setting up for the calibration.

Updating the USBL Calibration

Once the USBL corrections have been determined, WinFrog must be updated in order for them to be applied. At present, this is not an automated process. After the final iteration of the USBL corrections processing is complete, the results, as displayed in the **Calibration Results** dialog box and printed in the **USBL Report**, must be manually entered in the appropriate USBL HYDROPHONE data item transducer configuration.

To Update the USBL Calibration Data in WinFrog

- 1 Access the calibration vehicle's **Configure Vehicle-Devices** dialog.
- 2 Highlight the **USBL HYDROPHONE** data item and click **Edit** or double-click on it.
- 3 Click the appropriate **Configure Transducer** button to display the dialog shown below.

Configure USBL Transducer

Calibration Corrections

Range Scale Factor	Head Rotation Correction
1.00000	0.00000
Pitch Correction	Roll Correction
0.00000	0.00000

NOTE: Corrections sign conventions are
Roll=(+)Stbd down; Pitch=(+)Stern down

USBL System Internal Offsets

Offsets from the point the data is related to, to the transducer. These values will be subtracted from the USBL output data to get data related to the transducer.

Fore/Aft	Port/Stbd	Z (down +)
5.00m	-5.00m	10.00m

WinFrog Offsets, from CRP to Transducer

Fore/Aft	Port/Stbd	Depth (down +)
5.00m	-5.00m	10.00m

OK Cancel Help

- 4 Enter the USBL corrections **exactly** as presented in any of the calibration displays and reports, including the same sign convention.

Confirmation Tests

The results printed in the **USBL Calibration Report** are, in themselves, a confirmation of the success and validity of the correction values determined. However, this is seldom accepted as the only confirmation.

To Confirm the USBL Calibration Results

Confirmation of the USBL calibration results generally requires that the calibration vehicle perform a specific action after changing the WinFrog configuration to track the deployed beacon as if it were a remote vehicle.

- 1 To change to tracking mode, first add a vehicle to WinFrog.
- 2 Attach the USBL BEACON data item to it and set the ID code to that of the deployed beacon.
- 3 Change the USBL HYDROPHONE data item attached to the calibration vehicle to **Tracking** mode.

The calibration vehicle will then execute a perform a predesigned maneuver and monitor the position of the tracked beacon. The objective of the this maneuver is similar to that for the design of the calibration data collection pattern itself, i.e. to orient the hydrophone with respect to the beacon such that observations to the beacon are made from all sides of the hydrophone in a controlled and uniform manner. The major difference is that the effect of the changes in the orientation is used to determine if the USBL corrections are valid, rather than to actually determine the corrections themselves. Typical maneuvers are the spin test, where the vehicle maintains station near the beacon while rotating its heading 360° , and simply steaming a line towards, over and away form the beacon.

If the results and application of the USBL corrections are correct, the beacon position will remain static within a specified tolerance.

If the corrections are incorrect, the beacon's position will appear to shift as the calibration vehicle performs its maneuver. This shift will be correlated to the orientation of the calibration vehicle with respect to the beacon.

Summary of the USBL Calibration Process

- 1 Ensure that all devices involved are operating properly and are correctly configured. These include the USBL, GPS, gyro and attitude sensor.
- 2 Ensure that all devices and their associated data items are added to WinFrog and the calibration vehicle, respectively. Confirm the configurations.
- 3 Ensure a valid **Working Xponder** file is opened.
- 4 Design the appropriate directory structure and file naming standard to ensure the data will be saved in manner that is easy to understand and manage.
- 5 Determine the data collection pattern to use.

- 6 Deploy a **Beacon** in the calibration area, taking a fix with the surface navigation to determine the estimated deployment location. Alternatively, if the beacon is deployed with an ROV (standard for deep water calibrations) take several fixes using the uncalibrated USBL system to determine an estimate for the deployment location.
- 7 Determine the depth of the beacon as precisely as possible.
- 8 Edit the **Working Xponder** file and ensure that a **USBL Fixed** beacon is present for the deployed beacon. Enter the beacon name, estimated deployment coordinates, the best determination of the depth (as is possible), and the beacon's code.
- 9 Setup the calibration data collection in WinFrog and following the pattern, collect the data, saving regularly to disk during the process.
- 10 Upon completion of the data collection. Copy the calibration file and set the copy's attributes to **Read Only**.
- 11 Process the data:
 - Beacon position determination.
 - Review the data (position and range LOPs) and remove obvious bad data based upon trends. not residuals.
 - Setup and solve for the beacon position.
 - Review the same data again, this time refining the editing using examination of both the LOPs and their residuals.
 - Resolve the beacon position.
 - Repeat until satisfied with the results.
 - USBL Corrections determination
 - Review the data (bearing and depth LOPs) and remove obvious bad data.
 - Setup and solve for the USBL corrections.
 - Review the data and refine the editing. Include the USBL report in the examination and analysis of the results to assist the editing.
 - Resolve the USBL corrections.
 - Repeat until satisfied with the results.
 - Save the final calibration file.
 - Save the report to an enhanced metafile for subsequent inclusion in a document/report.
- 12 Apply the results, entering the corrections in the appropriate USBL HYDROPHONE transducer configuration, being careful to enter the data exactly as produced in the calibration.
- 13 Perform a confirmation as required.
- 14 Perform any necessary file management and cleanup of intermediate files.

Chapter 21: Basic Ribbit

Introduction

Ribbit is a data processing program written by Fugro Pelagos to provide data processing capabilities primarily for WinFrog data. This software makes the processing of WinFrog data easier, quicker, and safer than using various third party programs. (ASCII XYZ data can also be used in Ribbit, but with limited functionality. More details on this are below in the **Data Input** section).

There are two versions of Ribbit available: **Basic Ribbit** and **Ribbit Cable and Pipeline**. The differences between these programs lies in the addition of a **3D Digital Terrain Model viewer** and the ability to generate **Profile View Data Panels** in the **Cable and Pipeline** version only.

Note: in this document the terms **Ribbit** and **Basic Ribbit** are used interchangeably.

Ribbit is a standalone program designed to run on 32-bit Windows™ platforms. Data storage and memory usage may be maximized during data processing, so a large hard drive and plenty of RAM should be available. The computer's display should also be of a "higher" quality. Although the software will operate on a computer equipped with an 800 by 600 pixel display, it is recommended that a 1024 by 768 pixel display be used. This improves the quality of the various graphical displays found in Ribbit. The software will not operate at a resolution lower than 800 by 600 pixels.

Although Ribbit can be operated simultaneously with WinFrog on the same computer, this is not recommended. Not only will the performance of the programs suffer, conflicts within the operating system may also cause fatal system crashes. However, data processing with Ribbit should not be left until the end of the project either. It is important to verify both data quantity and quality while there is still an opportunity to correct for any shortcomings.

This chapter deals with all aspects of using Ribbit for data processing, in the order that they are found in the program. You may determine that your processing efforts are better undertaken utilizing the various tools in a different order. For example, you may wish to edit each individual data type before any merging or modifications are undertaken (as opposed to the order that these steps are found below). Although Ribbit is flexible in accepting these varied approaches, note that there is no "undo" button available to quickly reverse your actions.

To aid with training, a sample data set is included with the Ribbit installation kit. It is installed in the **Samples** directory, within the **Ribbit** directory. (i.e., **C:\Program Files\Fugro Pelagos\Ribbit\Samples**). This data set allows you to experiment with the software and to explore its features prior to editing “real” data. The data are from a small hydrographic survey conducted in San Diego, California in April 1997, and consist of data from a NMEA-compliant DGPS receiver (Leica MX400) and a NMEA-compliant echosounder (Furuno FCV-582).

As with all Fugro Pelagos software, Ribbit is in a constant state of change and improvement. Select **Help > About Basic Ribbit** to see which version of the program you are operating.

An Overview of Ribbit

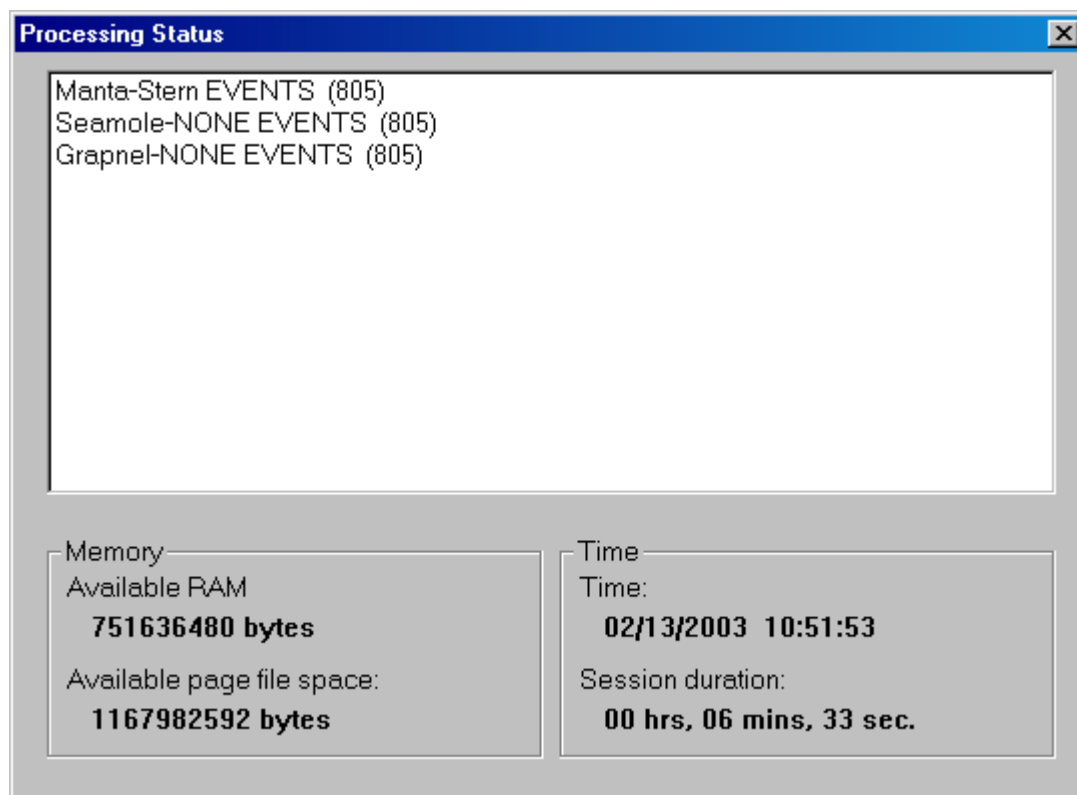
Start Up

The Basic Ribbit program is included with all WinFrog installation disks; this version of the program is provided as “freeware” and subsequently does not require the use of any security devices at startup.

Ribbit is internally configured the same way each time the program is started. This differs from WinFrog, which retains all configuration changes each time the program is stopped, then recalls the configuration the next time the program is started. Each time a Ribbit session is closed, the program deletes (i.e. “forgets”) all data input and editing configurations.

Status Window

To view the Status window, select **Tools > Status Window** from the main menu. If the window is already displayed, a checkmark will appear beside this item. To close the Status window, click the X in the top right corner of the window or repeat the steps followed to open it.



The Status window displays the loaded data, memory and time status of the current processing session. The ‘loaded data’ box lists the WinFrog **data records** currently held in memory and available for processing by the available tools. The specific **data items** contained within these records are not listed.

The current available memory (RAM) and the available page file space are displayed to provide information regarding how close the computer is operating to its memory capacity. Ribbit processing module will accept as much data as there is system memory for, but may become sluggish when the amount of available RAM is low and the page file is being used for data storage.

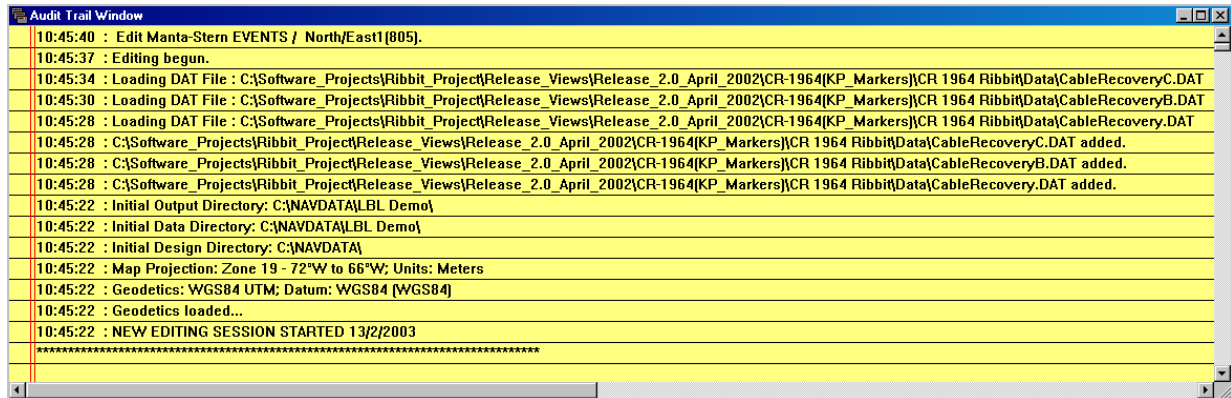
You can decide how much data Ribbit can handle on your computer by watching the status window RAM value. This helps determine when it may be necessary to process data as several separate datasets instead of as one large dataset.

Audit Trail “Notepad”

Ribbit maintains an audit trail of the data loading, processing and editing steps executed for each session. This trail has an associated file and window.

The **Audit Window** displays the audit trail for the current processing session, including time tags, of all events that have taken place. Each time a task is executed, such as loading a data file or performing a correction using the data

correction tool, a report of the task is added to the audit trail; if the Audit window is open, it is updated to display it. The events for the current processing session can be scrolled through using the scroll bars located on the bottom and right side of the window.



To view the Audit window, select **Tools > Audit Window** from the main menu. If the window is already displayed, a checkmark will appear beside this item. To close the Audit window, click the X in the top right corner of the window or repeat the steps followed to open it. This window can also be resized and minimized.

The **Audit File** contains the audit trail. This audit file is automatically created when Ribbit is first started. It is placed in the program directory and is called 'audit.trl'. If the audit file already exists, the audit data from each successive processing session is appended to the file. Because each session is appended to the audit file, the file may become quite large over time. To avoid this you should periodically copy and rename the audit file, and then delete the original. Every entry to the audit trail is written to the audit file.

Menu Items

File, Edit and Search

The File, Edit and Search pull-down menus contain options related to text editing of ASCII files. These options behave in the same way as similar menu items found in standard word processors or in Windows® NotePad and are provided to allow manual editing and inspection of WinFrog data files. The **File | Open** menu item enables you to select a file from among the common WinFrog file types and to open it into the text editor. Once a file is open it may be edited directly. The **Cut** and **Paste** commands under the **Edit** menu and the **Find** and **Replace** commands under the **Search** menu may be used to assist in editing. These commands behave in exactly the same manner as the similar commands in the Windows® NotePad program. Data files may be printed using the standard **Print**, **Print Preview** and **Print Setup** commands. In most cases

these menu items represent a relatively minor set of functions that are rarely used during a typical Ribbit processing session.

System Configuration File -- Load

When you select **File | System Config File ... | Load**, a Standard Windows ‘*open file*’ dialog box is opened, enabling you to pick the cfg file to be loaded into the current Ribbit processing session.

After the operation is complete you are notified with a message indicating the configuration file has been loaded.

This operation will update the existing Ribbit initialization file with the information in the selected configuration file.

System Configuration File – Save

When you select **File | System Config File ... | Save**, a Standard Windows ‘*save file*’ dialog box is opened, enabling you to pick the cfg file to be saved to disk. After the operation is complete you are notified with a message indicating the configuration file has been saved.

This operation will save the existing Ribbit initialization file to the selected configuration file.

Project Directories

When you select **File | Project Directories**, a dialog box is opened enabling you to select the ‘**Data Directory**’ and the ‘**Output Directory**’ for Ribbit to use for processing. Select the ‘**Browse**’ button for each operation to open a Standard Windows ‘select folder’ dialog box to select the appropriate directory.

Data Input, Tools, and Data Output

These menu items (**Data Input**, **Tools**, and **Data Output**) provide access to all of Ribbit’s processing functions.

Ribbit’s **Data Input** dropdown menu provides you the ability to input both WinFrog and generic **ASCII XYZ** data types. See the **Data Input** section below for complete details on all of these Ribbit data input tools.

Ribbit’s **Tools** dropdown menu provides you with various numerical and graphical data editing functions including; tools for managing the individual data records, merging one data type with another data type, interpolating data based on specified time intervals, applying corrections to the data, filtering the data, and changing the geographic coordinate system to which position data are referenced. See the **Tools** section below for complete details on all of these Ribbit processing tools.

The **Data Output** dropdown menu contains three different output utilities that allow you to create an **ASCII** text file, a **DXF** format plan view map, and a Microsoft Access™ **.mdb** format data file. See the **Data Output** section below for complete details on all of these Ribbit output functions.

Data Input

Ribbit's **Data Input** dropdown menu allows you to input **WinFrog** and **ASCII X,Y,Z** data types. Furthermore, three different WinFrog data formats can be imported: **Automatic Event** data (**.dat**, **.rcv**, **.src**), **Manual Event** data (**.log**), and **Raw** (**.raw**) data. Input of ASCII text also provides the following options: **X,Y,Z** (i.e. **Easting, Northing, Elevation**), **Y,X,Z** or **PC Time, Latitude, Longitude, Elevation**. ASCII data must be in comma or space separated format. You can also load data files in the **MS Access™** (**.mdb**) format. These database files contain **Time, Position**, and additional data.

The following sections detail each **Data Input** option.

Raw (.Raw) Files

Most data processing efforts use WinFrog's **raw** (**.raw**) format data files. Since the **.raw** data are truly “raw” in nature (i.e. no filtering or offsets are applied to the data), these files often provide a better “base” starting point for processing than would automatic event data.

Also, because WinFrog can be configured to record **.raw** data from devices as quickly as it is able (as opposed to some specified time or distance interval), these files can also provide a much larger volume of data to work with. See the **Eventing** chapter for details on how to collect **.raw** format data using WinFrog.

In order to fully appreciate the flow of data into and out of a Ribbit processing session, it is important that you become familiar with the WinFrog raw file format.

This format is simply a line-by-line list of all of the data from each individual instrument interfaced to WinFrog, logged record-by-record, and preceded by an identifying device code, the name of the device, and a time-stamp. An example of the format, taken from a WinFrog **.raw** file, is as follows:

```
303,MX400,861879726.45,65126.00,32.71174000,-117.22566000,2,6,1.4,1.40,-33.30,6.30,262
```

This is a raw record from a Leica MX400 DGPS receiver. The data are preceded by the **code** 303, which is the code for data output from a GPS receiver. Each type of device has its own preceding code. For example, an echosounder has a WinFrog code of 411, a digital compass or gyro has a code of 410, and so on. See the **WinFrog File Formats** appendix for a detailed description of these files and codes.

The next field contains the **name** of the device selected when it was first added. In this example, it is MX400. See the **Adding a Device** section in the **Peripheral Devices** chapter for details.

Following the name is the **time-tag**, which is a single number referred to as **PC time**. **PC time** is a common method of representing time in data files and represents the number of seconds elapsed since 00:00:00.0, January 1, 1970.

These first three fields of the raw data record are common to all devices.

The remaining fields in the raw file record are specific to the type of device creating the record. For example, the 303 record includes fields for **GPS Time of Week, Latitude, Longitude, Status, Number of Satellites, HDOP, Altitude**, etc.

Each individual line of data in a file is referred to as a **data record**, or **record**. Each **record** can contain several **fields**, where a single value within a field is referred to as a **data item**.

The WinFrog File Formats appendix contains specific details on the contents of every raw data record produced and recorded by WinFrog.

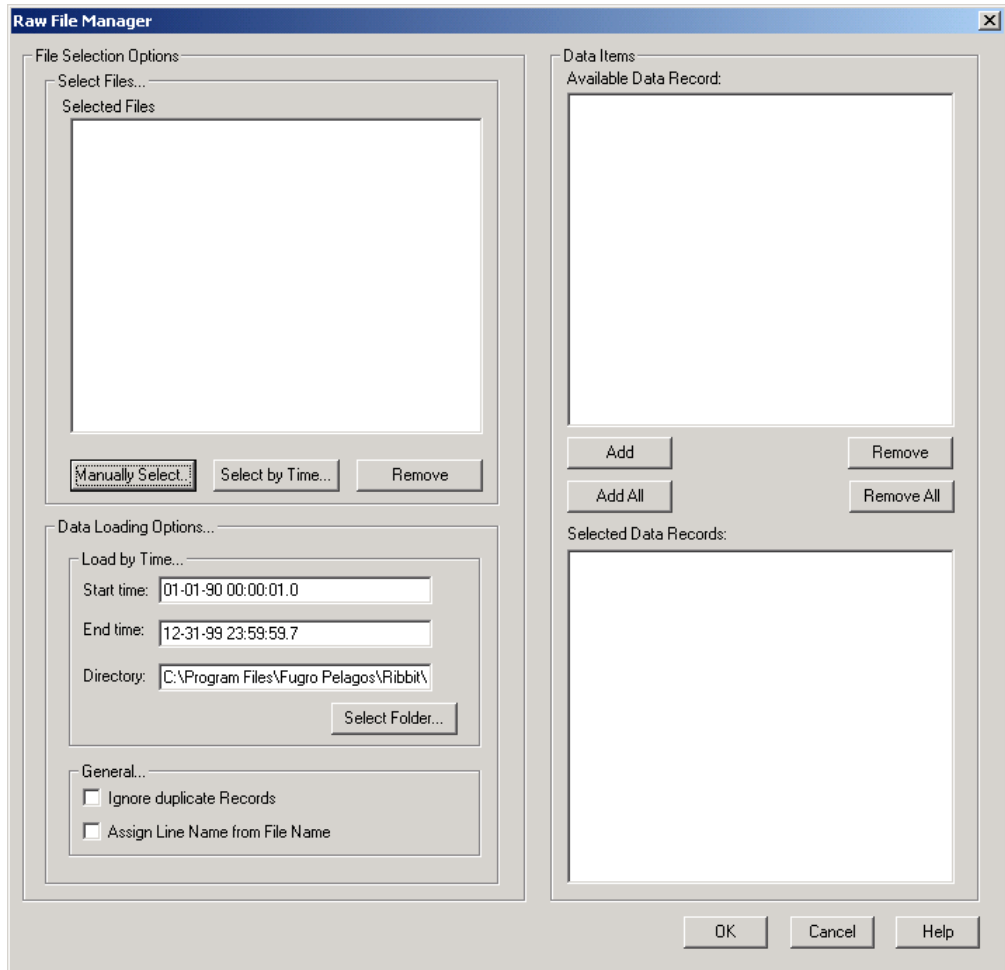
Loading Raw (.Raw) Data Files

As briefly mentioned above, the various options found under the main menu item **Data Input** are used to load files into Ribbit.

To Load WinFrog Raw (.raw) Files

- 1 Choose the **Select RAW data files...** option from the **Data Input** dropdown.

This action opens the **Raw File Manager** as seen in the next figure.



The **Raw File Manager** provides two methods for loading **.raw** files into the current data processing session: **Manually Select** and **Select by Time**. As the name suggests, **Manually Select** allows you to select **.raw** files manually, i.e. “by hand” and **Select by Time** is used to select **.raw** files by specifying a time window.

To Manually Select .Raw Files

- 1 In the **Raw File Manager** window, click the **Manually Select** button.
- 2 Navigate to the directory containing the files.

Note: see WinFrog’s main menu item **File> Select Working Directories** to see where the **.raw** data files were recorded. WinFrog’s default configuration places **.raw** data files in the **C:\Navdata** directory.

- 3 Select the desired **.raw** files.

Use the keyboard’s **Shift** or **Ctrl** keys to select multiple **.raw** files simultaneously.

- 4 Click **Open**.
- 5 Ribbit “reads” the selected **.raw** files and lists all of the different **Data Records** found in these files. Select the desired **Available Data Records** from the upper right-hand list.
- 6 Click **Add** to move the selected items to the **Working Data Records** list. Alternatively, double-click on the desired item in the Available Data Record list to move that item to the Working Data Records list; or click the **Add All** button to move all items in the Available Data Record list to the Working Data Records list.

If you change your mind and want to remove a Data Record from the Working Data Records list, you may do any of the following:

- highlight the item(s) in the list and click the **Remove** button to remove those selected items;
 - double-click on the item in the list to remove that one item; or
 - click the **Remove All** button to remove all the data records from the list.
- 7 Click **OK**. Ribbit now closes this window and displays “**Loading Data....**” while it loads the **Data Records** into the temporary memory. Note that the **Audit Trail** lists the selected **.raw** files and **Data Records**. The **Status Window** also displays all loaded **Data Records**.

To Select .Raw Files by Time

- 1 In the **Raw File Manager** window, enter a **Start time** and **End time** in the **Data Loading Options** section.
Note: the time must be entered in the **mm-dd-yy hh:mm:ss.s** format.
- 2 Click the **Select Folder** button and navigate to the directory containing the files. Click **OK**. Alternatively, enter the folder path and name in the **Directory** field.
Note: see WinFrog’s main menu item **File> Select Working Directories** to see where the **.raw** data files were recorded. WinFrog’s default configuration places **.raw** data files in the **C:\Navdata** directory.
- 3 Once the data loading options are specified, click the **Select by Time** button.
Only those **.raw** data files created between the designated start and end times (and residing in the current directory) are loaded into the **Raw File Manager**. Once the desired **.raw** files have been loaded into the **Raw File Manager**, the upper right list of **Available Data Records** will contain all of the data records available from the selected files. The next step is to select which **Data Records** are to be loaded into the current processing section.

- 4 Select the desired **Available Data Records** from the upper right-hand list.
- 5 Click **Add** to move the selected items to the **Working Data Records** list. Alternatively, double-click on the desired item in the Available Data Record list to move that item to the Working Data Records list; or click the **Add All** button to move all items in the Available Data Record list to the Working Data Records list.

If you change your mind and want to remove a Data Record from the Working Data Records list, you may do any of the following:

- highlight the item(s) in the list and click the **Remove** button to remove those selected items;
 - double-click on the item in the list to remove that one item; or
 - click the **Remove All** button to remove all the data records from the list.
- 6 Click **OK**.

Ribbit now closes this window and displays “**Loading Data...**” while it loads the **Data Records** into the temporary memory. **Note:** the **Audit Trail** lists the selected **.raw** files and **Data Records**. The **Status Window** also displays all loaded **Data Records**.

Data (.Dat, .Rcv, .Src) Files

WinFrog’s Data files refer to those files generated when **Automatic Eventing** is enabled, and include the **.dat**, **.rcv**, and **.src Record Types**. Each of these three **Record Types** can be loaded by using the **Select .DAT Data Files** utility. Ribbit places these three different **Record Types** into the same category because the files are identical in structure and content.

WinFrog’s **Automatic Event** data differs from **.raw** WinFrog data in that they do not represent data from any particular instrument, but rather represent the instantaneous state of navigation of a particular vehicle at the moment of the event. WinFrog events are discrete snapshots of the overall state of the vehicle, recorded at either specified distances along a survey line or at specified time intervals.

See the **Eventing** chapter for more details on data collection and data files.

To Load .Dat, .Rcv and .Src Data Files

- 1 From the **Data Input** menu, choose **Select DAT data files**
- 2 From the **Files of Type** dropdown menu, select the desired file type.
- 3 Navigate to the directory containing the desired file(s).

By default, WinFrog will place all of these data file types in the **C:\Navdata** directory. See WinFrog's main menu item **File >Select Working Files** to ascertain where these files are located.

- 4 Click **Open**.

Ribbit lists the loaded files in the **Audit Trail Notepad** and the **Status** window.

Manual Event (.Log) Files

WinFrog **Manual Event** files refer to those files containing data recorded manually at a specific point in time as defined by the user. **Manual Events** are stored in the Working **.log** file.

To Load Manual Event (.Log) Files

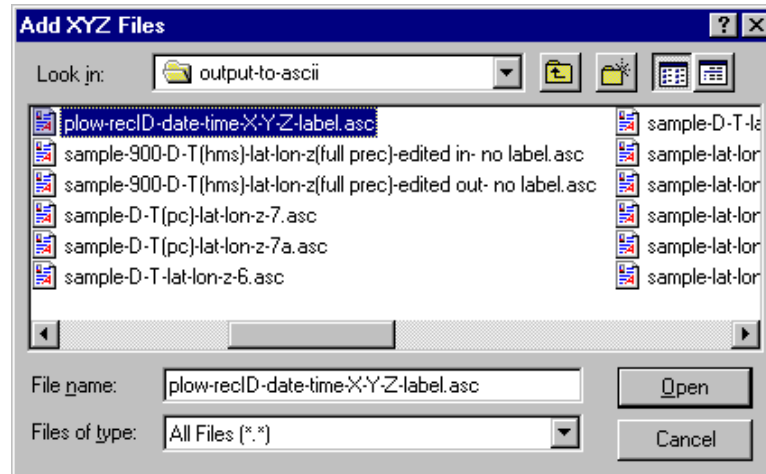
- 1 From the **Data Input** menu, choose **Select .LOG event files**
- 2 Navigate to the directory containing the desired file(s). By default, WinFrog will place all of these data file types in the **C:\Navdata** directory. See WinFrog's main menu item **File >Select Working Files** to ascertain where the **.log** files are located.
- 4 Click **Open**.

Ribbit lists the loaded files in the **Audit Trail Notepad** and the **Status** window.

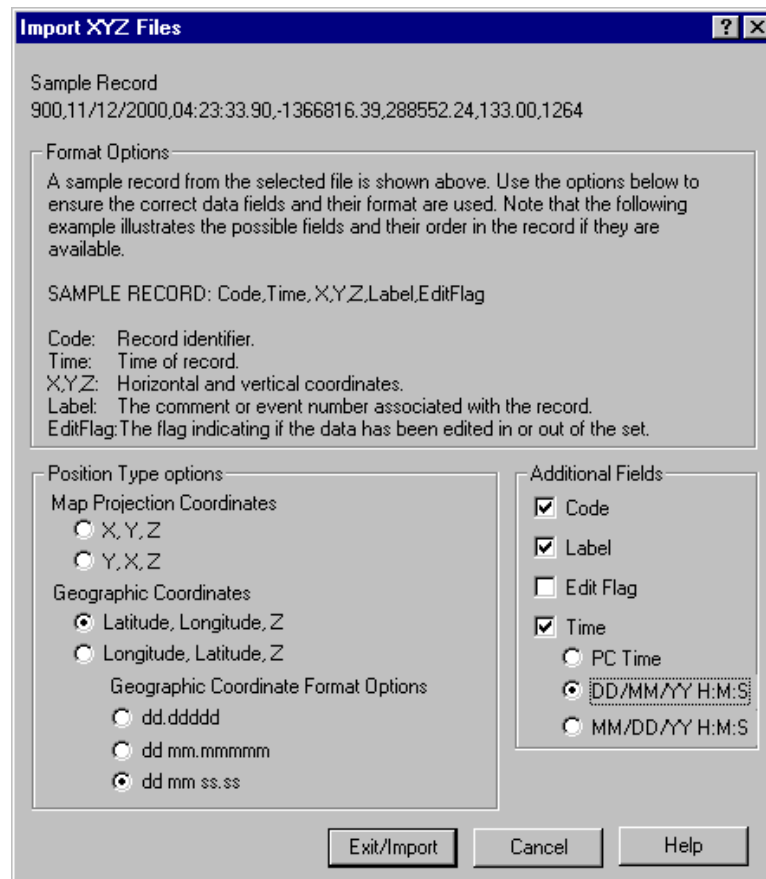
XYZ Data

XYZ Point files are files that can contain any number of fields which have XYZ or Lat,Lon, Z datafields.

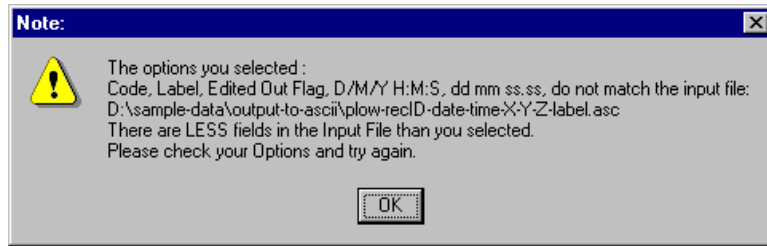
A dialog box is displayed when you select **Data Input | Select XYZ Point Files**. This dialog box is a standard Windows 'Add Files' box which allows you to select the drive, directory and filename. All filenames are displayed. Double-click a filename or click a filename and click **Open** to add the file to the current Ribbit processing session . This dialog box is as follows:



The next step is to choose the appropriate options that match the input file. The options supported are Code, Label, Edit Flag, Time and various forms of XYZ or LatLonZ. An example is indicated below:



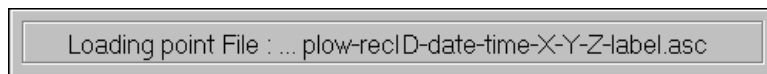
Selecting too **many** options for the selected input file will result in a message box like the following sample.



Selecting too **few** options for the selected input file will result in a message box like the following sample.



While XYZ files are loading, you are presented with a message like the one below.



Loading Tide Files

Ribbit is capable of loading and utilizing tide data from three different sources; Micronautics, Inc.'s World Tide program, the U.S. National Oceanographic and Atmospheric Administration (NOAA), and "generic" ASCII files.

World Tide files are identified by their **.tab** extension, while **NOAA**'s files use the **.tid** extension. The "generic" user-defined **ASCII** text format files can have any extension type.

Note: before any tide data are loaded into Ribbit, it is critical to confirm what units of measure (i.e. meters or feet) and time reference (i.e. local or UTC) are used in the tide file. It is also critical to confirm the same information for the water depth data to which the tides will be applied.

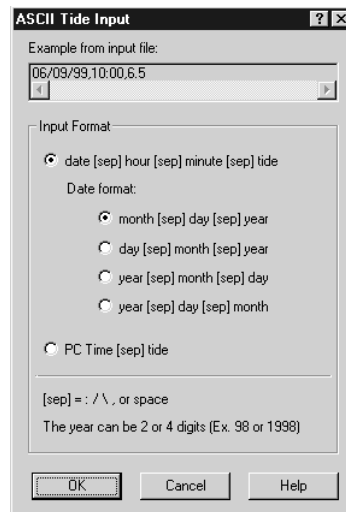
ASCII Files

This method allows you to use tide files made up of simply ASCII text **time** and **tide** data. This data can be in various formats, as specified below in the **ASCII Tide Input** dialog box.

To Load an ASCII Tide File

- 1 From the **Data Input** menu, choose **Tide Files> ASCII tide format**.
- 2 Navigate to the directory containing the desired file.
- 3 Select the desired file.
(As mentioned above, any file extension will be accepted).
- 4 Click **Open**.

The **ASCII Tide Input** dialog box opens, as seen in the next figure.



The **Example from input file** window displays the contents of the first line in the selected file.

- 5 Configure the **Input format** using the example as a guide.
- 6 Click **OK** to load the tide data and close this window.

World Tide (.Tab) Files

The World Tide program is used to generate predicted tides for any time period at thousands of locations covering the entire globe.

To Load a World Tide (.Tab) File

- 1 From the **Data Input** menu, choose **Tide Files> WorldTide 'TAB' file**.
- 2 Navigate to the directory containing the desired World Tide (.tab) file.
- 3 Select the desired .tab file.
- 4 Click **Open**.

NOAA Tide Files

The U.S. NOAA organization generates actual and predicted tide information for any time period at hundreds of locations covering the coastal United States. These **NOAA (.tid)** files can be downloaded from the NOAA web site.

To Load a NOAA (.Tid) Tide File

- 1 From the **Data Input** menu, choose **Tide Files> NOAA tide format**.
- 2 Navigate to the directory containing the desired **NOAA (.tid)** file.
- 3 Select the desired **.tid** files.

The screenshot shows a dialog box titled "NOAA Tide Input". It contains three main sections: "Data source", "Quality", and "Corrections". In the "Data source" section, "Station Code" is set to "9410170" and "Gauge number" is set to "1". In the "Quality" section, the "Use flagged data?" checkbox is checked, and "Max Std Dev" is set to "1.0". In the "Corrections" section, "Time correction" is "0.0", "Scale" is "1.0", and "Offset" is "0.0". At the bottom of the dialog are three buttons: "OK", "Cancel", and "Help".

- 4 Configure the following parameters of the **NOAA Tide Input** dialog box:

Data Source

Station Code

Enter the code for the tide station.

Gauge number

The number of the gauge (typically 1).

Quality

Use Flagged data?

Tide data are time stamped similar to the way .raw data are time stamped. If anything abnormal occurs at a specific time stamp that might make the data suspect, that data are flagged. You can choose to use the flagged data or not.

Max Std Dev:

When data are flagged, they are assigned a standard deviation that statistically describes how far the data may deviate from the truth. If you decide to use flagged data, you can

enter a standard deviation threshold so that suspect data are not used.

Corrections

Time correction:	Alters the time of the data when it is loaded.
Scale:	Scales the data by a constant value when loaded.
Offset:	Adds a constant value to the data when loaded.

- 5 Click **OK** to load the data.

Note: if it appears that the data are not loaded, check to ensure that the **Station Code** and **Gauge Number** are correct.

MS Access (.Mdb) Data

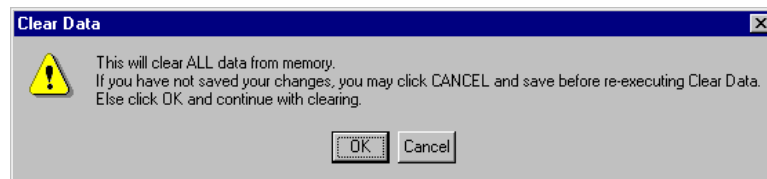
Microsoft's **Access™** is a program used in various database applications, including Fugro Pelagos, Inc.'s **WinFrog** and **Cable Route Design Database (CRDD)** software systems. The files generated and used by MS Access™ are identified by a **.mdb** extension.

To Load an MS Access (.Mdb) File

- 1 From the **Data Input** menu, choose **Input From MS Access Database**.
- 2 Navigate to the directory containing the desired **.mdb** file.
- 3 Select the desired **.mdb** file.
- 4 Click **Open** to close this window and load the file.

Clear Data

Clicking on this menu item when data is loaded in Ribbit will prompt you with the following dialog box:



Select **OK** to clear all data from memory or **Cancel** to perform other Ribbit actions.

Tools

The **Tools** menu is used to access functions that allow you to manipulate the **Data Records** and **Data Items** presently loaded in Ribbit. All changes made to the loaded data records or items are recorded in the **Audit Trail Notepad** window.

Note: as previously mentioned, at no point are the contents of the original data files overwritten to reflect the modifications made using any of Ribbit's tools.

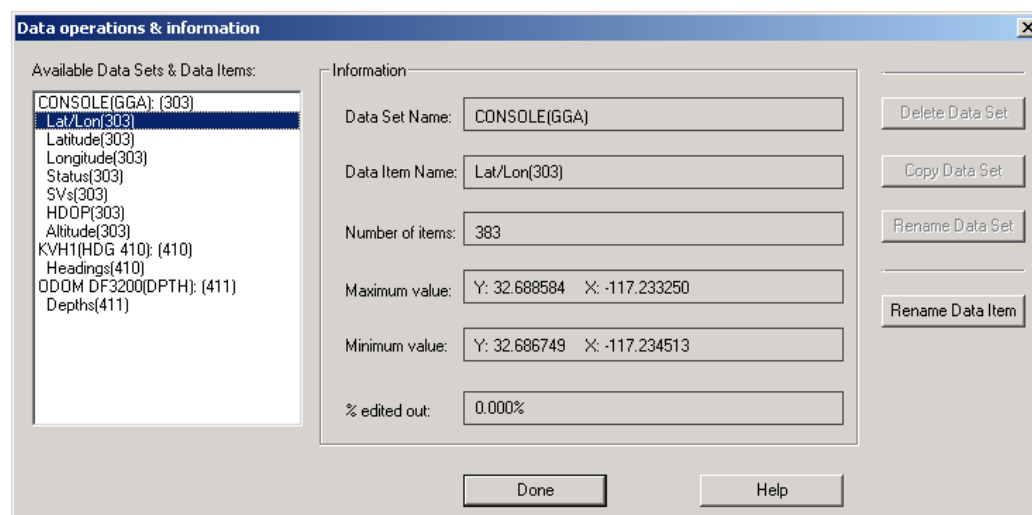
Data Operations

This tool allows you to determine the number of **Data Items** contained in each **Data Record**, as well as ascertain the **Minimum** and **Maximum** values of these **Data Items**. It also provides you with a value that summarizes the percentage of **Data items** that have been flagged as **Edited Out**. The **Data Operations** tool also allows you to **rename** loaded **Data Items** and **delete**, **rename**, and **copy** loaded **Data Records**.

To Perform Data Operations

- 1 From the **Tools** menu, choose **Data Operations**.

The **Data operations and information** window appears as seen in the next figure.



Available Data Sets and Data Items

This window lists all **Data Sets** and **Data Items** loaded in the current processing session. Click on any data set or data item to display its information.

Information

Details the specifics for any data set or data item in the **Available Data Sets and Data Items** list. The following information is displayed:

- Data Set Name
- Data Item Name
- Number of Items
- Maximum Value
- Minimum Value
- % Edited Out

Delete Data Set

This function allows you to delete any loaded **Data Set**.

To delete a **Data Set**, first click on the desired **Data Set** (found in the **Available Data Sets and Data Items** list), then select **Delete Data Set**. A **Confirmation required** message appears at this point. Select **Yes** to delete the selected **Data Set**.

Copy Data Set

This function allows you to copy any loaded **Data Set**.

To copy a **Data Set**, first click on the desired **Data Set** (found in the **Available Data Sets and Data Items** list), then select **Copy Data Set**. The **Copy Data Set** dialog box appears. Enter a name for the new **Data Set**, then select **OK**.

Rename Data Set

This function allows you to rename any loaded **Data Set**. This is required when more than one **Data Set** of the same type has been added, as Ribbit is unable to differentiate between **Data Sets** with identical names.

To rename a **Data Set**, first click on the desired **Data Set** (found in the **Available Data Sets and Data Items** list), then select **Rename Data Set**. The **Rename Data Set** dialog box appears. Enter the new name for the **Data Set**, then select **OK**.

Rename Data Item

This function allows you to rename any loaded **Data Item**. This is required when more than one **Data Item** of the same type has been added, as Ribbit is unable to differentiate between **Data Items** with identical names.

To rename a **Data Item**, first click on the desired **Data Item** (found in the **Available Data Sets and Data Items** list), then select **Rename Data Item**. The **Rename Data Item** dialog box appears. Enter the new name for the **Data Item**, then select **OK**.

Note: do not change the **record number type**. Ribbit requires this information to identify what type of data item it is.

Merging / Deskewing

The **Data Merging and Deskewing Tool** is used to interpolate values from one **Data Item** to the time stamps of another **Data Item**. This merging operation is used to unify multiple, separate **Data Items** into a single new **Data Item**.

All data merging performed in Ribbit is based on a linear interpolation over time. Depending on which **Data Item** is merged “to”, the data density of the new **Data Item** can increase, decrease, or remain the same. For instance, merging a raw **Depth Data Item** to a raw **Position Data Item** will typically reduce the number of depth measurements that will be used for subsequent processing. This is due to the fact that **Echosounders** typically output numerous depths per second (depending on water depth), whereas **Positioning Devices** typically are not capable of data output at more than once a second. Merging in this “direction” will result in a new **Data Item** containing the same number of records as contained in the **Positioning Data Item** (i.e. Ribbit will interpolate a depth value for the time stamps of each position).

On the other hand, you can merge a **Position Data Item** to a **Depth Data Item** to get a **Position** to match each **Depth** measurement. In this case Ribbit is creating extra positions to match each depth measurement time stamp.

Ribbit will interpolate between chronologically successive **Data Items** that are separated by less than the time set in the **Maximum time gap** box (entered in seconds). This helps eliminate interpolation errors that occur when interpolating over large time periods.

To Merge Data Items

- 1 From the **Tools** menu, choose **Merging/deskewing**. The **Merge/de-skew interpolation Control** dialog box opens.

Merge / de-skew interpolation Control

Interpolate FROM:

- Anschultz Gyro(HDG-910): (9°)
- Heading(910)
- DGPS1(GGA): (303)
- Lat/Lon(303)
- Latitude(303)
- Longitude(303)
- Status(303)
- SVs(303)
- HDOP(303)
- Altitude(303)
- DGPS2(GGA): (303)
- Lat/Lon(303)
- Latitude(303)
- Longitude(303)
- Status(303)
- SVs(303)
- HDOP(303)
- Altitude(303)
- LUSBL as ATS(NONE): (309)

Interpolate TO:

- Anschultz Gyro(HDG-910): (9°)
- Heading(910)
- DGPS1(GGA): (303)
- Lat/Lon(303)
- Latitude(303)
- Longitude(303)
- Status(303)
- SVs(303)
- HDOP(303)
- Altitude(303)
- DGPS2(GGA): (303)
- Lat/Lon(303)
- Latitude(303)
- Longitude(303)
- Status(303)
- SVs(303)
- HDOP(303)
- Altitude(303)
- LUSBL as ATS(NONE): (309)

Available Data Items

- Anschultz Gyro(HDG-910): (910)
- DGPS1(GGA): (303)
- DGPS2(GGA): (303)
- LUSBL as ATS(NONE): (309)
- NORCOM Datalogger(PPS): (413)
- NORCOM Datalogger(RDV ALL): (300)
- NORCOM Datalogger(HDG-910): (910)
- NORCOM Datalogger(DPTH-911)
- NOVARSER1(GGA): (303)
- PR-NOVARSER1(GGA): (303)
- Seaway Rover(PSN): (300)
- Seaway Rover(EVT-351): (351)
- Sperry Gyro(HDG-910): (910)
- TST209(PSN): (300)
- TST209(EVT-351): (351)

Interpolate to to produce

Maximum time gap: ☐ Combine data

- Double-click the desired **Data Record** or **Data Item** in the **Interpolate FROM** list. The selection now appears in the **Interpolate** field at the bottom of the **Interpolate FROM** list.

Note: selecting a **Data Record** will result in Ribbit merging all **Data Items** in that **Data Record**. It is preferred to merge single **Data Items**.

- Double-click the desired **Data Record** or **Data Item** in the **Interpolate TO** list.

The selection now appears in the **Interpolate** field at the bottom of the **Interpolate TO** list.

Note: selecting a **Data Record** will result in Ribbit merging all **Data Items** in that **Data Record**. It is preferred to merge single **Data Items**.

- Type a unique name in the **to produce** field at the bottom of the **Available Data Items** list.

- Enter a **Maximum time gap** value (in seconds) in the provided window.

Note: checking the **Combine Data** checkbox will cause the selected data to be combined with no interpolation.

- Click **Perform the Interpolation**. Notice that the new **Data Item** now appears in the **Available Data Items** list. The name is as specified above, while the record number is created by Ribbit.

- Click **Done** to close this window and return to the main Ribbit display.

Interpolation

The **Interpolation** tool allows you to create new data values via the linear interpolation of the time stamps of existing data. The interpolation is similar to the **Merging/Deskewing** tool in that the interpolation is based on time. However, it interpolates within a specific data record instead of from one record to another.

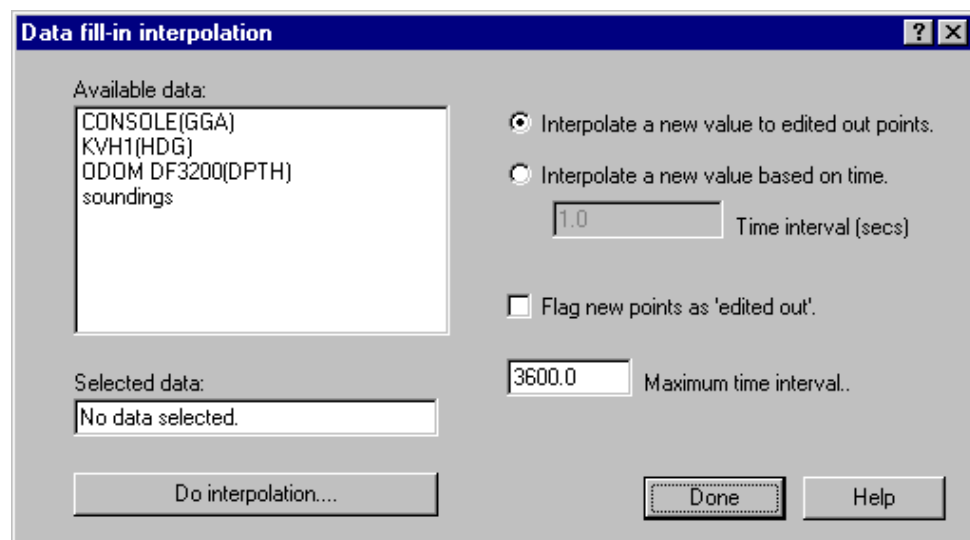
The **Data fill-in interpolation** dialog box provides two methods of record interpolation:

- 1 **Interpolate a new value to edited out points** initiates the creation of a new data value for each **Edited Out** data point, based on the nearest valid data points before and after the **Edited Out** data point being interpolated. This feature effectively generates new “good” data based on the time stamp of a “bad” data point.
- 2 **Interpolate a new value based on time** initiates the interpolation of a new value to a user-specified **Time interval**. For example, if raw GPS data was collected every 10 seconds, but positioning data is required every 5 seconds, this tool would be used to generate the new data points. As with the method mentioned above, data interpolation is based on time.

Data created using either interpolation technique can be flagged as **Edited Out** using the check-box selection. This allows you to identify the data as “non-original” data. A **Maximum time-interval** for interpolation can also be set.

To Interpolate Data

- 1 From the **Tools** menu, choose **Interpolation**. The **Data fill-in interpolation** dialog box appears as seen below.



- 2 From the **Available data** list, double click the desired **Data Record**. The item will appear in the **Selected data** window below.
- 3 Select one of the two options mentioned above. If **Interpolate a new value based on time** is selected, enter a **Time interval** value in seconds.
- 4 If desired, enable the **Flag new points as 'edited out'** option. (Typically this is selected).
- 5 Enter a **Maximum Time interval** (in seconds).
- 6 Click on the **Do Interpolation...** button.
- 7 Click **Done** to return to the main Ribbit window.

Apply Corrections

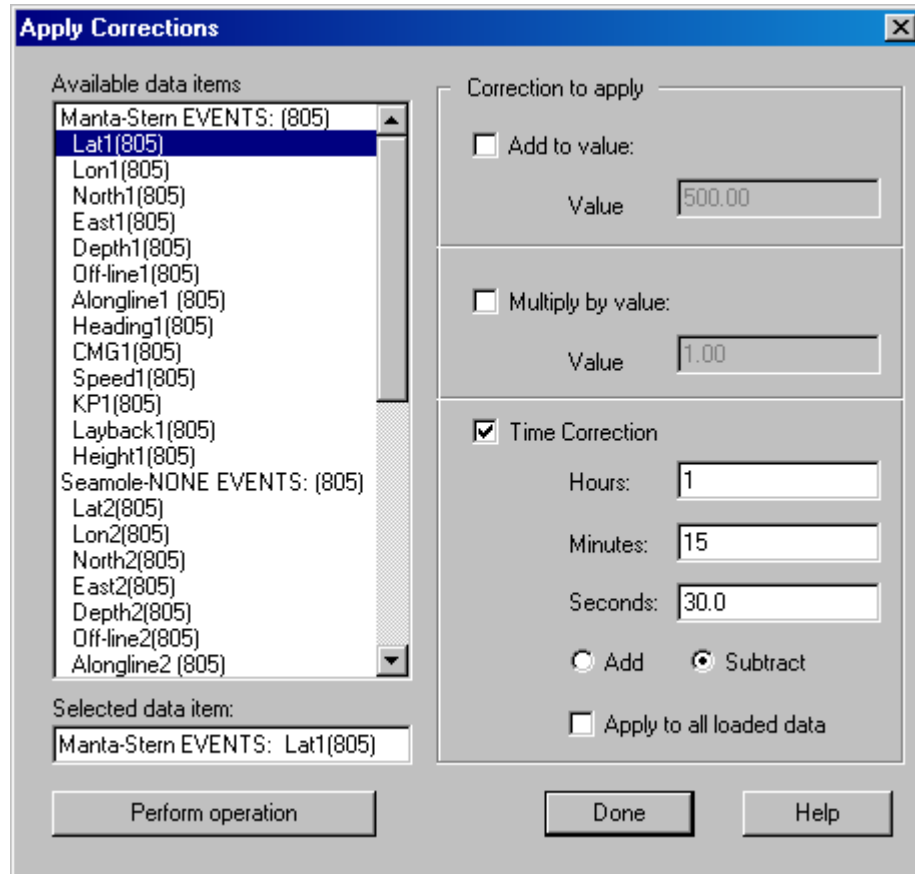
The ability to apply corrections to loaded **Data Items** is one of the most commonly used features in Basic Ribbit. Three different forms of corrections can be applied:

- the addition of a constant value to selected data
- the multiplication of selected data by a constant value
- the addition or subtraction of hours/minutes/seconds from the time-tag of selected data

It is recommended that you undertake these operations independently to ensure that the corrections are applied in the desired order.

To Apply a Correction to a Data Item

- 1 From the **Tools** menu, choose **Apply Corrections**.



- 2 From the **Available data items** list, double-click on the desired Data Item.
- 3 In the **Correction to apply** area, check the desired box.
- 4 Enter the desired correction value(s). Note that any combination of corrections can be applied in a single process. It is therefore important to note the order that the corrections are applied is first **Add**, second **Multiply** and lastly the **Time Correction**. The exception to this is if the **Apply to all loaded data** option is selected, in which case only the **Time Correction** is applied.

To subtract a constant from the selected Data Item, select **Add to value** and type in a negative value.

To divide the selected Data Item, enter a value of 1/constant.

- 5 If **Time Correction** is selected, select either the **Add** or **Subtract** radio button.
- 6 Click **Perform Operation**.

Filtering & Thinning

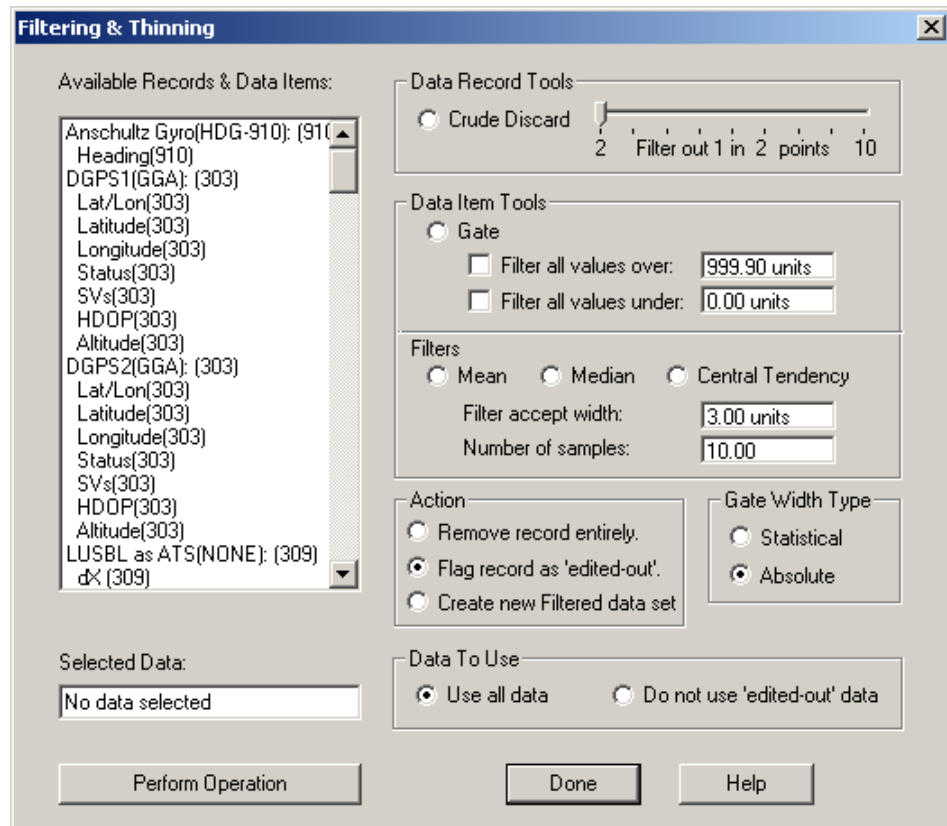
The **Filtering & Thinning** tool is primarily used to reduce (thin) the volume of data from a selected Data Item. This thinning is accomplished by gating out noisy data and removing outliers based on statistical modeling. The points that are filtered or discarded can be **removed entirely** or alternatively flagged as “**edited out**,” allowing you to reinstate (“edit in”) individual points later, if desired. When executing the Filters option, a third option for the filter results, **Create new Filtered data set**, is available. When this option is selected, the filter is applied, but as the filter moves through the data set, instead of the results of the filtered subset being used to test a given data point to determine if it lies within the specified tolerances, the filtered data point is added to a new data set, resulting in a new data set of filtered points.

Note: the “**Action**” (**Remove record entirely** or **Flag as ‘edited out’**) and **Data To Use** selections must be made before any tools found in this window are utilized. The **Action** selection defines whether the data points selected by the filtering and thinning tools will be deleted or simply flagged as “edited out.” The **Data To Use** selection allows you to include (or exclude) data that have previously been deemed “edited out.”

To Thin Out a Data Item

- 1 From the **Tools** menu, choose **Filtering & Thinning**.

The **Crude Discard** selection provides you with the ability to define the quantity of data to be removed or edited out.



- 2 From the **Available Records and Data Items:** list, double-click the desired Data Item.

The name of that particular Data Item now appears in the **Selected Data** field at the bottom of the **Available Records and Data Items:** list.

- 3 In the **Data Record Tools** area, click the **Crude Discard** radio button.
- 4 Move the mouse pointer to be precisely on top of the slide bar, then (while holding down the left mouse button) move the bar to set a value between **2** and **10**. This value indicates the amount of data to be removed (i.e. 2 indicates that 1 in 2 points in the selected Data Item will be removed or flagged as “edited out”).
- 5 In the **Action** area, select either the **Remove record entirely** or **Flag record as ‘edited-out’** radio button.
- 6 In the **Data to Use** area, select either the **Use all data** or **Do not use ‘edited-out’ data** radio button.
- 7 Click **Perform Operation**.

To Filter a Data Item

- 1 From the **Tools** menu, choose **Filtering & Thinning**. The **Data Item Tools** section of the **Filtering and Thinning** window provides you with four mathematical methods that can be applied to remove or edit out data from the selected Data Item.
 - Gate Filter
 - Mean Filter
 - Median Filter
 - Central Tendency

Gate Filter

The **Gate Filter** is used to filter out all data that is over or under user-defined limits.

To Apply a Gate Filter to a Data Item

- 1 From the **Tools** menu, choose **Filtering & Thinning**.
- 2 From the **Available Records and Data Items:** list, double-click the desired Data Item. That particular item now appears in the **Selected Data** field at the bottom of the **Available Records and Data Items:** list.
- 3 In the **Data Items Tools** area, click the **Gate** radio button.
- 4 Check the **Filter all values over** box and/or the **Filter all values under** box.
- 5 Enter the appropriate gating value(s). Ribbit assumes this value to be in the same units as the selected Data Item.
- 6 Click **Perform Operation**.

Mean Filter

Data Items can also be filtered using the Mean Filter. In mathematical terms a mean value is the average value of all included points. The Mean Filter requires the entry of a **Filter accept width** and **Number of samples** values.

The **Number of samples** is the total number of observations that are used to determine the mean value. If an even value is entered (as per the default of 10), Ribbit will calculate the mean of 10 accepted points total (5 accepted points found before and 5 points after the point in question). If an odd value is entered for the number of samples, the **following** points will include the “extra” point. The point in question is not used in the mean calculation.

Ribbit then takes the calculated mean value and adds and subtracts the value found in the **Filter accept width** to determine an upper and lower acceptance value. The point in question is then compared to these acceptance values. If the

point falls outside the acceptance value window, it is either removed entirely or flagged as edited out.

Alternatively, if the **Create new Filtered data set** option has been selected, the results of the filter algorithm will be added to the new data set.

To Apply a Mean Filter to a Data Item

- 1 From the **Tools** menu, choose **Filtering & Thinning**.
- 2 From the **Available Records and Data Items:** list, double-click the desired Data Item. That particular item now appears in the **Selected Data** field at the bottom of the **Available Records and Data Items:** list.
- 3 In the **Filters** area, click the **Mean** radio button.
- 4 Enter values for **Filter accept width:** and **Number of samples**.
- 5 Click **Perform Operation**.

Median Filter

Data Items can also be filtered using the **Median Filter**. In mathematical terms, a median value is a value that has an equal number of observations below and an equal number of observations above it in the sample data set. The **Median Filter** requires the entry of a **Filter accept width** and **Number of samples** values.

The **Number of samples** is the total number of observations that are used to determine the median value. If an even value is entered (as per the default of 10), Ribbit will calculate the median of 10 accepted points total (5 accepted points found before and 5 points after the point in question). If an odd value is entered for the number of samples, the **following** points will include the “extra” point. The point in question is not used in the median calculation.

Ribbit then takes the calculated median value and adds and subtracts the value found in the **Filter accept width** to determine an upper and lower acceptance value. The point in question is then compared to these acceptance values. If the point falls outside the acceptance value window, it is either removed entirely or flagged as edited out.

Alternatively, if the **Create new Filtered data set** option has been selected, the results of the filter algorithm will be added to the new data set.

To Apply a Median Filter to a Data Item

- 1 From the **Tools** menu, choose **Filtering & Thinning**.

- 2 From the **Available Records and Data Items:** list, double-click the desired Data Item. That particular Data Item now appears in the **Selected Data:** field at the bottom of the **Available Records and Data Items:** list.
- 3 In the **Filters** area, click the **Median** radio button.
- 4 Enter values for **Filter accept width:** and **Number of samples:**
- 5 Click **Perform Operation**.

Central Tendency Filter

Data Items can also be filtered using the **Central Tendency Filter**. In mathematical terms, a central tendency value is the value found at the center of a line that is best fit through the sample data set. The **Central Tendency Filter** requires the entry of a **Filter accept width** and **Number of samples** values.

The **Number of samples** is the total number of observations that are used to determine the central tendency value. If an even value is entered (as per the default of 10), Ribbit will calculate the central tendency of 10 accepted points total (5 accepted points found before and 5 points after the point in question). If an odd value is entered for the number of samples, the **following** points will include the “extra” point. The point in question is not used in the central tendency calculation.

Ribbit then takes the calculated central tendency value and adds and subtracts the value found in the **Filter accept width** to determine an upper and lower acceptance value. **Note:** with this particular filter, the **Filter accept width** value can be defined in the **Gate Width Type** section to be in **Absolute** Data Item units or **Statistical** units of Sigma (one standard deviation).

The point in question is then compared to these acceptance values. If the point falls outside the acceptance value window, it is either removed entirely or flagged as edited out.

Alternatively, if the **Create new Filtered data set** option has been selected, the results of the filter algorithm will be added to the new data set.

To Apply a Central Tendency Filter

- 1 From the **Tools** menu, choose **Filtering & Thinning**.
- 2 From the **Available Records and Data Items:** list, double-click the desired Data Item. That particular Data Item now appears in the **Selected Data:** field at the bottom of the **Available Records and Data Items:** list.
- 3 In the **Filters** area, click the **Central Tendency** radio button.

- 4 Enter values for **Filter accept width** and **Number of samples**. As mentioned above, use the **Gate Width Type** radio buttons to change the **Filter accept width** from Data Item units to statistical units of Sigma.
- 5 Click **Perform Operation**.

Configure/Transform Geodetics

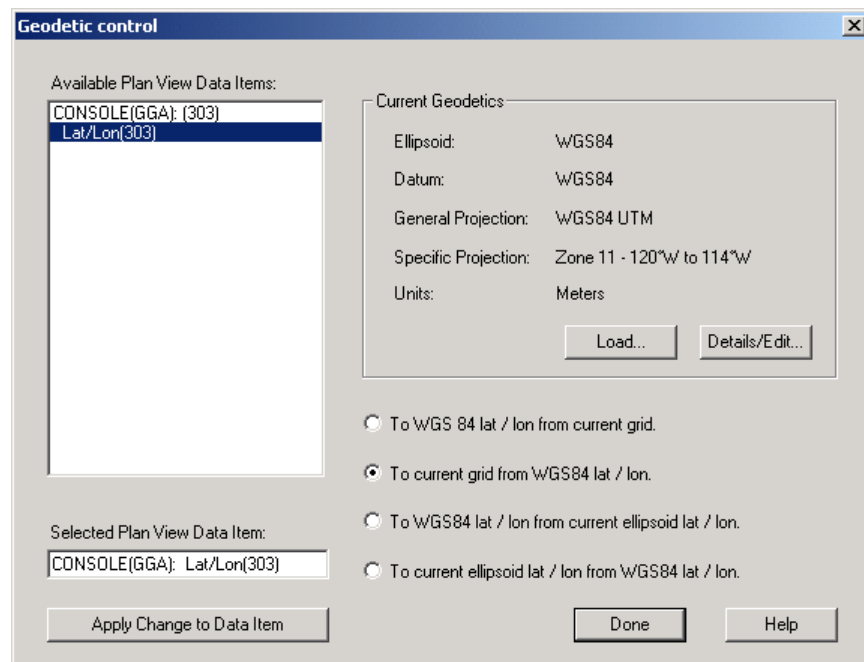
The **Configure/Transform Geodetics** tool allows you to convert the geodetic parameters (reference ellipsoid, datum shifts and map projection) of a loaded positional Data Item. There are four conversions that can be undertaken using this tool.

- 1 Positional **Data Items** recorded as WGS84 referenced lat/long coordinates can be converted to lat/long referenced to another datum or to map projection Northing/Easting coordinates.
- 2 Positional **Data Items** recorded as non-WGS84 referenced lat/long coordinates or map projection Northing/Easting coordinates can be converted to WGS 84 lat/long coordinates.

Note: errors made in the specification of geodetic constants will be carried throughout an entire survey and can have disastrous results. Therefore, it is imperative that you understand the implications of modifying the geodetic constants and ensure that all values are set correctly.

To Change a Data Item's Geodetics

- 1 From the **Tools** menu, choose **Configure/Transform Geodetics**.



- 2 Review and change, if necessary, the current geodetics. There are two options to do this:
 - a. Click the **Load** button to access the WinFrog cfg or ini file from which you can directly load the geodetic and map projection parameters, or
 - b. Click the **Details/Edit** button to open the **Geodetics** dialog box in which you can specify both the map projection constants and the working ellipsoid and datum.
- 3 Once the current geodetics have been selected you can convert any available plan view data item to/from the WGS84 coordinate system. From the **Available Plan View Data Items** list, double-click the desired item.

This places the selected item into the **Selected Plan View Data Item** field.
- 4 Click the desired radio button.

Note: if you are converting from one non-WGS84 coordinate system to another non-WGS84 coordinate system, you must first convert the data set to WGS84 and then convert from WGS84 to the other working system.
- 5 Click the **Apply Change to Data Item** button.
- 6 Click **Done**.

Apply Offsets

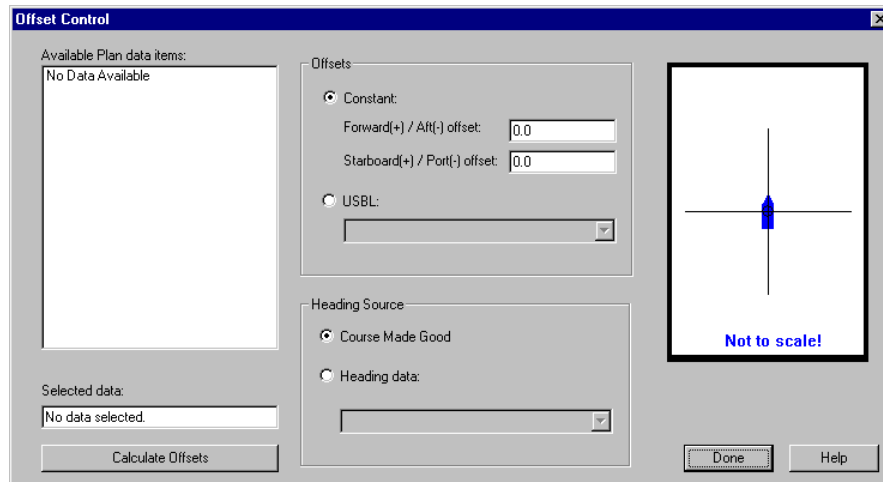
Basic Ribbit's **Apply Offsets** tool allows you to horizontally offset the coordinates contained in any loaded positional Data Item. This is necessary when events have been recorded in the field without having the correct **Tracking Offset** enabled or perhaps incorrect offsets were entered in WinFrog's **Offsets** window.

The most common use of this tool is to offset raw GPS antenna positions to the location of the vessel's echosounder. Without this offset calculation, the depths will be incorrectly related to the GPS antenna position.

It is critical that any offset that is applied must use a gyro device **Data Item** for heading information. The use of **Course Made Good** "headings" is only relevant if the vessel is truly progressing in the same direction that the vessel is pointed.

To Apply a Horizontal Offset to a Positional Data Item

- 1 From the **Tools** menu, choose **Apply Offsets**.



- 2 Double-click the desired Data Item from the **Available Plan data items:** list. (Only those data items containing horizontal positioning data are presented).

This places that data item in the **Selected data:** field.

- 3 Enter the desired offset values into their appropriate boxes, along with the appropriate mathematical sign: forward (+) or aft (-), starboard (+) or port (-).

The **Graphics** window displays the direction of the entered offsets before they are applied (**Note:** this is **not** to scale). This display helps eliminate errors caused by entering in the wrong sign for offsets.

- 4 In the **Heading Source** area, click either the **Course-Made-Good** radio button or the **Heading data:** radio button.

Course-Made-Good is calculated using consecutive positional measurements, whereas **Heading data:** comes from raw heading observations recorded in the field. The dropdown menu displays a complete list of all available **Heading Data items**.

- 5 Click **Calculate Offsets**.

Overplot Removal

The **Overplot Removal** tool is used for creating hydrographic sounding charts in which only a specific result is required, namely only the shallowest depths. It performs a shoal-biased thinning of the soundings data. This means that the data will be thinned to leave only one item within a specified radius, with this record being the minimum (i.e. shallowest) sounding.

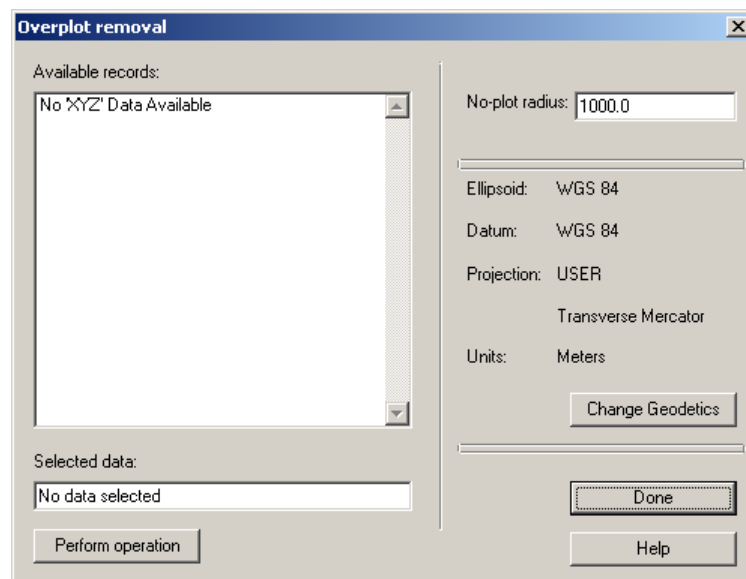
Because the **Overplot removal** tool filters a **Z** dimension based on its horizontal **X/Y** coordinates, it is necessary to first convert one or two dimension Data Items

to a three dimension Data Item using the **Interpolation** tool. (i.e. interpolate a Depth Data Item (one dimension) to a Position Data Item (two dimensions) to generate an **X/Y/Z** (three dimensions) Data Item.

Furthermore, the resulting three dimensional data record must be in **grid** Northing/ Easting coordinates. You must use the **Geodetics** tool to convert the geographic **lat/lon** coordinates to **grid** coordinates before the overplot removal tool can be used. Also, note that this operation can be time consuming for large sets of data.

To Apply Overplot Removal to a Three Dimensional Data Item

- 1 From the **Tools** menu, choose **Overplot Removal**.



- 2 Double-click the desired Data Record as found in the **Available records:** list.
This places the record in the **Selected data:** field below the **Available records:** list.
- 3 Enter a value in the **No-plot radius:** field.
Note: the units of the entered **radius** refers to the units displayed in the **Geodetics** area of the **Overplot removal** dialog box.
- 4 Click **Perform operation** to execute the overplot removal.
This results in a new Data Record named **Reduced**. This data set contains only the shoal-biased soundings.

Interactive Data Editor

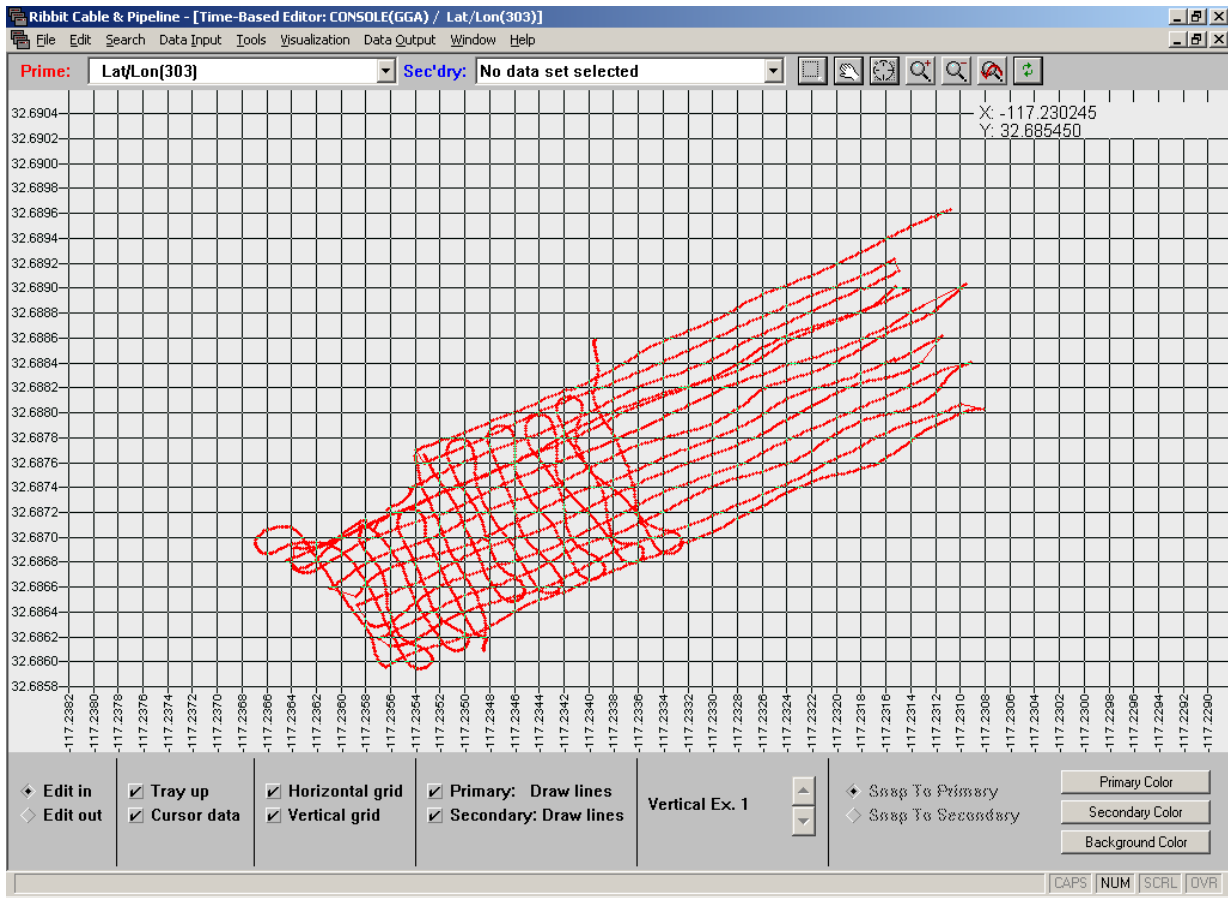
The **Interactive Data Editor** allows you to graphically view and edit individual Data Items loaded into the current processing session.

You can view up to two Data Items simultaneously; The first Data Item viewed is called the **Primary** Data Item and the second is called the **Secondary** Data Item. The Primary and Secondary Data Items must be from the same category. For example, **Plan data** and **Profile data** cannot be viewed at the same time. Plan Data Items are plotted by their Northing/Easting values, while Profile Data Items are plotted in the Y-axis relative to time along the X-axis. Since Profile Data Items can be edited in this way, this editor is also referred to as the **Time-Based** editor.

The **Edit out** feature allows for the removal of user selected data from the current processing session, while the **Edit in** feature can be used to re-instate “edited out” data.

To Edit a Data Item using the Interactive Data Editor

- 1 From the **Tools** menu, choose **Interactive Data Editor**.



- 2 Select the desired Data Item from the **Primary** dropdown menu.

Ribbit graphically displays the selected Data Item data. Ribbit automatically centers the data and optimally scales the data to fit within the limits of the display space.

- 3 If a second Data Item is to be viewed, select the desired Data Item from the **Secondary** dropdown menu.

Ribbit does not automatically adjust the data scales for the second Data Item. Therefore, it might not be visible without adjusting the graphic controls. The graphic controls, located in the upper right panel of the **Time-Based Editor**, provide you with the ability to zoom in on a specified area with the **Rectangle Zoom** tool, **Pan**, **Snap to Data**, **Zoom-In** and **Zoom-Out**, and return to a previous scale and center display setting with the **Zoom Previous** tool.

- 4 If the **Edit Out** box is checked, individual data points can be “edited out” by drawing a box around the particular point(s) with the cursor. (Hold down the left mouse button while drawing the box).

A data point that has been flagged as “edited out” is displayed in gray regardless of which Primary or Secondary Data Color has been selected.

Note: only Primary Data Points can be edited. Also, remember that any points flagged as “edited out” are not used in any subsequent processing or final output results.

- 5 If points have been mistakenly edited out, they can be edited back into the processing session by checking the **Edit In** box and then once again drawing a box around the point(s) with the cursor. This returns the point to its original color and re-includes the point in all subsequent processing.
- 6 The upper right-hand corner of the **Time-Based editor** displays **Time and Values** and information specific to one Data Item, referenced to the cursor position. This feature is enabled or by checking the **Cursor Data** box at the bottom of the **Time-Based editor**.
- 7 You can force Ribbit to have the lower tool “tray” remain visible along the bottom panel of the **Time-Based editor** by checking the **Tray Up** box at the bottom of the **Time-Based editor**.
- 8 The **Vertical Exaggeration** function can be used to shows more detail in items that have small vertical variances with respect to horizontal axis. The **Vertical Exaggeration** is changed by clicking the **Up** or **Down** arrows.
- 9 Horizontal and vertical grid lines can be turned off or on in the display. Display the grid lines by checking the **Vertical grid** box and the **Horizontal grid** box.

- 10 Select the **Primary Data Color** and **Secondary Data Color** buttons to change the color of the selected Data Item. The display's background color can be changed by clicking the **Background Color** button and selecting the desired color.

Note: using a display with a resolution of less than 1024 by 768 pixels may limit the availability of some of the features discussed above.

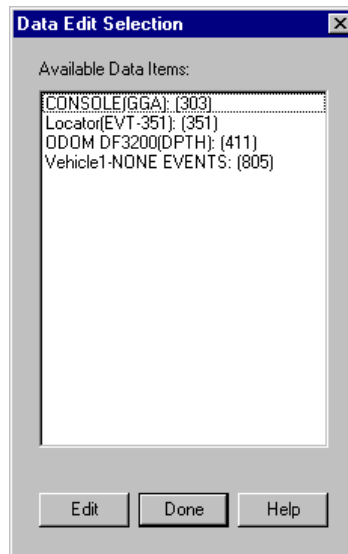
- 11 Click the **X** in the top right corner of the **Time-Based Editor** window (**NOT** the corner of the entire Ribbit window) to close the **Interactive Data Editor**.

Spreadsheet Editor

As the name implies, the **Spreadsheet Editor** allows you to edit the contents of any loaded Data Record through the use of a spreadsheet-style text editor. This editing tool allows you to not only change the status of a data string, but to also change the value of any Data Item contained in the selected Data Record.

To Edit a Data Item Using the Spreadsheet Editor

- 1 From the **Tools** menu, choose **Spreadsheet**. The **Data Edit Selection** window appears as seen below.



- 2 Select the desired Data Record from the **Available Data Items** list.
- 3 Click on the **Edit** button. The **Edit Data Items** spreadsheet dialog box opens.

Edit Data Values: CONSOLE(GGA): (303)

	Time	Edit	Latitude[303]	Longitude[303]	Status[303]	SVs[303]	HDOP[303]	Altitude[303]
1	Sep 30, 1996 15:59:22.94	In	32.68962700	-117.23108400	2.00000000	7.00000000	1.10000000	3.20000000
2	Sep 30, 1996 15:59:24.00	In	32.68961700	-117.23110600	2.00000000	7.00000000	1.10000000	3.35000000
3	Sep 30, 1996 15:59:25.02	In	32.68960700	-117.23113700	2.00000000	7.00000000	1.10000000	3.07000000
4	Sep 30, 1996 15:59:26.01	In	32.68959600	-117.23116000	2.00000000	7.00000000	1.10000000	3.06000000
5	Sep 30, 1996 15:59:27.01	In	32.68958600	-117.23118500	2.00000000	7.00000000	1.10000000	3.33000000
6	Sep 30, 1996 15:59:28.04	In	32.68957600	-117.23120900	2.00000000	7.00000000	1.10000000	3.53000000
7	Sep 30, 1996 15:59:28.97	In	32.68956700	-117.23123300	2.00000000	7.00000000	1.10000000	3.55000000
8	Sep 30, 1996 15:59:29.93	In	32.68955700	-117.23126000	2.00000000	7.00000000	1.10000000	3.50000000
9	Sep 30, 1996 15:59:31.05	In	32.68954700	-117.23128500	2.00000000	7.00000000	1.10000000	3.39000000
10	Sep 30, 1996 15:59:32.00	In	32.68953700	-117.23131100	2.00000000	7.00000000	1.10000000	3.40000000
11	Sep 30, 1996 15:59:32.98	In	32.68952700	-117.23133600	2.00000000	7.00000000	1.10000000	3.40000000
12	Sep 30, 1996 15:59:34.04	In	32.68951700	-117.23136000	2.00000000	7.00000000	1.10000000	3.51000000
13	Sep 30, 1996 15:59:35.15	In	32.68950500	-117.23138300	2.00000000	7.00000000	1.10000000	3.44000000
14	Sep 30, 1996 15:59:35.98	In	32.68949300	-117.23140900	2.00000000	7.00000000	1.10000000	3.43000000
15	Sep 30, 1996 15:59:37.14	In	32.68948000	-117.23143200	2.00000000	7.00000000	1.10000000	3.35000000
16	Sep 30, 1996 15:59:37.94	In	32.68946800	-117.23145700	2.00000000	7.00000000	1.10000000	3.43000000
17	Sep 30, 1996 15:59:39.02	In	32.68945600	-117.23148000	2.00000000	7.00000000	1.10000000	3.39000000
18	Sep 30, 1996 15:59:40.14	In	32.68944300	-117.23150400	2.00000000	7.00000000	1.10000000	3.31000000
19	Sep 30, 1996 15:59:40.98	In	32.68943100	-117.23152900	2.00000000	7.00000000	1.10000000	3.23000000
20	Sep 30, 1996 15:59:41.99	In	32.68941800	-117.23155300	2.00000000	7.00000000	1.10000000	3.17000000
21	Sep 30, 1996 15:59:43.05	In	32.68940600	-117.23157900	2.00000000	7.00000000	1.10000000	3.35000000
22	Sep 30, 1996 15:59:44.00	In	32.68939500	-117.23160200	2.00000000	7.00000000	1.10000000	3.40000000
23	Sep 30, 1996 15:59:44.98	In	32.68938100	-117.23162500	2.00000000	7.00000000	1.10000000	3.46000000
24	Sep 30, 1996 15:59:46.01	In	32.68936600	-117.23165200	2.00000000	7.00000000	1.10000000	3.24000000

OK Cancel

- Use the slide bar found at the right side of the display to view additional data strings. If you click on any data field in the spreadsheet editor, you can also use the keyboard's **Page Down** button to view additional data.

Use the slide bar found at the bottom of the display to view additional Data Items contained in each of data string.

- To change the status of a data string, i.e., to be included (in) or "edited out" (out), click on the desired string's **Edit** value, then use the dropdown window to select the appropriate option.
- To change the value of a particular Data Item, double-click on the desired Data Item's value, then use the keyboard's left and right arrow buttons to move to the appropriate digit. Now, simply enter the new value(s) as desired. **Note:** all Data Item values, except **Time**, can be modified.
- Once all editing is complete, click on the **OK** button to return to the **Data Edit Select** dialog box.
- Click on the **OK** button if you are finished editing.

Data Output

Basic Ribbit can output data in **ASCII** text, **.DXF** graphics, and **MS Access™ .MDB** data base formats. The **Data Output** menu provides access to each of these utilities.

Note: if the ASCII text or .DXF graphics Data Output formats are selected, only those Data Items with an "edited in" status will be included in the final output product. MS Access™ .MDB data base files retain all Data Item information, including status.

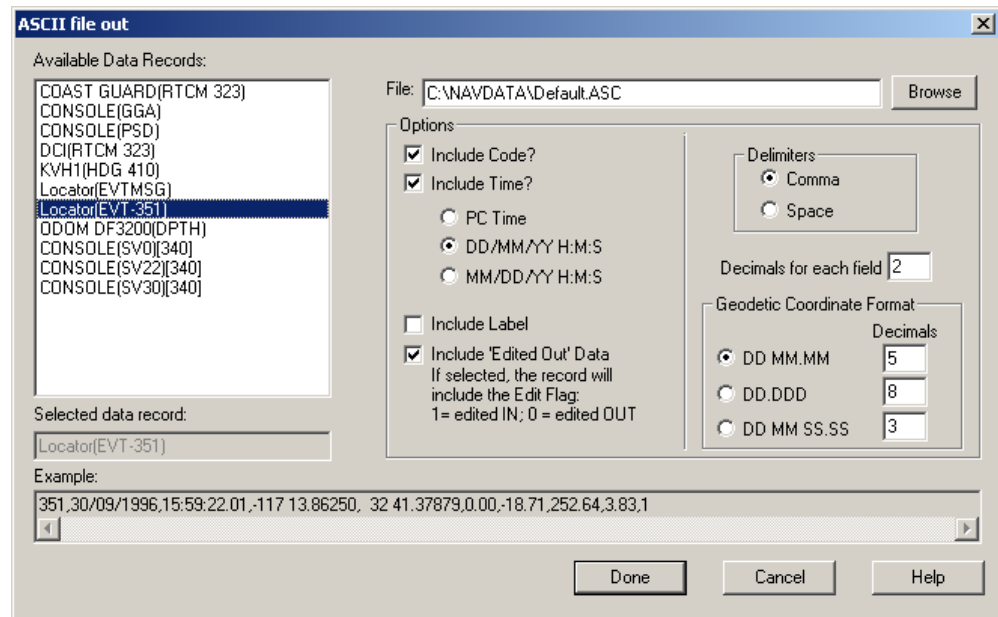
ASCII File Output

ASCII files, also known as flat text files, are simple text files that can be read by any text editor (such as Word™, NotePad™, Wordpad™), spreadsheet editor (such as Excel™ or Lotus™), and even some mapping software systems (such as AutoCAD's Quicksurf™).

Note: only individual Data Records may be exported using the **Output to ASCII** feature. If you wish to export a combination of Data Items, you must first interpolate one to the other using the **Interpolation** tool. Alternatively, individual ASCII files can be combined using text or spreadsheet editors.

To Output Data as ASCII Text

- 1 From the **Data Output** menu, choose **Output to ASCII file**.



- 2 From the items in the **Available Data Records** list, select the desired Data Record to output into ASCII format.

The selected data record appears in the **Selected data record** field. An example of how that record will be formatted when it is output in ASCII format appears in the **Example** field. This example represents a single line of data as it will be written to the ASCII file. This enables a quick check of the format prior to actually writing the file. Changes made to any of the **Options** available in the **ASCII file out** dialog box are instantly reflected in the **Example** field.

- 3 Check the desired options in the **Options** area.

Select **Include Code** to include the three digit record identifier or code. Remember that each data record has a unique code to identify it from other records.

Select **Include Time** to include the time recorded for every data item in that record. Some data may have interpolated time values. The time can be in either PC Time (in seconds from 00:00 on January 1, 1970), in regular Day/Month/Year Hours:Minutes:Seconds format or in Month/Day/Year Hours:Minutes:Seconds

Select **Include Label** to include the label for every data item in that record. This information can be useful to identify each record by number.

Select **Include 'Edited Out' Data** to include an edited out value for each record. This value will be '1' for edited data records and '0' for unedited data records.

- 4 In the **Delimiters** area of the **Options** dialog box, check the **' , ' Separator** radio button to create comma separated data fields or check the **' ' Separator** radio button to create space separated data fields.
- 5 Specify the number of decimals used to output the data to the file in the **Decimals for each field** edit box. All data except time, and geodetic coordinate values (latitude and longitude) are governed by this entry.
- 6 For any latitude and longitude values in the output data, you can specify how they are written in one of three formats, namely DD MM.MM (degrees and decimal minutes), DD.DDD (decimal degrees) or DD MM SS.SSS (degrees, minutes and seconds). For each choice you may also specify the number of decimals output. The resolution of output grid coordinates is governed by the **Decimals for each field** control above.
- 7 Click the **Browse** button to navigate to the desired location where the new file will be created and to define the name of the new file.

Note: by default an **.asc** file extension will be added to the entered file name. This can be changed to any desired extension if required.
- 8 Click **OK** at the bottom of the **ASCII file out** dialog box to generate the new file.

DXF File Output

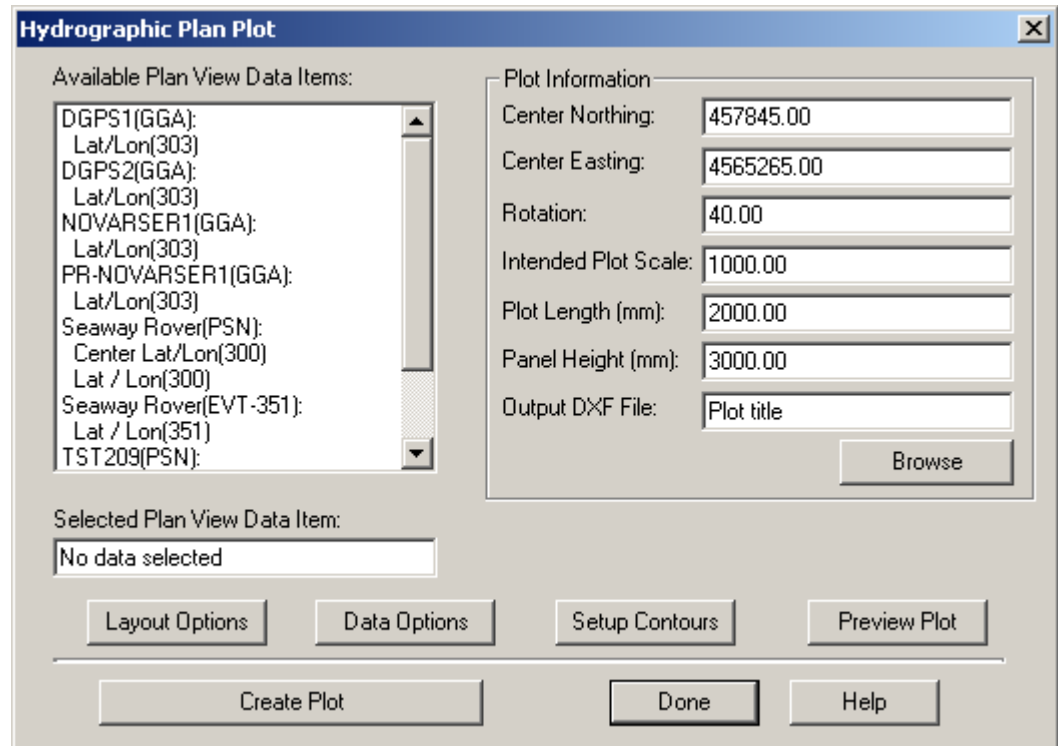
This **Data Output** option is used to generate plan view charts in the popular **.DXF** format. As implied by the name, (an abbreviation for **Drawing Exchange Format**), the DXF file format is used to exchange graphical data between various CAD software packages including AutoCAD[™], PageMaker[™], CorelDraw[™], ArcView[™], and MapInfo[™]. These systems can then be used to modify the contents of the DXF chart. DXF drawings can also be input into a Microsoft Word[™] document if equipped with the appropriate filter.

Note: all items depicted in the DXF charts created by Ribbit are in real world map projection coordinates.

The DXF charts created by Ribbit consist of multiple layers, with each layer containing a separate component of the drawing.

To Create a DXF Chart

- 1 From the **Data Output** menu, choose **Output to DXF file**. The **Hydrographic Plan Plot** dialog box is displayed, as seen below.



- 2 Select the appropriate Data Item from the **Available Plan View Data Items** list. Only those Data Items containing positional data (i.e. Lat/Long or Northing/Easting coordinates) are presented for selection.

Double-click on the desired Data Item to select it. The **Selected Plan View Data Item** window will display the name of the Data Item chosen.

Note: if you select a Data Item that contains Latitude /Longitude coordinates, you must ensure that the **Configure Geodetics Tool** is configured correctly in terms of Datum and Zone before the DXF chart is created.

- 3 The **Plot Information** area options must be defined for each chart created. These parameters define the size, rotation, and real world location of the chart.

Center Northing: and

Center Easting:

Enter the map projection grid coordinates of the center of the chart. As mentioned above, the coordinates cannot be specified in units of latitude/longitude.

Rotation:

Enter a value to define the amount of rotation that will be applied to the chart's border. As previously mentioned, the data and grids depicted in the chart are always in real world map projection coordinates, and so are never rotated from their original locations. The rotation is entered in degrees as measured clockwise from North.

Intended Plot Scale:

Enter an integer value to define the scale factor used in the chart. Entering a value of 1000, for example, tells Ribbit that 1 unit on the chart will represent 1000 units in the real world. This value is used to calculate the size of the border and text items.

Plot Length (mm): and

Plot Height (mm):

Enter the chart's horizontal length and vertical length dimensions. These values are entered in millimeters, and together with the scale determine the area that is represented in the created chart.

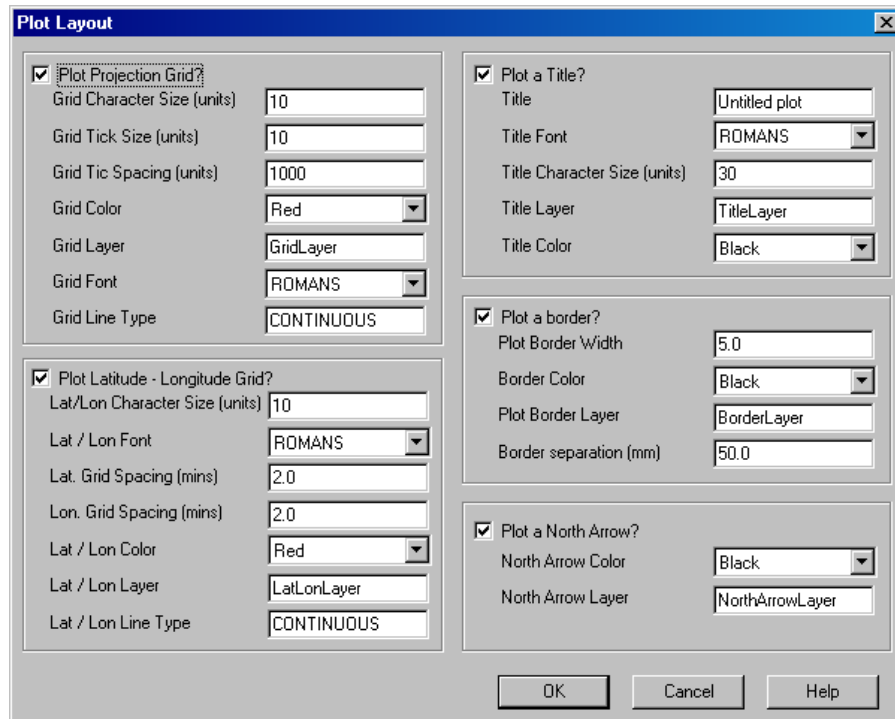
Output DXF File:

Enter the name and location of the .DXF file to be created.

Browse button

Opens a navigation dialog box where a new file can be created or an existing file located.

- 3 Click the **Layout Options** button. The **Plot Layout** dialog box appears as seen below.



The **Plot Layout** dialog box allows you to define if and how two grids, a title, a border, and a North arrow will be plotted in the **.DXF** chart.

- 4 Configure the various **Plot Layout** options as desired.

Note: if a dimension entry is requested in “units,” this refers to real world units as opposed to plotted units; it may require some calculation to derive the real world values. For example, if a grid annotation is to be plotted at a size of 10 mm, with a chart scale of 1:1000, the “units” entry would be 10, as determined by multiplying both values by a factor of 0.01.

Plot Projection Grid?

Check this option to generate a series of projection grid Northing and Easting “crosses” on the **.DXF** chart. You must define the size of the annotations (**Grid Character Size** in grid units), the size of the grid “ticks” (**Grid Tick Size** in grid units), and the spacing of the grid “ticks” (**Grid Tick Spacing** in grid units).

You can also change the color of the grid and annotation (**Grid Color**), the name of the layer to which this information will be written (**Grid Layer**), the AutoCADTM text font (**Grid Font**), and the type of AutoCADTM line that will be plotted (**Grid Line type**).

**Plot Latitude - Longitude
Grid?**

Check this option to generate a series of latitude and longitude lines on the .DXF chart. The options presented for this feature are the same as those for the Projection grid with one key difference; the **Latitude** and **Longitude Grid Spacing** are specified in minutes of arc rather than real world units. For calculation purposes, 1 minute of arc is approximately 1852 meters in length.

Plot a Title?

Check this option to plot the title entered in the provided window (**Title**). You can also define the **Title Font**, **Title Character Size** (in real world units), the name of the AutoCAD™ layer on which the title is to be placed (**Title Layer**), and the color of the title text (**Title Color**).

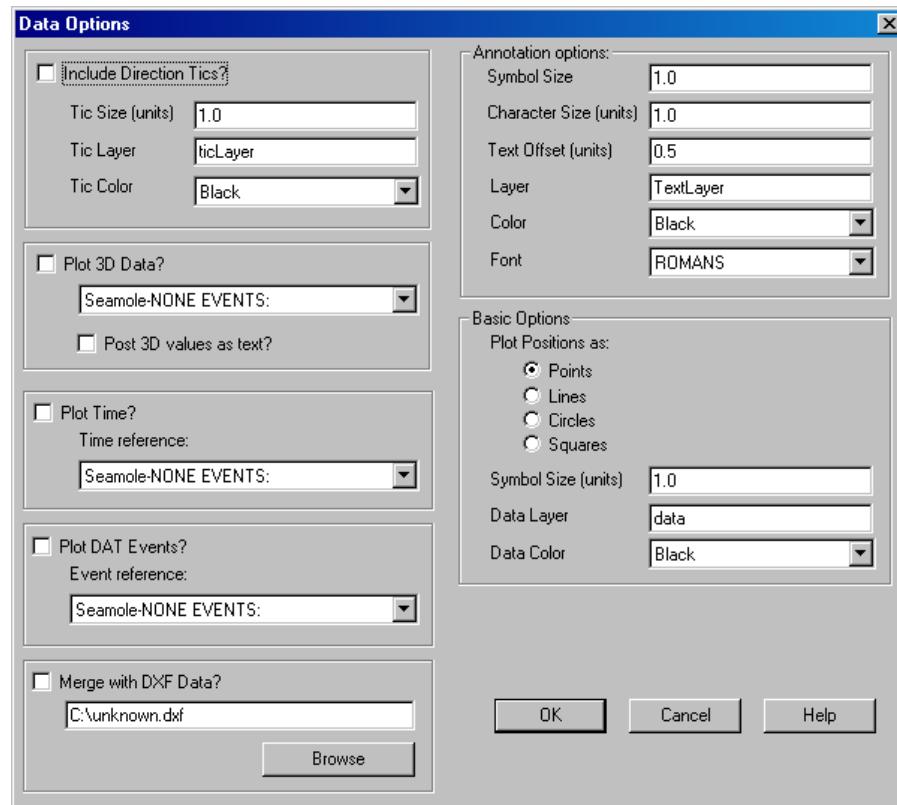
Plot a border?

Check this option to plot a border around the drawing. You can also define the border width (**Plot Border Width** in real world units), the color of the border (**Border Color**), the name of the AutoCAD™ layer on which the border will be placed (**Plot Border Layer**), and the separation between the plot border and the overall drawing limits (**Border separation in mm**).

Plot a North Arrow?

Check this option to plot a **North Arrow**. You can define the color of the arrow (**North Arrow Color**) and the name of the AutoCAD™ layer on which the north arrow is to be plotted (**North Arrow Layer**). The location and size of the North arrow are automatically determined by Ribbit based on the size and scale of the drawing.

- 5 Click **OK** to save these settings and return to the main **Hydrographic Plan Plot** dialog box.
- 6 Click the **Data Options** button. The **Data Options** dialog box appears as seen below.



The **Data Options** dialog box controls what data will be included in the **.DXF** chart and how the data are presented.

Include Direction Tics?

Check this option to enable the drawing of a line from each data point in the direction equal to the vessel's Course Over Ground at that moment. You can define the length of the line (**Tic Size** in real world units), the name of the drawing layer to which the tics will be written (**Tic Layer**), and the color of the tics (**Tic Color**).

Plot 3D Data?

Check this option to enable the plotting of a third dimension Data Item at each positional data point, i.e. a point in the DXF file will have X, Y, and Z values rather than just X and Y plan coordinates. The "Z" Data Item is selected using the provided dropdown menu.

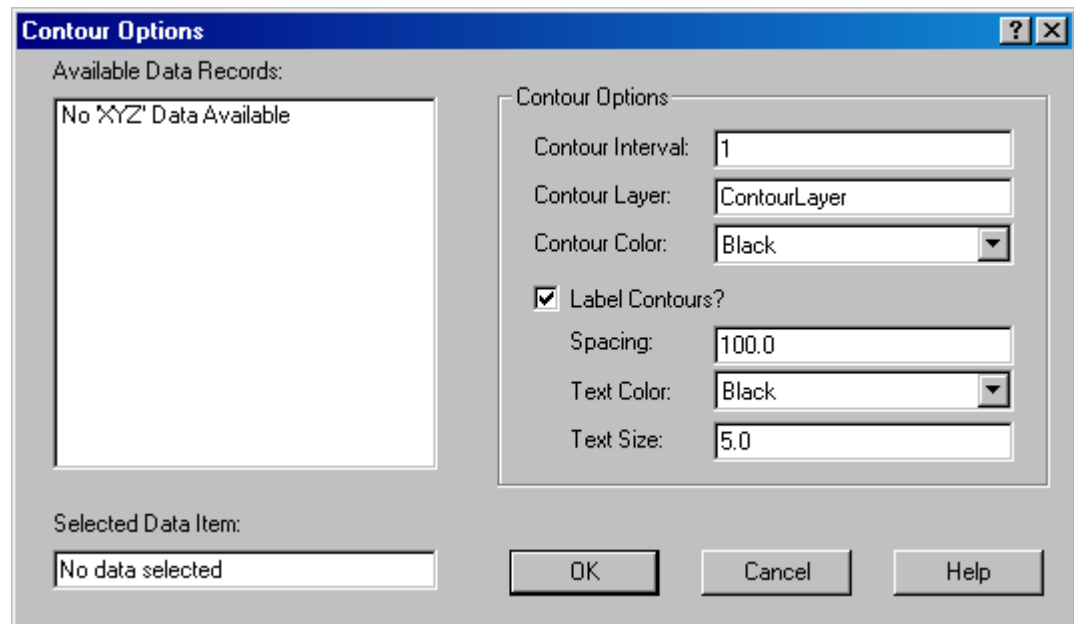
Post 3D Values as text?

Check this option to have Ribbit plot the value of the 3rd dimension (i.e. "Z") Data Item value beside the data point. You must also select **Plot 3D Data?** above. See **Annotation options** below to define how the

Plot Time?	values will be appear on the chart. Check this option to have Ribbit annotate each data point with the time that that particular event was recorded. Use the Time reference: dropdown menu to select the Data Item that will provide the time reference.
Plot DAT Events?	Check this option to enable the plotting of automatically generated event data (i.e. those events generated by WinFrog based on user-specified time or distance downline intervals). Use the Event reference dropdown menu to select the desired Data Item.
Merge with DXF Data?	Check this option to enable the plotting of an existing .DXF file in the newly created .DXF Chart. Only those features in the selected existing DXF file that are within the borders of the new DXF chart will be added to the file being created, i.e., the existing .DXF file will be cropped to the area being plotted. Use the Browse button to navigate to the desired .DXF file.
Annotation Options:	This portion of the Data Options window provides you with the ability to customize various annotation configuration options, including; the size of the symbol that will be plotted to represent that event (Symbol Size in real world units), the annotation's character size (Character Size in real world units), the offset of the annotation from the data point (Text Offset in real world units), the name of the layer that the Data Options will be written to (Layer), the color of the various Data Options (Color), and font of the annotation (Font).
Basic Options	This portion of the Data Options dialog box allows you to control the way that the positional data will be plotted on the .DXF chart. Select the appropriate radio button to have Ribbit plot the data points as Points, Lines, Circles, or Squares. The Symbol Size box allows you to define the size of the selected symbol; the entry

here (in real world units) defines a **line's** length, a **circle's** radius or a **square's** side length. The name of the layer the points will be added to and the color of the data can also be modified.

- 7 Click **OK** to save these settings and return to the **Hydrographic Plan Plot** dialog box.
- 8 Click the **Setup Contours** button. The **Contour Options** dialog box appears as seen below.



The **Contour Options** dialog box is used to configure the plotting of contours in the plan view .DXF chart. Contours are lines drawn joining points of common elevation, hence only three-dimensional (i.e. “X/Y/Z”) Data Records can be used. See the section above on **Merging/Deskewing** to create three dimensional X/Y/Z data.

- 9 Double-click the desired **Data Record** in the **Available Data Records** list. The **Data Item** name now appears in the **Selected Data Item:** field.
- 10 Configure the **Contour Options** as required.

Contour Interval:	Enter the contour interval in real world units.
Contour Layer:	Enter the name of the layer the contours will be drawn to.
Contour Color:	Select the color the contours will be drawn in.
Label Contours?	If the contours are to be annotated, select this checkbox.

Spacing	Enter the interval (spacing) of the contours between annotations (e.g. 100 would mean annotate the even 100 contours).
Text Color	Select the color the contour annotations will be drawn in.
Text Size	Enter the size of the annotation text in real world units.

- 11 Click **OK** to save these settings and return to the **Hydrographic Plan Plot** dialog box.

At this point you should preview the .DXF chart to ensure that all of your configuration entries were made correctly.

- 12 Click **Preview Plot**. Ribbit will generate a chart based on the various configuration selections mentioned above.
- 13 Click **Done** to return to the **Hydrographic Plan Plot** dialog box.
- 14 If the chart appearance is suitable, click **Create Plot** button to create the .DXF chart file in the pre-defined location. If the chart requires further modifications, simply re-configure the appropriate dialog boxes as detailed above.
- 15 Click **Done** to return to the main Ribbit window.

DXF File Output Font Options

When the **DXF File Output** option is used, Ribbit provides dropdown lists for you to select fonts from for annotation of the data and background information. The default font options are ARIAL, COURIER and ROMANS. However, these are augmented with the use of the **ribbit_DXF_fonts.txt** file. This is a simple ASCII text file that is installed into the Ribbit directory during the installation process. It contains a list of basic fonts that AutoCAD® supports. Every time you access the primary configuration dialogs for the DXF Output File option, Ribbit looks for this file and if it is available, reads it and creates a list of available fonts that are then presented whenever a font is required as part of the DXF File Output parameters.

It is possible to edit this file and add fonts that you would like to have included in the font list. The file can be edited and saved using any ASCII text editor such as Windows Notepad. Each font is added on its own line in the file.

It is important to note the following:

- The original copy of this file contains fonts that have been determined as being supported by a basic AutoCAD® installation.

- The file is not generated by scanning the storage media for font files.
- The presence of a font in this file does not guarantee that it will be supported by subsequent processing/displaying packages.

MS Access™ .MDB File Output

.MDB files are database files created and utilized by Microsoft's Access™ program. As the .MDB file format is one of the file types that Ribbit can input, creating an .MDB file during a processing session provides you with a single usable backup file of all currently loaded data. This could potentially save time in future editing sessions.

Note: Ribbit writes all data to the .MDB file, regardless of status (i.e. even those Data Items with an “edited out” status will be recorded to file.)

To Output Data to a .MDB File

- 1 From the **Data Output** menu, choose **Output to MS Access Database**. A standard Windows™ “Save as” dialog box opens.
- 2 Navigate to the appropriate directory and enter the desired file name. Ribbit will add the .mdb extension automatically.
- 3 Click on the **Save** button to initiate the creation of this file and return to the main Ribbit window.

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Tutorial: Simulated Bathymetric Survey

This tutorial provides you with a brief introduction to some of the basic capabilities offered by the WinFrog integrated navigation and data management system. It also uses step-by-step directions to guide you through the configuration and use of some basic navigation and survey functions in WinFrog. These instructions assume that you have installed WinFrog (at the root level of the **C:** drive) and are ready to begin demonstration exercises. It is also assumed that you are familiar with the operation of **Microsoft Windows** and have some familiarity with the use and purpose of integrated navigation systems. See the appropriate chapters in the **WinFrog User's Guide** for more details regarding all aspects of WinFrog operation.

At the beginning of each new project, essential components of the WinFrog integrated navigation software must be properly configured. Though each project or application has different requirements, some standard procedures must be followed before WinFrog can be used successfully.

In this tutorial, you are guided through the procedures used to set up a typical WinFrog configuration and will then generate data for a simulated project. The goal of this tutorial is to give you a “feel” for the program and how you would use it in the field.

Procedural Steps

Here are the steps to follow in WinFrog to collect data in a typical bathymetric survey:

- Configure Geodetics
- Configure Units of Measure
- Create Working Files
- Create Working Directories
- Configure Peripheral Devices
- Configure Vehicles
- Configure Displays
- Create Survey Lines
- Configure Events
- Collect Data
- Check Data
- Process Data (using Ribbit)

Sample Project

Your client requires a bathymetric survey of a specific region of San Diego Bay, California. This project will be identified as **Project1**.

The **Geodetic Datum** and **Map Projection** to be used are the **North American Datum 1927** (aka **NAD27**) with the **California State Plane Coordinate System (SPCS) Zone 6**. **Datum Shifts** to be used are as follows (**Working to WGS 84**):

dX: -8.000m

dY: 159.000m

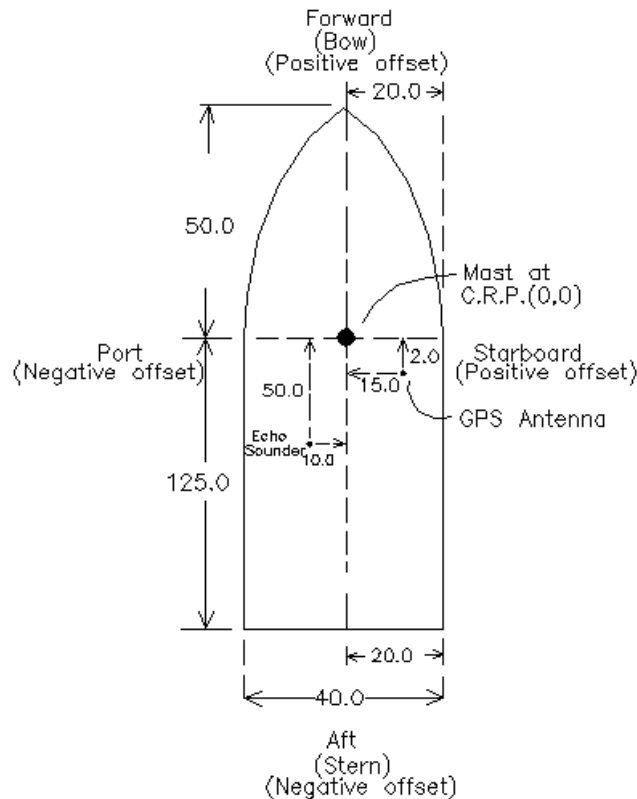
dZ: 175.000m

The client has specified data collection at **20** foot intervals along lines spaced every **20** feet. The survey boundaries are specified as follows (**SPCS CA Zone 6**):

Northwest corner: N 244 000.0, E 1 734 000.0

Southeast corner: N 243 000.0, E 1 733 000.0

The figure below represents the dimensions of the survey vessel, **LOCATOR**.



There are three peripheral devices on the vessel: a simulated GPS receiver, a simulated gyro, and a simulated echosounder.

First Steps

Before initiating any data collection, you must configure WinFrog for the project. Although each project has its own unique demands and requirements, there is a common approach used for the WinFrog configuration. **Note:** Although this tutorial utilizes simulated devices, you would still follow the same routine to configure a real project.

The first step is to launch the program either in “demo” or “real-time” mode. (See **Starting WinFrog in Chapter 1: Introduction** for more details.) Many of the pre-project configuration requirements (such as configuration of **Geodetics** and creation of **Working Files**) can be completed before getting onboard the vessel by using WinFrog in “demo” mode. Only the addition of devices to a vehicle’s position is prohibited.

If this pre-project work is performed on a computer other than the one to be used on the project, you must remember to transfer all required files (including the **Winfrog_3.ini** file) to the appropriate (similar) location on the working computer system.

Geodetics

“**Geodetics**” are the parameters that describe the mathematical shape of the earth and need to be configured in WinFrog early in any project’s preparation stages. A “**Geodetic Datum**” is a specific coordinate reference frame to which geodetic positions are referenced. A **Geodetic Datum** is defined by its **Reference Ellipsoid** and the location of its origin. If you are using a GPS receiver for positioning and have selected to use a datum other than **WGS84** (the datum to which the GPS coordinates are referenced), you must also enter the **Datum Shift** values. See more information on **Datum Shifts** below.

It is necessary to know which **Geodetic Datum**, as well as which **Map Projection** will be used on a project. **Map Projections** are used to convert coordinates from the earth’s spherical shape to a flat (plane) surface.

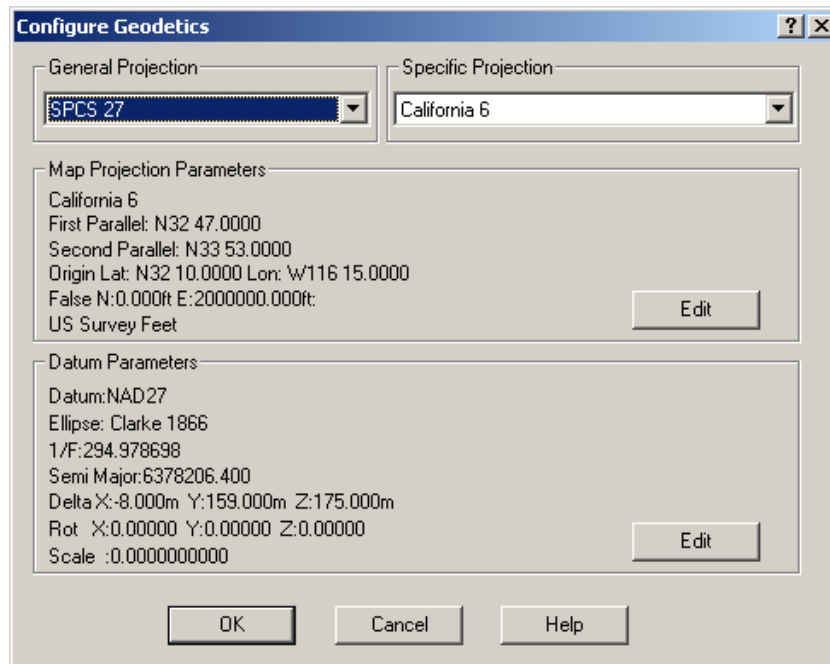
Several common **Geodetic Datums** and **Map Projections** are available as pre-configured options in WinFrog. WinFrog also has the capability to accept user-defined systems. Configuring the geodetics must be done at the start of the project so that all **Survey Lines**, **Waypoints**, **Picture** data, and **Vehicle Positions** entered refer to the correct reference system.

The importance of setting geodetics properly cannot be overstated. Setting geodetics improperly results in surveying an erroneous location or surveying a location different from the location you believe you are surveying. Errors made in specifying geodetic constants will be carried throughout an entire survey and may be very difficult, if not impossible, to undo. Therefore, it is imperative that you understand the implications when configuring or modifying the geodetic

constants and ensure that all values are set correctly. It is **crucial** that the geodetics are configured carefully before the project begins.

To Configure Geodetics

- 1 From the **Configure** menu, choose **Geodetics**.



Start in the **General Projection** dropdown menu. Scroll through the menu to see the nine pre-configured selections. Notice that these selections are really **Datum** selections (map projections in conjunction with commonly used geodetic ellipsoids). One of the available options is **User**, which allows you to configure your own custom projection/datum parameters as required.

- 2 For our sample project, it was specified that the **NAD27 Datum** will be used with the **California State Plane Coordinate System (Zone 6)**. Scroll through the **General Projection** dropdown menu and select **SPCS 27**.
- 3 Scroll through the **Specific Projection** dropdown menu and select **California 6**.

This zone is used for work in the area around San Diego, California. The **Map Projection Parameters** portion of the **Configure Geodetics** dialog box shows the particular parameters of the **SPCS Zone 6** projection. These are fixed parameters and do not require any editing or modifications.

Note: the unit of measure used with this datum is the **US Survey Foot**.

Because you are using the **NAD27** datum and not the **WGS84** datum (as specified in the **General Projection**), it is now necessary to edit the **Datum Parameters** in the **Configure Geodetics** dialog box, particularly to define the

working ellipsoid parameters and its relationship to the **WGS84** Ellipsoid. The **SPCS 27** datum uses the **Clarke 1866** Ellipsoid as its reference model and no modifications are required to this ellipsoid's parameters (i.e.: semi major axis and inverse flattening).

The **Datum Shifts** between **NAD27** and **WGS84** are different for every location and are required in WinFrog to correct the positional information received from the GPS receiver (which refers to WGS 84) to the **Working Datum**, in this case NAD27. Datum shift values are sometimes specified by the client to provide consistency with previous projects. Other projects may require you to derive the datum shifts by using GPS observations on a local datum monument, or by referring to a **National Imagery and Mapping Agency (NIMA)** publication.

The following datum shifts are specified for our project: (Working to WGS 84):

dX: -8.000m

dY: 159.000m

dZ: 175.000m

To view the entered **Datum Shift** values, click the **Edit** button in the **Datum Parameters** portion of the **Configure Geodetics** dialog box to see the **Datum Parameters** dialog box.

The image shows a 'Datum Parameters' dialog box. It has two main sections: 'Working Ellipsoid' and 'Datum'. In the 'Working Ellipsoid' section, the 'Name' is 'Clarke 1866', 'Semi Major Axis' is '6378206.40m', and 'Inverse Flattening' is '294.97869820'. In the 'Datum' section, the 'Name' is 'NAD27', 'Shift Method' is 'Bursa-Wolf (7 param.)', 'DX to WGS84' is '-8.000m', 'DY to WGS84' is '159.000m', 'DZ to WGS84' is '175.000m', 'Scale (parts per unit length)' is '0.0000000000', 'Rot X' is '0 0 00.00000', 'Rot Y' is '0 0 00.00000', and 'Rot Z' is '0 0 00.00000'. A note at the bottom of the 'Datum' section states: 'Rotations are from local datum to WGS84 using Bursa-Wolf sign convention (opposite from the US DOD)'. At the bottom, there is a 'NADCON Area' dropdown set to 'CONUS' and three buttons: 'OK', 'Cancel', and 'Help'.

When the NAD27 and SPCS Zone 6 options are chosen (as described above), WinFrog provides default datum shift values for NAD27 in the San Diego area, as per NIMA specifications.

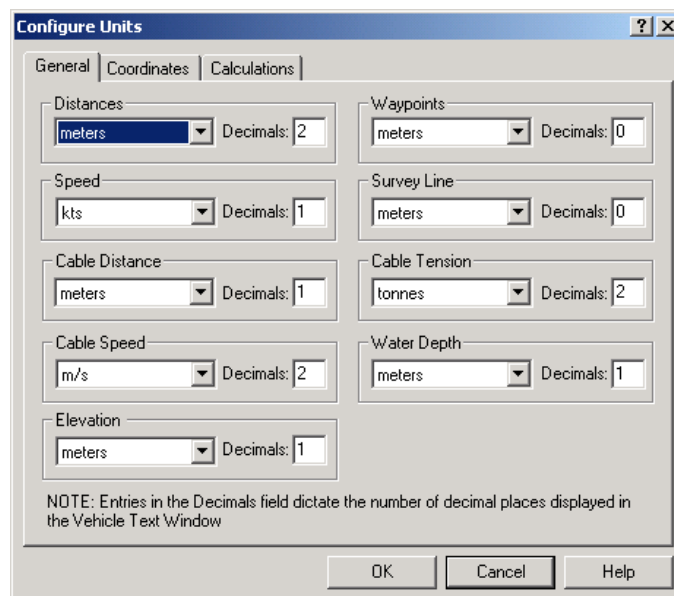
In this case, the default values match those specified in the project outline, so no changes are required. You must always confirm that you are using the correct signs (positive or negative) for all datum values.

Note: some datums may require scale and rotation corrections, as well as the datum shifts.

- 4 Click **OK** to close this dialog box and **OK** again to close the **Configure Geodetics** dialog box.

Units of Measure

Rather than having to specify a unit of measure or coordinate type each time you make an entry, you can configure WinFrog to default to the correct type of value. It is best to do this at the beginning of the project.



To Configure Units of Measure

- 1 From the **Configure** menu, choose **Units**.
- 2 On the **General** tab in the **Distances** area, click the **US Survey Feet** option. This allows us to be consistent with the units used in the specified SPCS Zone 6 datum/projection.

Note: the US Survey Foot differs very little from a standard foot.

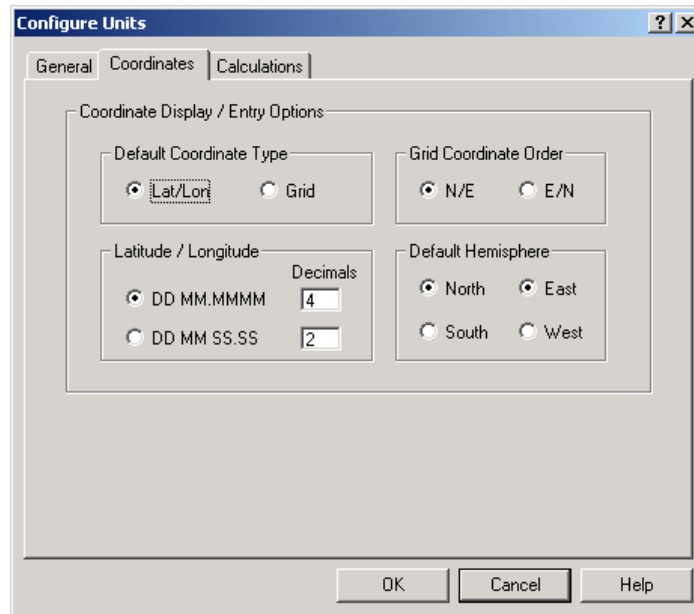
$$1 \text{ US Survey Foot} = (12/39.37)\text{m} = 0.3048006 \text{ meters}$$

$$1 \text{ Standard Foot} = 0.3048 \text{ meters}$$

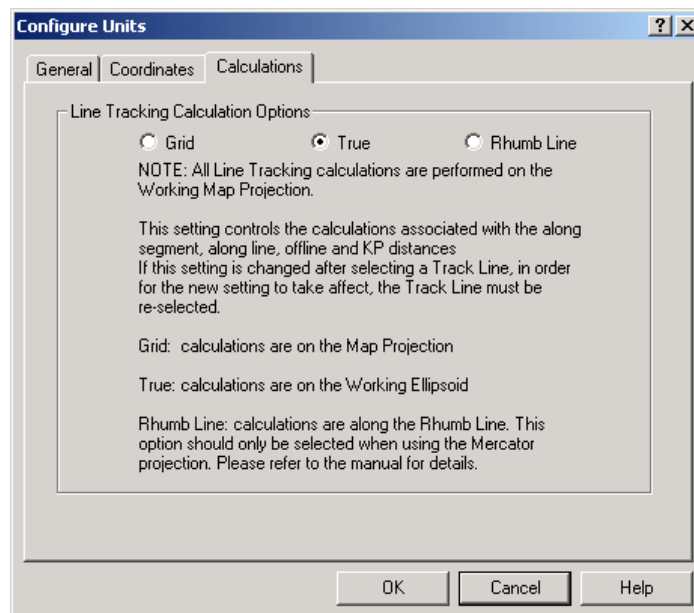
The difference between these units of measure is only 0.01 feet at distances of 10,000 feet. Obviously, for most entries, this difference will have little affect.

Choose the **US Survey Feet** option for **Waypoints** and **Survey Line** too.

- 3 **Grid** (Northing and Easting) coordinates were provided for this project, rather than geographical coordinates (latitude and longitude). The default coordinate type is **Lat/Lon** and needs to be changed for this project. Select the **Coordinates** tab of the **Configure Units** window and click the **Grid** radio button to change the **Default Coordinate Type**.



- 4 Select the **Calculations** tab. All line tracking values, specifically **Distance Down Line** and **Offset** tracking, should typically refer to **True** calculations. Click the **True** radio button to change this option.



- 5 Click **OK** to save the changes and close the **Configure Units** dialog box.

Working Directories

Before a project starts, it is prudent to setup and organize your **Working Files** and **Working Directories** so project data can be easily found and retrieved.

The **Working Directories** are where WinFrog stores and retrieves **raw data** and generates data for **Networked Smart Remote systems**.

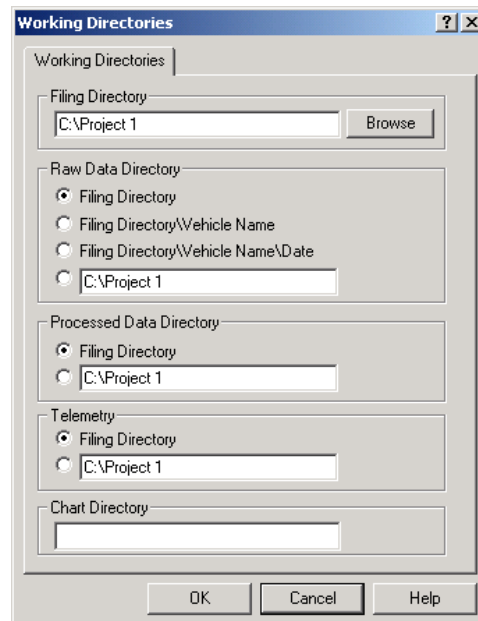
You can select an existing directory or create a new directory to be a **Working Directory**. Again, in terms of organization, it is best to have just one main **Working Directory** for each project. In WinFrog, this is referred to as the **Filing directory**. Subdirectories can be added within this file, if required.

To Define a Working Directory for a New Project

- 1 From the **File** menu, choose **Select Working Directories**.

The **Working Directories** dialog box is used to tell the program where to store your data. Looking at the **Filing Directory** field, you notice that there is already a default directory for data storage, **C:\NAVDATA**. The default directory for all data storage is **C:\NAVDATA** because the **Filing Directory** radio button in each data area is clicked. Notice that other radio buttons could be clicked in the data areas and that any directory, or directories, could be named to store these data. For this sample project, you will assign one specific directory for all data storage - **C:\Project1**.

- 2 In the **Filing Directory** field, type **C:\Project1**.
- 3 Click **OK**. WinFrog now creates a new directory named **Project1** on the C drive.
- 4 From the **File** menu, choose **Select Working Directories** again.



Confirm that the name of the **Filing Directory** in each data field now reads **C:\Project1**.

- 5 Click **OK** to close the **Working Directories** dialog box.

Working Files

After setting up the **Working Directories**, you must choose or create the “**Working Files**.” Working Files are used by WinFrog to store data and to provide waypoint and survey line information, etc. WinFrog creates different types of **Working Files** to contain these different types of information. All files created by WinFrog are easily identified by their unique three letter file extensions.

Types of Working Files	File Extensions
Survey Lines	PTS
Waypoints	WPT
Data files list (list of Data [DAT] files)	ALG
Seismic_Receiver (list of Receiver [RCV] files)	ALL
Seismic_Source (list of Source [SRC] files)	ASC
Logs	LOG
Picture	PIC
Charts	RML
CRDD Database	MDB

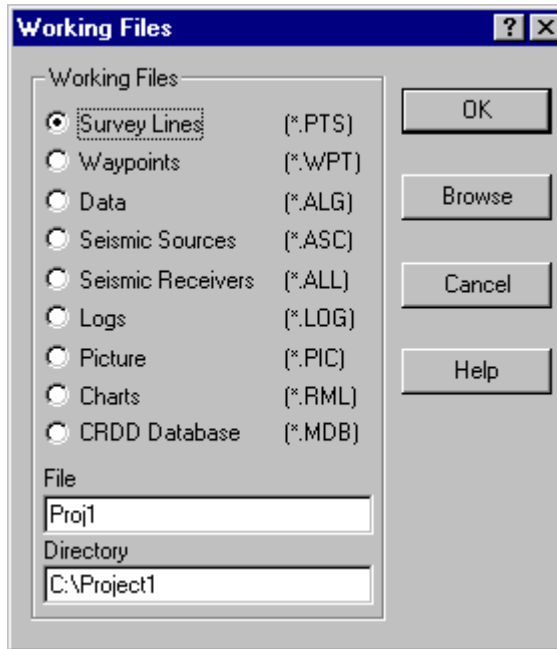
These files (with the exception of the chart and CRDD database files) are all text based (ASCII) data files created by WinFrog with the data written in a WinFrog-specific format.

Some files, specifically graphics and database files, are not WinFrog-specific. The format of the data in these files was specified by their third party creators. WinFrog was modified to use these “industry standard” formats.

WinFrog can access **Working Files** from anywhere on the computer, but it is best to place the **Working Files** in the **Working Directory** in order to keep the project organized.

To Define the Working Files

- 1 From the **File** menu, choose **Select Working Files**.



By default, the **Survey Line** radio button is selected.

At the bottom of the **Working Files** dialog box, notice the default name of the survey lines file (**surline**) and in which directory it is stored (**C:\ NAVDATA**). You will want to change both. You've already set up a specific directory for our sample project called **Project1**; that's where you will create the **Working Files**.

It is usually not necessary to create all of the listed **Working Files**. For this tutorial (and most simple hydrographic projects) you need to create only the following Working Files: **Survey Line (.PTS)**, **Waypoint (.WPT)**, and **Data (.DAT)**.

- 2 With the **Survey Line** radio button still selected, type **Proj1** in the **File** field.
- 3 In the **Directory** field, type **C:\Project1**.
- 4 Click the **Waypoint** radio button.
- 5 Type **Proj1** in the **File** field.
- 6 Type **C:\Project1** in the **Directory** field.
- 7 Click the **Data** radio button.
- 8 Type **Proj1** in the **File** field.
- 9 Type **C:\Project1** in the **Directory** field.
- 10 Click **OK**.

Note: If you had already created the required file types, it may be quicker to use

the **Browse** function to locate the files and specify them as **Working Files**.

I/O Devices (Peripheral Devices)

The next step is to define which **I/O devices** (also referred to as peripheral devices) you are going to use in your project. WinFrog uses the computer's serial ports to input information from many devices. For example, if the computer is configured with a 16-port Digiboard™ serial card, WinFrog can read data from 16 different devices. The devices must be correctly wired to the serial port (typically using the RS232 protocol) and correctly (internally) configured to output the desired information with the desired communications protocols.

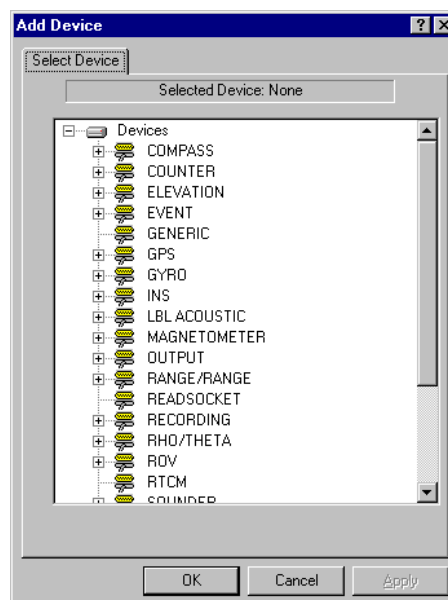
For this tutorial, we will add three **I/O Devices**: a **Simulated GPS Receiver**, a **Simulated Gyro**, and a **Simulated Echosounder (Sounder)**. (The terms sounder and echosounder are used interchangeably throughout this document and the industry.) Since WinFrog has the capability to configure more than one vehicle, the process of adding devices requires two distinct steps.

First, the devices are added to WinFrog. Some I/O devices may require a “generic” configuration at this point. Next, the I/O devices are added to the desired vehicle. Most I/O devices must be edited again at this point to suit the unique application on this vehicle.

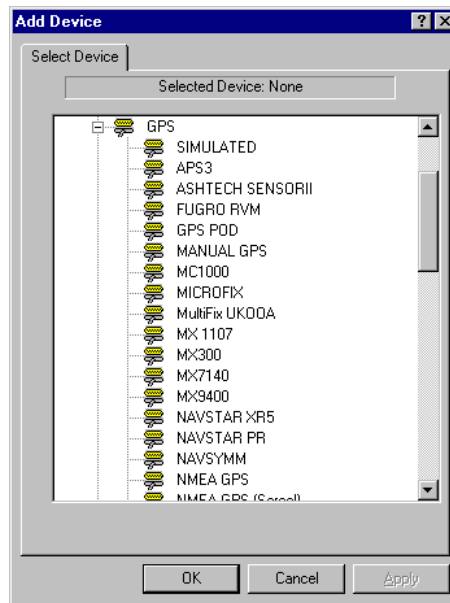
To Add Peripheral Devices to WinFrog

Although we are using simulated devices for this exercise, the steps indicated below are the same for adding “real” devices to WinFrog.

- 1 From the **Configure** menu, choose **I/O Devices... > Add**. The **Add Device** window appears, as seen below.



- 2 In the **Select Devices** scroll box, click on the “+” symbol beside the **GPS** group name. A list of all the GPS receivers that can be used by WinFrog is presented.



- 3 Double-click on the **SIMULATED** device (or click once on the device and then click the **OK** button).

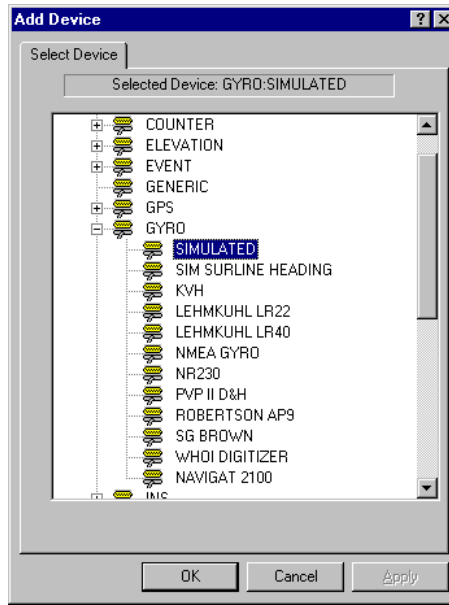
You’ve just added the **Simulated GPS** device to WinFrog. If you had added a “real” GPS device, a **Device I/O Parameters** window would have opened at this point, requiring you to select the specific communication parameters (baud rate, data bits, parity, and stop bits) for that device.

Add the two other devices in a similar manner.

- 6 Select **Configure | I/O Devices... > Add**.

The same **Add Devices** dialog box opens as it did in **Step 1**.

- 7 In the **Devices:** scroll box, click on the “+” symbol beside the **Gyro** group name. A list of all the gyros that can be used by WinFrog displays.
- 8 Double-click on the **Simulated** gyro device.



- 9 Repeat these steps to add the **Simulated Sounder** receiver from the **SOUNDER** device group.

Once the **I/O Devices** are added to WinFrog, they must also be added to the vehicle. This step occurs after the vehicle is configured and is detailed below in the section titled **Defining the Vehicle's Data Source and I/O Devices**.

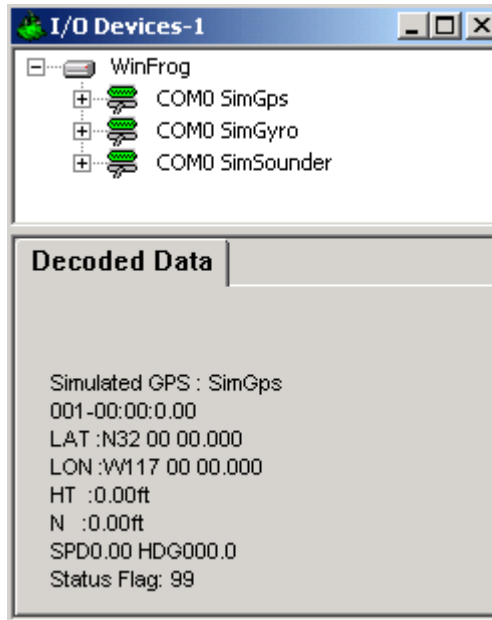
Viewing the I/O Device Data

WinFrog's **I/O Devices** window displays the data being received from the interfaced devices. This window should always be visible to ensure that the correct data are being consistently received by WinFrog.

This window also provides you with a right-click shortcut to add a new **I/O Device (Add I/O)**, edit the device's communications parameters (**Edit I/O**) or use the generic configuration (**Configure Device**) should the device's configuration require modification. Until you are familiar with the devices in WinFrog, it is wise to check the configuration of all devices added to WinFrog.

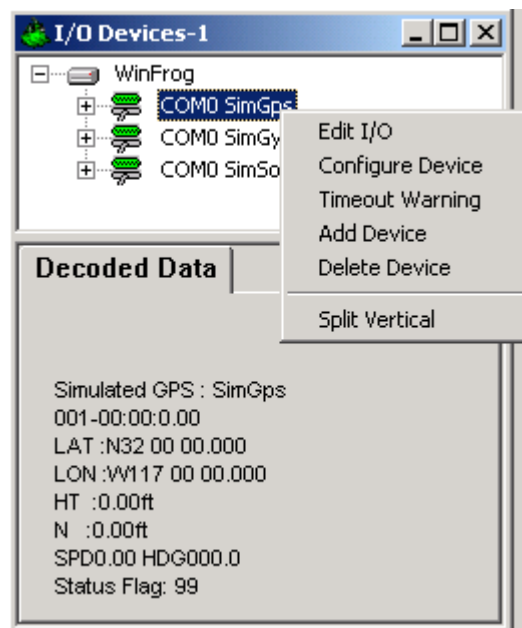
To View the I/O Devices Window

- 1 Select the main menu item **View | I/O Devices**.



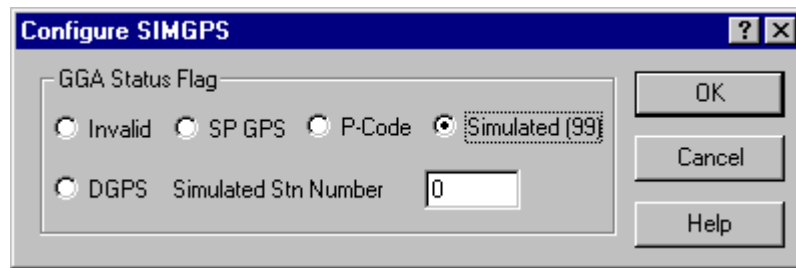
The top section of the window displays all of the I/O devices that have been added to WinFrog. The bottom section shows data from the currently highlighted device.

In order to configure a device, edit its I/O parameters, or delete the device, highlight the device and then click the right mouse button. Choose the appropriate option from the dropdown list.



As mentioned above, you should check the configuration of each device when you add it. **Note:** not all devices will require configuration at this level. For this sample project the only device that can be configured is the SimGPS device.

- 2 Right-click on the SimGPS device and select **Configure Device**.
- 3 Choose the default **Simulated (99) GGA Status Flag** option.



- 4 Click **OK** to save your selection.
- 5 In real-time operations, you should leave the **I/O Devices** window open so that you can quickly check to ensure that the devices are updating correctly. If you feel that you need to see the data from more than one device at the same time, you can open additional **I/O Devices** windows.

Configure the Vehicle

The next step is to configure the vehicle. WinFrog's default configuration contains only one vehicle, aptly named **Vehicle 1**. WinFrog supports up to 25 independent vehicles, each of which can have their own name, size, color, offsets, and devices.

There are no limits to the number of I/O devices that can be added to a vehicle. You can have multiple GPS receivers, gyros, etc. attached to a vehicle. In those cases where there are more than one of the same I/O device type, you must decide which device will be the **Primary** and which will be the **Secondary** device.

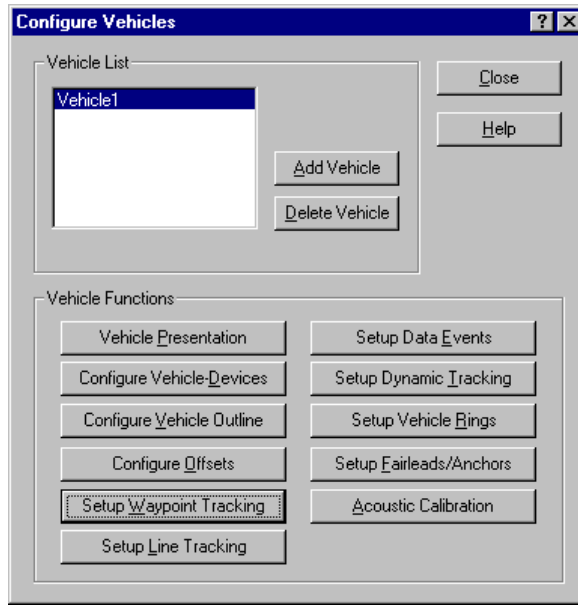
Note: an I/O device can also be added to more than one vehicle. This functionality is rarely used for anything other than simulated devices.

For this sample project, rather than adding a new vehicle you will modify the default vehicle.

To Configure a Vehicle

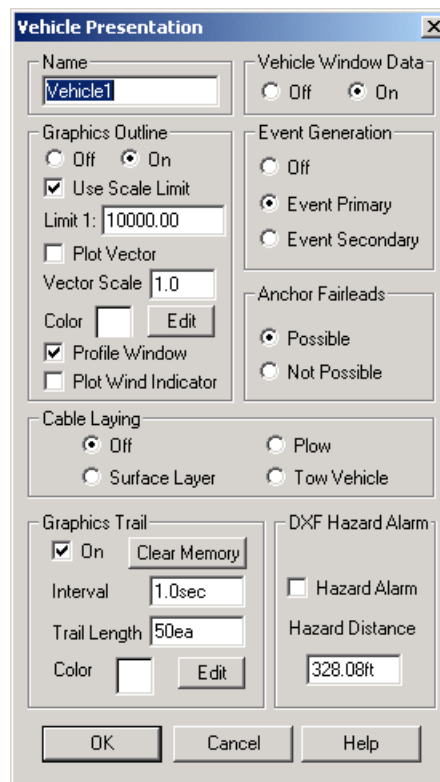
- 1 From the **Configure** menu, choose **Vehicles**. **Vehicle 1** is highlighted in the **Vehicles** window. (A vehicle must be highlighted in order to be edited.)

There are 11 configuration options presented in the **Configure Vehicles** dialog window. For typical (simpler) projects it is not required to select all options. The following paragraphs detail only those options that must be addressed now, specifically **Configure Offsets**, **Configure Vehicle Outline**, **Configure Vehicle-Devices**, and **Vehicle Presentation**.



The **Setup Data Events**, **Waypoint**, and **Line Tracking** features are addressed in the sections discussing real-time eventing and tracking. See the appropriate sections in the **WinFrog User's Guide** for more information on the other configuration options.

- 2 Click the **Vehicle Presentation** button to display the **Vehicle Presentation** window, as seen below. **Note:** most of the options in the **Vehicle Presentation** window default to the desired settings.



The **Vehicle Window Data** field defaults to **On**, which enables you to see this vehicle's information in the **Vehicle Text** window.

The **Event Generation** field defaults to **Event Primary** to specify that this vehicle will be used to generate automatic events.

The **Cable Laying** field defaults to **Off**. This requires change only if the **Cable Management Module** is being used.

- 3 In the **Name** field, type the name of the vehicle. In this case enter **Locator**.
- 4 In the **Graphics Outline** section **Color** field, select **Edit** and choose the desired color.
- 5 The **Graphics Trail** field defaults to **On**. This specifies that the “trail” will be drawn on the **Graphics** screen, showing where the vehicle has been. Modify the values in the **Interval** and **Trail Length** windows as desired.
- 6 The settings of the other presented options (such as **Profile Window**, **Anchor Fairleads** and **Hazard Alarm**) are of no consequence for this tutorial. See the appropriate sections in the **WinFrog User's Guide** for details about these features.
- 7 Click **OK** to close the **Vehicle Presentation** window.

Vehicle Dimensions

The next step is to define the dimensions of the **Locator** vehicle. WinFrog is pre-configured with a default vehicle shape, but you should always measure the dimensions for the vessel you are using and enter them into WinFrog. This aids the pilot in real-time navigation and also helps confirm **Device** and **Tracking Offset** entries. In this case, we are provided with the **Locator's** dimensions (see the sample project page).

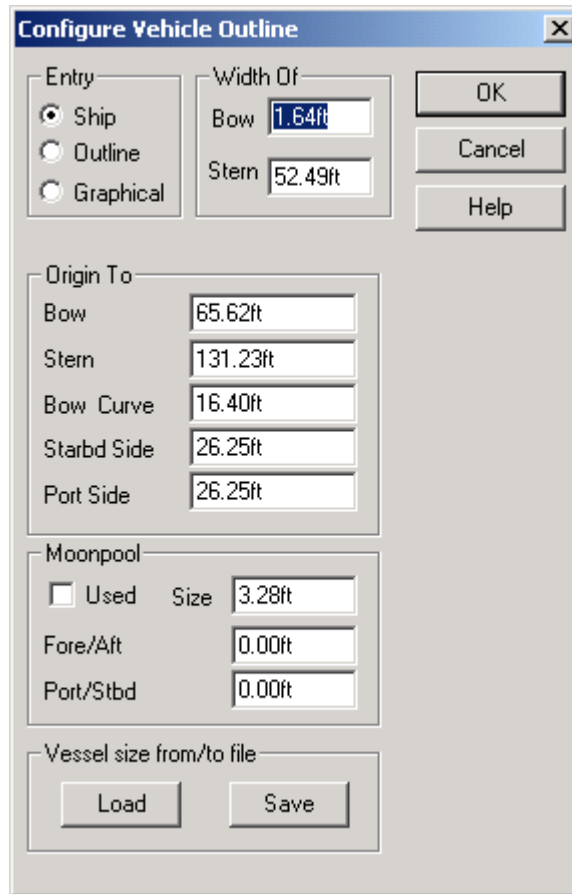
All dimension (and offset) measurements entered in WinFrog are made from a reference position on the boat, referred to as the **Common Reference Point (CRP)**. Typically, this is the position of the GPS antenna, but it can be any point on the boat. For example, it could be referenced to the echosounder transducer, the main mast, the center of the boat, etc. Once the location of the **Common Reference Point** has been established, all **Dimension** and **Offset** measurements must be made from that location.

To Configure a Vehicle's Dimensions

- 1 With the **Configure Vehicles** window still open, click the **Configure Vehicle Outline** button. The **Configure Vehicle Outline** window appears.
- 2 In the **Entry** area, select the **Ship** radio button. This allows for a simplified

entry of a generic ship shape. The **Outline** and **Graphical** options allows you to enter a very detailed shape, but this is a much more involved process and is usually not necessary.

- 3 Change the values in the **Width Of** and **Origin To** fields so they match those settings from the vessel's specification sheet, as provided.



The image shows a Windows-style dialog box titled "Configure Vehicle Outline". It contains several sections for configuring a vehicle's outline. The "Entry" section has three radio buttons: "Ship" (selected), "Outline", and "Graphical". The "Width Of" section has two text boxes: "Bow" with the value "1.64ft" and "Stern" with the value "52.49ft". The "Origin To" section has five text boxes: "Bow" (65.62ft), "Stern" (131.23ft), "Bow Curve" (16.40ft), "Starbd Side" (26.25ft), and "Port Side" (26.25ft). The "Moonpool" section has a "Used" checkbox (unchecked) and three text boxes: "Size" (3.28ft), "Fore/Aft" (0.00ft), and "Port/Stbd" (0.00ft). The "Vessel size from/to file" section has "Load" and "Save" buttons. On the right side of the dialog are "OK", "Cancel", and "Help" buttons.

Note: the word "origin" in **Origin To** refers to the **CRP** and that all values in this window are entered as **positive** values.

- 4 Click **OK** to close the **Vehicle Outline** dialog box and save the entries.

Defining the Vehicle's Data Source and Devices

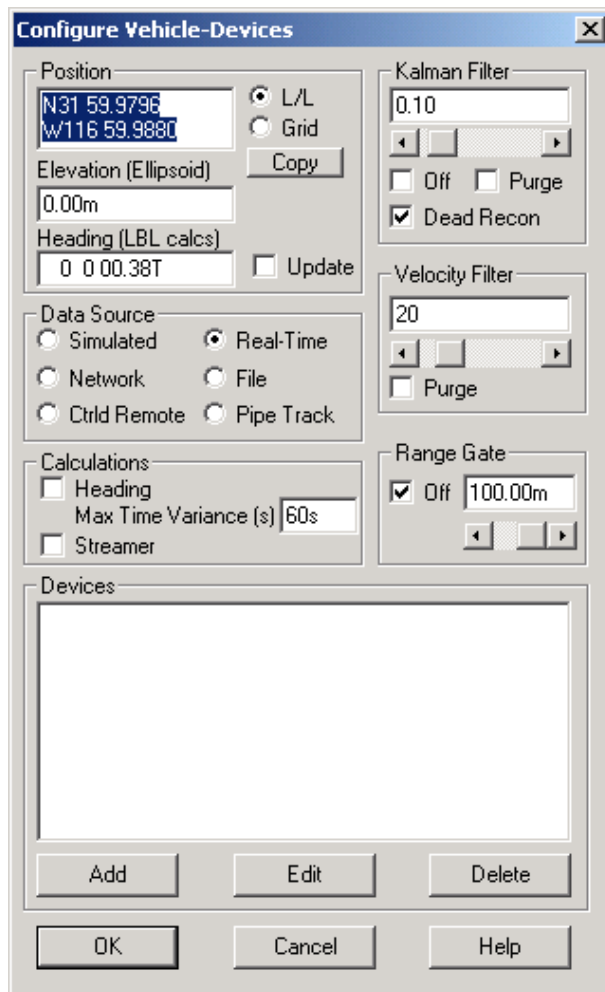
The next step is to define the vehicle's **Data Source**. The **Data Source** selection tells WinFrog from where it will receive its information. A vehicle can obtain its data from real-time devices, radio telemetry networks, computer networks, simulators, previously recorded files, or from layback calculations relative to another vehicle.

Usually, the data being used by a vehicle are from a real-time data source. On larger operations, where there are computers networked together, **Smart Remote** systems will use the **Network** data source. Some multiple vessel operations will utilize the radio telemetry systems to send and receive data. (In this case, the **Telemetry** data source is used).

To Define the Vehicle's Data Source

- 1 With the **Configure Vehicles** dialog box still open, click the **Configure Vehicle-Devices** button.
- 2 In the **Data Source** area, make sure the **Real-Time** radio button is selected.

With the **Data Source** now defined as **Real-Time**, you must define which of the real-time devices (previously added to WinFrog) will be added to the Locator's **Device** list.



- 3 Click the **Add** button at the bottom of the **Configure Vehicle-Devices** dialog box.

- 4 The **Select Data Items** window displays, showing all of the devices that were added to WinFrog in the **Available Data Items** list. In this case, we will add all of the listed devices to the Locator. Highlight the item that you want to add.
- 5 Click **OK** to complete the step. Repeat Steps 4 and 5 until all of the required devices (**SimGPS**, **SimSounder**, **SimGyro**) are listed in the **Configure Vehicle-Devices > Devices** window.
- 6 As mentioned above in the **Adding Devices to WinFrog** section, since no two vehicles are exactly alike (in terms of where the devices have been located or how they will be used), each device must be edited if it is added to a vehicle.

Different devices require different parameters to be modified to suit the particular application.

For example, in order for the incoming positional information to be related to the correct location on the vehicle, you must tell WinFrog where the GPS antenna is located in relation to the CRP.

Highlight the **GPS**, **SimGps**, **Position** device in the **Configure Vehicle-Devices** dialog box, then click the **Edit** button.

- 7 The **Configure Position** dialog box displays. The **Calculation** options are for when more than one positioning device is added to the vehicle. Only **Primary** devices are used to provide a vehicle's position. Data from **Secondary** devices (of any type of device) are not used in calculations. The information from those devices is only monitored.

In our case, and in most cases, only one device of each type is added to a vehicle. Therefore, each device added to a vehicle should be designated as **Primary**.

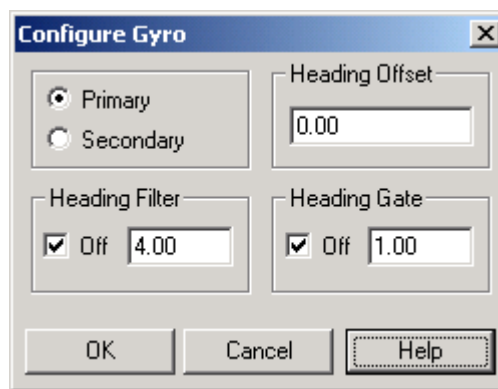
The image shows a 'Configure Position' dialog box with the following settings:

- Calculation:** ☒ Primary, ☐ Secondary. ☐ Use for Heading Calculations.
- Graphics:** ☒ Off, ☐ On.
- Elevation:** ☒ Off, ☐ On.
- Accuracy:** 5.00m.
- Code:** 0.
- Offsets:**
 - Fore/Aft:** 0.00m
 - Port/Stbd:** 0.00m
 - Height:** 0.00m

Buttons: OK, Cancel.

- 8 Under the **Graphics** area, click the **On** radio button. This will display the GPS antenna's position on the ship in the **Graphics** window.
- 9 In the **Elevation** entry field, select **Off**. **On** is only used if you are using a high accuracy (mm level) RTKGPS system. This option relates water depth values to the GPS ellipsoid.
- 10 The **Accuracy** and **Code** values do not typically require change from the defaults.
- 11 In the **Offsets** area of the **Configure Positions** dialog box, you must enter the offset from the **CRP** to the GPS antenna. These **Offset** entries must also include the correct sign to indicate the direction of the offset.

Referring to the provided vessel diagram, you see that the **Fore/Aft** offset is 2.0 feet aft of the CRP, so enter - (negative) **2.0** in the **Fore/Aft** entry window. Enter **15.0** in the **Port/Stbd** entry field.
- 12 In the **Height** entry field, type **10.0**. This is the height of the GPS antenna above the vertical reference. This is only used if an attitude sensor is attached to the vehicle in which case the GPS antenna position is reduced to the vertical reference "zero".
- 13 Click **OK** to confirm these entries and return to the **Configure Vehicle-Devices** dialog box.
- 14 From the **Devices** list, select **GYRO,SimGyro,HEADING** and click **Edit**.
- 15 The **Configure Gyro** dialog box displays, as seen below.



Ensure that the gyro is designated **Primary**.

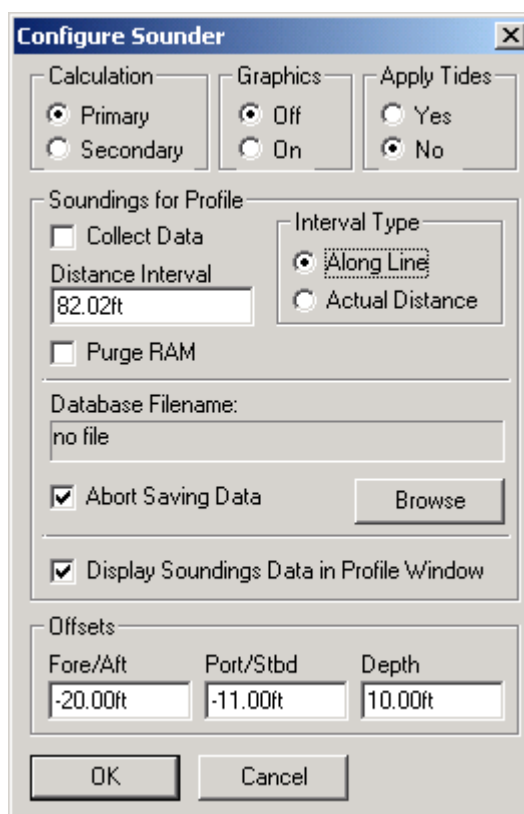
A **Heading Offset** is usually required to make the data from the gyro match the vessel's actual heading. This is a result of the gyro device's "zero" reference mark not being perfectly lined up with the vessel's centerline. A simple method of determining the offset is to run the vessel at (or near) its maximum speed and compare the **Course Made Good (CMG)** to the vessel heading. Ideally, they will be the same. If they are not, calculate the

difference and enter the value in the **Heading Offset** window. The **Offset** value is added to the value being received from the gyro device before the data are applied to the vessel. It is not necessary to enter a value in the **Heading Offset** field for the sample project.

The **Heading Filter** and **Heading Gate** are typically not required unless the data from the gyro is somewhat unstable. Leave these options set to **Off**.

Click **OK** to confirm the entries and to return to the **Configure Vehicle-Devices** dialog box.

- 16 Highlight the **Sounder, SimSounder, Bottom Depth** device in the **Configure Vehicle-Devices** dialog box, then click the **Edit** button.



- 17 The **Configure Sounder** window appears, as seen above. For a typical survey you can leave most of the options at the default settings, checking the following to ensure that they are correct:
 - Designate the sounder as **Primary**.
 - The **Apply Tides** button will only work if a tide gauge or predicted tide file is added to the vehicle. In this case, leave this set to **No**.
 - The **Soundings for Profile** options configure the use of sounding data in WinFrog's **Profile** window. By default, the **Abort Saving Data** button is checked. This setting is fine for the sample project.

- The application of **Offsets** to an echosounder's data is often misunderstood. The **Fore/Aft** and **Port/Stbd** entries are used only for graphical representation purposes and are not used except to plot (in the **Graphics** window) where the echosounder is located. However, the **Depth** offset value is extremely important. Most echosounders are capable of outputting various types of depth data. **Depth Below Surface (DBS)**, **Depth Below Transducer (DBT)**, and **Depth Below Keel (DBK)** are the most common data types. You must know what data are being sent from the sounder, then enter the **Depth** value here to ensure that the depths recorded in WinFrog will be referred to the water surface.

Note: sounder depths are entered as **positive** values. In this case, enter **10.0 ft**.

- 18 Click **OK** to close the **Configure Sounder** dialog box and return to the **Configure Vehicle-Devices** dialog box.
- 19 Click **OK** to close the **Configure Vehicle-Devices** dialog box and return to the **Configure Vehicles** dialog box.

Vehicle Tracking Offsets

Due to the physical restrictions often encountered when installing peripheral devices, such as a GPS antenna or echosounder on a vessel, it is usually required that a **Tracking Offset** be established and enabled for real-time tracking/data recording. **Tracking Offsets** allow you to correlate the GPS antenna position to any point on the vehicle.

For example, during data collection on our sample project, you will want to track and record the position of the echosounder. Another example might be if you were dropping divers into the water over a specific point on the bottom. In this case, you would want to track that point on the vessel where the divers jump off so that you can place the divers as close to the intended waypoint as possible.

Instead of constantly changing the required **Tracking Offset** values, WinFrog has an **Offset** table where you can configure and save up to 15 different entries. This allows you to quickly choose a **Tracking Offset** from the table as required.

Note: only one **Offset** can be tracked at a time.

Do not confuse the **Tracking Offset** with the **Vehicle Shape Offset** or **Device Offsets**. The **Vehicle Shape Offsets** are simply for the presentation of the vessel in the **Graphics** window, while the **Device Offsets** are used to relate all devices to the vessel's **CRP**. The **Tracking Offset** establishes what point of the vessel will be tracked and, hence, what coordinates will be stored during eventing.

As mentioned previously, all of the offset and dimension measurements you enter in WinFrog are made **from** the CRP on the boat.

To Configure a Tracking Offset

- 1 With the **Configure Vehicles** window still open, click the **Configure Offsets** button. The **Configure Offsets** dialog box opens, as seen below. Initially, all of the offset entry windows are empty.
- 2 In the **Name** area, enter the name of the offset point. For our example, enter the name **Echo Sndr**. From the provided measurements (see the ship diagram), the **Fore/Aft** offset of the echosounder is **-50.0** ft, **Port/Stbd** offset is **-10.0** ft. Enter **0.0** for the **Elev** offset.
- 3 Check the **Trail** option so that you can see a trail of “bread crumbs” coming from this point on the **Graphics** window. (See **Graphics Trail** configuration under the **Configure Vehicles > Vehicle Presentation** option for more **Graphics Trail** configuration options).

On	Plot Label	Name	Fore/Aft	Port/Stbd	Elev	Trail
☒		Echo Sndr	-50.00m	-10.00m	0.00m	☒
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐
☐			0.00m	0.00m	0.00m	☐

☒ Off ☒ Use Heading ☐ Use CMG

OK Cancel Help

- 4 Check the **Plot** option so that you can see a small circle (along with the **Offset Name**) plotted on the **Graphics** display showing you where the **offset** is located on the vessel.

- 5 At the bottom of the **Configure Offsets** window, select the **Use Heading** radio button. This is the most accurate choice (and sometimes the only valid choice). Unless the vessel is constantly at speed and the **CMG (Course Made Good)** is the same as the vessel's heading, the **CMG** value will fluctuate in every direction, between positional updates. These fluctuating data cannot be used for accurate **Offset** position calculations.
- 6 Turn **On** the **Echo Sndr** offset.
Note: this has several implications:
 - The coordinates displayed for this vessel in the **Vehicle Text** window now refer to this offset point.
 - All tracking information (distance/bearing to a waypoint or line tracking SOL/EOL/Offtrack data) now refers to this **Offset** point.
 - The coordinates recorded in the automatic events data (**.DAT**) files will refer to this **Offset** point.
- 7 Click **OK** to close the **Configure Offsets** dialog box and save the entries.
- 8 As mentioned above, the other options in the **Configure Vehicles** window are addressed further in the WinFrog User's Guide. For now, click **Close** to close the **Configure Vehicles** dialog box.

Vehicle Text Window

The **Vehicle Text** window displays real-time information in text form for all WinFrog vehicles. This window is user-configurable and can include information such as the vehicle's name, position, heading, and speed, as well as a host of other data. The **Vehicle Text** window also offers shortcuts to various configuration options.

One **Vehicle Text** window can be toggled to display information for multiple vehicles or, alternatively, you can open multiple **Vehicle Text** windows to display this data for each individual vehicle. Typically, due to limited display space, only one **Vehicle Text** window is visible. Also, because of the importance of the data available, the **Vehicle Text** window is typically left "on display" throughout a project.

In the sample project, you will open only one **Vehicle Text** window.

To Display the Vehicle Text window

- 1 Select **View > Vehicle text**. The **Vehicle Text** window displays at the bottom of the WinFrog display, as seen below.

Vehicle1	16:10:17.8	EVT OFF		
N32 00.0000	W117 00.0000	N3540435.68m	E499999.96m	RAW REC OFF
SPD 0.0kts	HDG 000.0	COG 250.2	WD 147.5m	

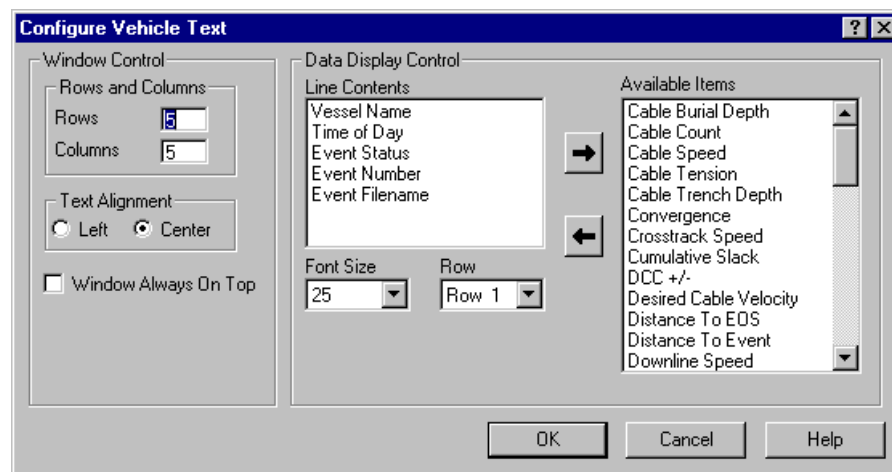
The **Vehicle Text** window configuration is saved in the **Winfrog_3.ini** file. Every time the **Vehicle Text** window is enabled, the same data are displayed in the same location of the window. By default, the **Vehicle Text** window is configured to display five rows and five columns of data.

The data displayed in this window are also user-configurable to suit personal/operational preferences. Upon program shutdown, WinFrog will record this new **Vehicle Text** window configuration in the **Winfrog_3.ini** file.

For our sample project, we will add an extra item (**Line Bearing**) as it is not among the default items automatically displayed in the window.

To Configure the Vehicle Text Window

- 1 Select **Configure > Vehicle Text**. (Or, move the mouse pointer within the **Vehicle Text** window limits and click the right mouse button and choose the **Configure Vehicle Text** option.)
- 2 The **Configure Vehicle Text** dialog box displays with the **Data Display Control** area showing **Line Contents** on the left and the **Available Items** on the right, as seen below.



The **Vehicle Text** window is divided into five rows with **Row 1** located at the top of the window and **Row 5** at the bottom. The **Line Contents** window displays what data are displayed in the row displayed in the **Row** dropdown box. Change the **Row** to see its configuration in the **Line Contents** window. (See the **Operator Display Windows** chapter for definitions of the **Available Items**.)

- 3 Select **Row 5** from the **Row** dropdown box. By default, **Line Name**, **Distance to SOL**, **Distance to EOL**, and **Port/Starboard** data are displayed in this row.
- 4 From the **Available Items** list (the list on the right side of the window), select **Line Bearing**, then click the **left arrow** to move **Line Bearing** from the **Available Items** list to the **Line Contents** list.
- 5 Click **OK** to save the changes and close this dialog box.

Note: the window spaces allocated for these data items will remain blank until there are data to display.

Graphics Window/Display

The **Graphics** window is the main navigational display generated by WinFrog. It is a real-time, scaled, plan view representation of the WinFrog positional data. It provides a graphical representation of the positions of all vehicles, as well as any **Waypoints**, **Survey Lines**, **Picture Files**, **Charts**, and **Data Events**.

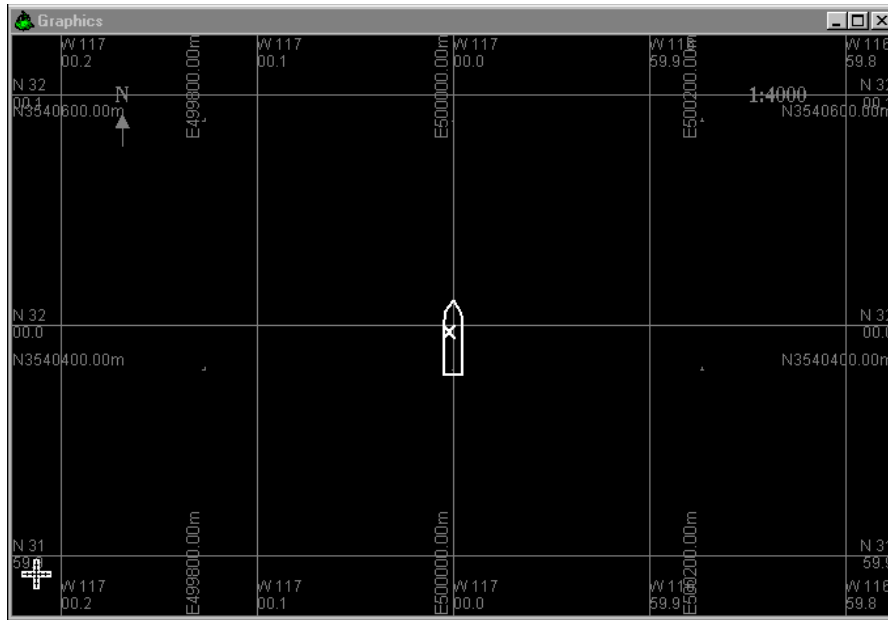
You can control the display of **Parallels of Latitude** and **Meridians of Longitude**, as well as **Map Projection Northing** and **Easting** gridlines. The **Graphics** window can be centered on a fixed point or follow any WinFrog vessel. The **Rotation**, **Scale** and **Color** of the **Graphics** display can also be configured to your preferences.

For multi-vehicle applications, more than one **Graphics** window can be displayed to show the data for each vehicle. Each of the **Graphics** windows can be independently configured.

In this sample project, you will display only one **Graphics** window and will configure it to display **Survey Lines**, **Waypoints**, a **North Arrow**, **Projection** and **Geographic Grids**, **Working Data (.ALG)** file contents, and **Working Log (.LOG)** file data. You will also configure the **Graphics** window to be oriented “North Up” and centered on the **Locator** vehicle.

To Display the Graphics Window

- 1 Select **View > Graphics**. The **Graphics** window displays.

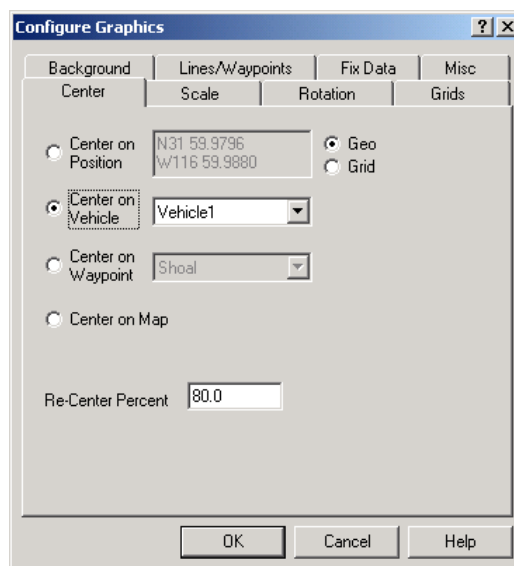


By default, WinFrog will center the **Graphics** window on the first vehicle listed. Since we have only configured one vehicle, the **Graphics** window is centered on the **Locator's CRP**.

To Configure a Graphics Window

- 1 Select the main menu item **Configure > Graphics**. (For a shortcut to the **Configure Graphics** menu, position the mouse pointer within the limits of the **Graphics** window, right-click and choose the **Configure** option.)

The **Configure Graphics** window has eight tabs offering multiple options on each page. Only those items mentioned above will be addressed here. (For more information refer to the **Operator Display Windows** chapter).



- 2 **Center** - Click on the **Center** tab and select the **Center on Vehicle** radio button. The **Re-Center Percent** indicates how far the vehicle can move from the center of the **Graphics** window before the display is re-drawn (and re-centered). The computer will slow down excessively if you enter a small value (less than say 50%). The default value of 80% is adequate for most applications.
- 3 **Rotation** - Click on the **Rotation** tab. The default **Manual Rotation Angle** is set to **0.00**.

Note: When you are tracking a survey line, you will want to change this to **Rotate to Survey Line**. This will ensure that the **Graphics** display will be oriented so that the current survey line segment will be “straight up” on the display. This makes it easier for the vehicle pilot to keep the vehicle on line.
- 4 **Grids** - Click on the **Grids** tab. The default settings have the **Enable Projection Grid** and **Enable Geographic Grid** options enabled. No changes need to be made for the sample project.
- 5 **Misc.** - Click on the **Misc** tab. The **Plot North Arrow** option defaults to enabled status, as typically desired.
- 6 **Fix Data** - Click on the **Fix Data** tab. The **Plot Data Files** and **Plot Log Files** default to enabled status, as typically desired. The colors ensure that the data will be visible on the black background of the graphics screen and can be edited as desired.
- 7 **Lines/Waypoints** - Click on the **Lines/Waypoints** tab. The **Plot Survey Lines** and **Plot Waypoints** options default to enabled status, as typically desired.

Look at the other **Configure Graphics** options, paying particular attention to the **Scale** tab. The **Zoom Factor** is the amount that the scale will change each time you click the **Zoom In** or **Zoom Out** button on the toolbar. You might want to change this value later to slow down the zooming effect, depending upon your personal preferences.

Because you haven't yet created any survey lines or waypoints, or collected any Data, only the **Vehicle**, **Grids**, **North Arrow** and **Scale** are currently visible in the **Graphics** window.

Graphics Display Zooming

At different times throughout a survey you will want to see different areas of the **Graphics** display. **Zoom Out** to see a larger area at lesser detail or **Zoom In** to see a smaller area at greater detail.

To Zoom Out

- On the toolbar, click the **Zoom Out** button (the second button from the left on the toolbar, the icon of a magnifying glass with a minus sign to the right of it). Based on the **Zoom Factor** value entered when you configured the **Graphics** window (default factor is 2.0), the scale of it will be multiplied by that value each time this button is clicked.

Notice that the vessel's size does not change after you zoom out past a scale of 1:10000, which allows you to see the vehicle when at higher scales. This option is configurable in the **Configure Vehicle > Name > 1:10000 limit** option.

You can also **Zoom Out** by placing the mouse pointer within the limits of the **Graphics** window then clicking the right mouse button. Select the **Zoom Out** option to **Zoom Out** once.

To Zoom In

- On the toolbar, click the **Zoom In** button (the first button from the left on the toolbar, the icon of a magnifying glass with a plus sign to the right of it).
- You can also **Zoom In** by placing the mouse pointer within the limits of the **Graphics** window then clicking the right mouse button. Select the **Zoom In** option to **Zoom In** once.

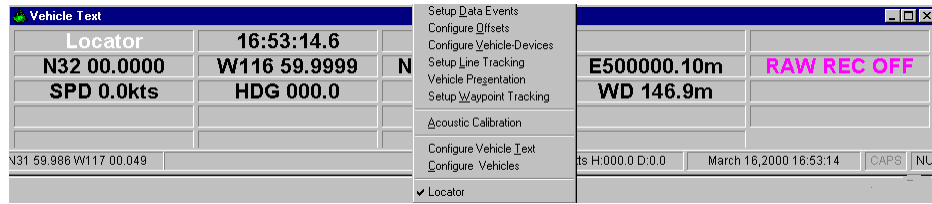
Vehicle Navigation in Simulation Mode

As previously mentioned, this tutorial relies on **Simulated Real-Time** devices for the vehicle's positioning, heading, and depth data. This section explains how to use the simulators to navigate the vessel. These skills are required later during **Survey Line Tracking** and **Data Collection**.

To Change the Position of the Vehicle

The coordinates for the project limits are defined on the sample project page. Since we had configured the **Graphics** window to be centered on the **Locator** vehicle, we must move the **Locator** to the same area so that we can see the work area. We will move the vehicle to approximately the center of the work area, at the following grid coordinates: **N243 500, E6295500**.

- 1 Position the mouse pointer within the boundaries of the **Vehicle Text** window and click the right mouse button. Choose the **Configure Vehicles** option and then click the **Configure Vehicle-Devices** button when the **Configure Vehicles** window displays.



- 2 In the **Position** entry area of the window, highlight the **Northing** value and type **N243500**. Next, highlight the **Easting** value and enter **E6295500**.
- 3 While still in the **Configure Vehicle Calculations** window, select the **Update** checkbox (immediately below the **Copy** button).
- 4 Click **OK** and close the **Configure Vehicles** window. Notice in the **Graphics** window and the **Vehicle Text** window that the **Locator** has moved to the newly-defined position.

Note: There is a shortcut to changing the vehicle's position, detailed below.

To Change a Vehicle's Position Using the Display Position Feature

- 1 First, ensure that only the **Display Position** button is highlighted in the **button toolbar**.



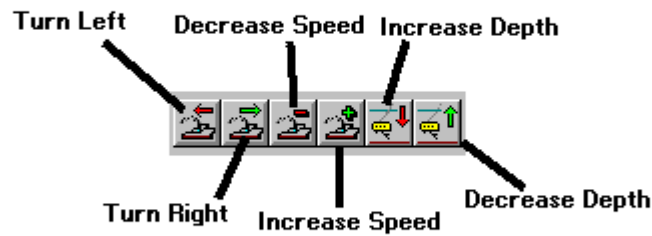
Now, when you left-click anywhere on the **Graphics** window you will see a "cross" drawn at that point. The coordinates of that point are displayed in the lower status bar at the bottom of the screen (just below the **Vehicle Text** window) and also recorded in the Windows "clipboard memory".

- 2 To move the vehicle to the newly recorded position, repeat **Step 1** of the previous steps (to open the **Configure Vehicle-Devices** dialog). Next, simply click the **Copy** button in the **Position** group at the top left corner of the dialog box. The mouse pointer coordinates are copied to the **Position** entry window and the **Update** option is automatically checked. Now click **OK** to make the **Locator** move to that position.

Driving the Vehicle in Simulation Mode

To Configure the Simulator

WinFrog has simulator tools that allow you to "drive" the boat while sitting at your desk. By default, WinFrog has **Turn Left (Port)**, **Turn Right (Starboard)**, **Speed Decrease**, and **Speed Increase** buttons along the button toolbar, as seen below:



- 1 Select the main menu item **Configure | Simulator** to change the effect that the simulator buttons have on the vehicle. In the **Configure Simulator** dialog box you can specify the incremental values as desired. You may find the **Heading** increment more useful set to **1 degree** per mouse “click” rather than the default of **5 degrees**.
- 2 Click **OK** to close this window.

You can observe the vehicle’s simulated **Speed, Heading** (and water depth) data updating in the **Vehicle Text** window.

To Drive the Vehicle in Simulation Mode

- 1 Zoom in sufficiently so that you can see the outline of the **Locator** in the **Graphics** window.
- 2 Click on the **Turn Right** and **Turn Left** buttons, as needed, to steer the vessel. Each time you click on these buttons the heading will increase or decrease by the amount set in the **Simulator Configuration**.
- 3 Click the **Increase Speed** button to send the **Locator** forward or the **Decrease Speed** button to slow the vessel.

Note: If you click the **Decrease Speed** button too many times, the vessel will start moving backwards.

Survey Lines and Waypoints

During the planning stages of a typical survey, you are provided with the coordinates of the specific location (or limits of) the area to be surveyed. From these coordinates, you will prepare a series of “tracks” for the vessel to follow in order to collect data. In WinFrog, these tracks are called “**Survey Lines**”.

Basically, **Survey Lines** are a series of points joined together to make a line. The **Working Survey Line File** can contain an unlimited number of individual survey lines.

In addition to the survey lines, you may want to display and track various points of interest found in the survey area. These single points are referred to as **Waypoints**. You can enter as many waypoints into the **Working Waypoint File** as you like, but you can only track **one** waypoint at a time.

Survey Lines

As mentioned above, a **Survey Line** is basically a series of points joined together in consecutive order to create a line.

A **Survey Line** is made up of the following components:

- 1 **Start of Line (SOL)**
- 2 Points where the line direction changes, referred to as **Alter Courses (A/Cs)**. **A/Cs** are also referred to as **Segments** in the **Survey Line** coordinate entry window.
- 3 **End of Line (EOL)**

You can create a **Survey Line** as long as you like, with as many **A/C** s as you wish. You can also add a **Radius** to a point to create a curved line. The line color can also be modified to help differentiate one line from another.

All **Survey Lines** are stored in the **Working Survey Line (.PTS)** file. Each **Survey Line** in the file is treated independently, identified by a user-entered name.

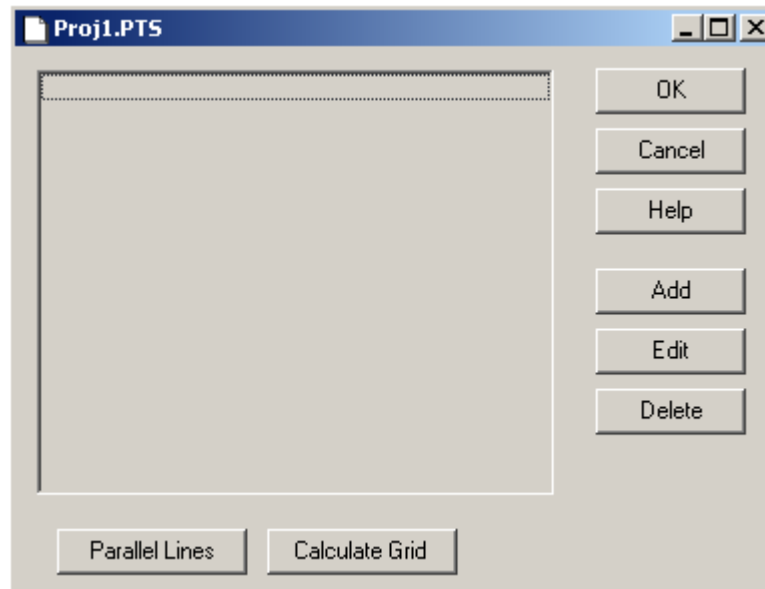
Note: it is possible, but not advisable, to have two lines with the same name in the same **Working Survey Line** file.

Once a **Survey Line** has been defined in the **Working Survey Line** file, it can then be displayed in WinFrog's **Graphics** window. You can also track any survey line with any WinFrog vehicle. Once you have selected which survey line to track, WinFrog calculates such information as distances from the **SOL** and **EOL**, as well as cross-track distance (perpendicular to the survey line). This information can then be displayed in various WinFrog windows to assist the helmsman in keeping the vessel on course. (See the **Operator Display Windows** chapter of the WinFrog User's Guide for more information on displaying **Line Tracking** information).

Note: A vehicle can track only one **Survey Line** at a time. Multiple vehicles can track the same (or different) **Survey Lines** simultaneously.

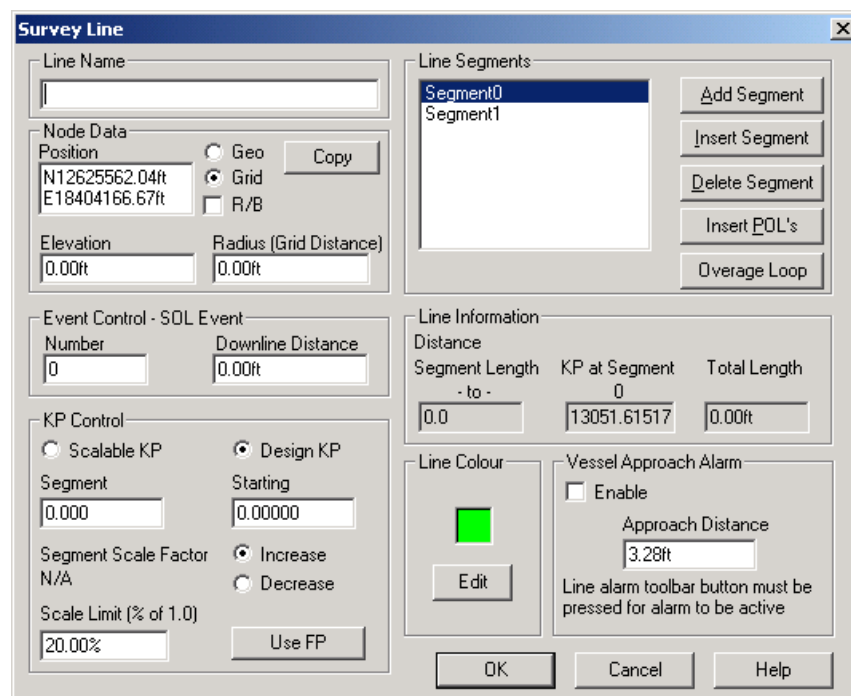
To Create New Survey Lines

- 1 From the **File** menu, click **Edit Working Files... > Survey Lines**.



WinFrog opens the **Proj1.PTS** dialog box because you had earlier specified **Proj1.PTS** to be the **Working Survey Line** file (**File | Select Working Files**). The file is empty at startup.

- 2 Click the **Add** button.



- 3 Type **Line1** in the **Name** field at the top of the **Survey Line** dialog box.

- 4 Make sure **Segment0** is selected in the **Line Segments** area.
- 5 You can enter coordinates in either **Geo** or **Grid** coordinates. In our example, we were provided with **Grid** coordinates. We defined units (**Configure | Units**) during configuration so the **Coordinate** defaults to **Grid** in this window.
- 6 Highlight the value beside the “**N**” in the **Coordinate** entry window.

The sample provided coordinates for the Northwest and Southeast limits of the site. We will create survey lines that are oriented North to South within these limits.
- 7 For the first coordinate, type in a Northing of **244000**. (The full entry should read “N244000.”)
- 8 Highlight the value beside the “**E**” in the **Coordinate** entry window.
- 9 Enter **1734000**. You’ve just defined the North end of **Line1**.
- 10 Select **Segment1** in the **Line Segments** area.
- 11 Highlight the value beside the “**N**” in the **Coordinate** entry window.
- 12 Enter **243000**.
- 13 Highlight the value beside the “**E**” in the **Coordinate** entry window.
- 14 Enter **1734000**. You’ve just defined the South end of **Line1**.

Note: The order in which the coordinates are entered is significant because it determines the direction of the survey line, as well as which side of the line will be considered the **Starboard** and **Port** side of the survey line. The significance of this will be apparent when you create other survey lines parallel to this survey line and when you enable **Survey Line Tracking**.

- 15 In the **SOL (Start of Line) Event** part of the window, enter **100** in the **Number** window and **0.0** in the **Downline Distance** window. These are default values that will appear when you start recording **Automatic Events**.
- 16 Click **OK** to close the **Survey Line** window. Note that **Line1** has now been added to the contents of **Proj1.PTS**

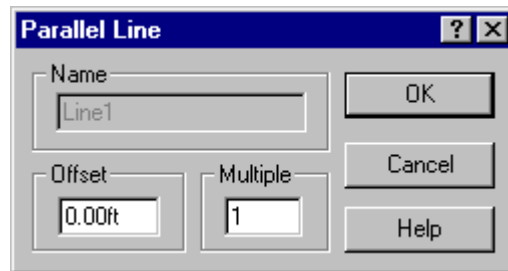
To create other survey lines, you would just repeat this process, giving the new survey lines unique names. You can edit existing lines to add new segments or curves to them. For this project, you will create survey lines parallel to **Line1**. You could do this manually, by repeating the above process, but it is quicker to use WinFrog’s **Parallel Lines** function.

To Create Survey Lines Parallel to an Existing Survey Line

You must now create more **Survey Lines** to fill up the survey area defined by the client. Remember that the client specified that the survey lines be spaced **20.0** feet apart. You must complete a simple calculation to determine how many lines will be required to fill the area. In this case, the survey lines are running true North to South, so we can simply subtract the lesser Easting from the greater Easting to get the East-West dimension. ($1734000.00 - 1733000.00 = 1000.00$ feet) Now, by dividing 1000.00 feet by the 20 foot spacing, we know the number of survey lines we'll need equals 50.

Because we entered the survey lines from the North end to the South end, North to South is now considered to be the survey line's "forward" direction. This means that when we create other survey lines, parallel to this one, we must put in a **negative** offset value to have them be created to the left (**East**) of the chosen line.

- 1 With the **Proj1.PTS** dialog box still open (**Edit Working Files...Survey lines**), select **Line1** (if it is not currently selected).
- 2 Click the **Parallel Lines** button at the bottom of the dialog box.



Because **Line1** was highlighted when you clicked the **Parallel Lines** button in the **Proj1.PTS** dialog box, the line that you're about to create will be parallel to **Line1**. If there were other lines available to choose from in the **Proj1.PTS** dialog box, you could have selected one of those and you would be creating a new survey line parallel to that one.

- 3 Highlight the **Offset** field.
- 4 Type **-20**.
- 5 Highlight the **Multiple** field.
- 6 Type **50**.

This specifies that you will create fifty survey lines twenty feet to the port side of **Line1**. In WinFrog, **Starboard** offsets are entered as **Positive** values and **Port** offsets are entered as **Negative** values. If you had created **Line1** from South to North instead of from North to South, then **Line1** would be oriented in the opposite direction and you would have entered a **positive** offset to create the fifty parallel survey lines in the correct location (to the east of **Line1**).

- 7 Click **OK** to close the **Parallel Line** creation window. You've just created fifty new survey lines. Note the names of the new survey lines. WinFrog takes the original survey line name and appends it with the offset value. You can now highlight and edit any of these as you wish.
- 8 Click **OK** to close the **Proj1.PTS** dialog box. Notice that the survey lines now appear as green lines in the **Graphics** window.

Waypoints

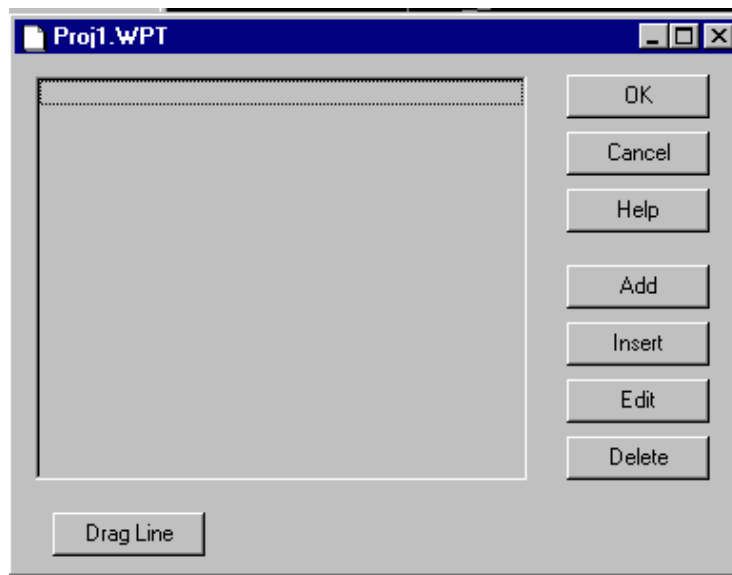
A “**waypoint**” is a single point of specific interest. For example, a waypoint could be the position of a shoal, a shipwreck, a pier, etc. WinFrog can be configured to calculate and display the **Range** and **Bearing** from a vehicle's **Tracked Offset** to a **waypoint**. As the vehicle moves, WinFrog automatically re-calculates the **Range** and **Bearing** and updates the vehicle information in the **Vehicle Text** window.

You can also configure WinFrog to sound an **Alarm** if the vehicle gets within a certain distance of a **waypoint** or if the vehicle gets a certain distance away from a **waypoint**.

The **Working Waypoint** (.wpt) file can contain hundreds of waypoints.

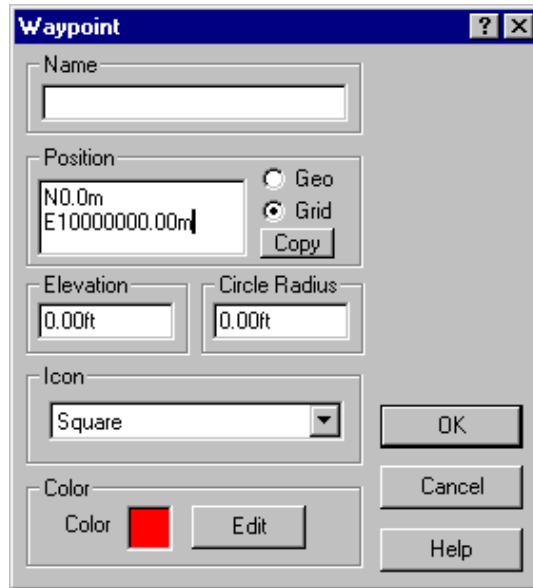
To Create New Waypoints

- 1 From the **File** menu, click **Edit Working Files... > Waypoints**.



WinFrog opens the **Proj1.WPT** dialog box because **Proj1.WPT** is the name you originally gave the **Working Waypoints File**.

- 2 Click the **Add** button.



- 3 In the **Name** field, type **Shoal**.
- 4 Because we were provided with **Grid** coordinates and set those in the configuration, the **Grid** radio button should already be selected by default.
- 5 Highlight the value beside the **N** in the **Position** field.
- 6 Type **243500**.
- 7 Highlight the value beside the **E** in the **Position** field.
- 8 Type **1733500**.
- 9 We will enter an **Elevation** as well, although this is not always required. Note that you are entering an **Elevation**, so depths must be entered as negative values. Enter a value of **-5.0** ft.

Entering an elevation value allows you to see the point in its correct vertical position in WinFrog's Profile Window. (See the **Operator Display Windows** chapter in the WinFrog User's Guide for more information on the Profile Window.)

Entering an elevation will not affect the **Range** calculated to the waypoint because this is always the **Horizontal** distance value.

- 10 In the **Circle Radius** field, highlight **0.00**.
- 11 Type **20**. This instructs WinFrog to draw a circle of 20 feet radius around the waypoint in the **Graphics** window. **Note:** this is simply for graphical purposes, and not an alarm radius. A radius alarm will be configured below.

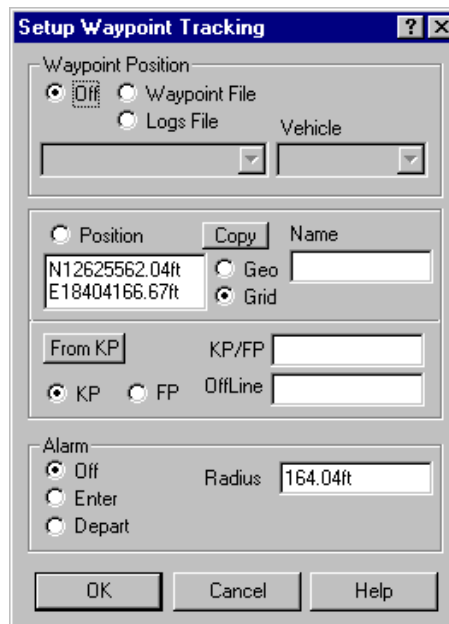
- 12 In the **Icon** field dropdown menu select **Rock**. This instructs WinFrog to draw a unique icon at the defined coordinates. This helps identify the waypoint in the **Graphics** window.
 - 13 Edit the color as desired. Again, this will help identify the waypoint in the **Graphics** window.
 - 14 In the **Waypoint** dialog box, click **OK**. The **Shoal** waypoint is now added to the **Working Waypoint** file. If necessary, repeat these steps to add more waypoints in a similar manner.
 - 15 When finished adding Waypoints, click **OK** to close the **Proj1.WPT** dialog box.
- The **Shoal** now appears in the **Graphics** display at the specified coordinates.

Tracking a Waypoint

Now that you've identified where a potential hazard is, you'll want WinFrog to warn you if **Locator** comes too close to this location.

To Track a Waypoint

- 1 With the mouse pointer in the **Vehicle Text** window, click the right mouse button and select the **Setup Waypoint Tracking** option. The **Setup Waypoint Tracking** dialog box opens, as seen below:



- 2 In the **Waypoint Position** area, click the **Waypoint File** radio button.

You now select the waypoint that you want to track. In this case, there is only one waypoint in the **Working Waypoint File (Shoal)**, so it automatically appears in the dropdown menu.

- 3 In the **Alarm** area, click the **Enter** radio button. This specifies that the alarm will sound when the vehicle enters the specified distance.
- 4 Enter **50** in the **Radius** field.
- 5 Click **OK**.

The **Name** of the Waypoint, along with the **Range** and **Bearing** from the **Locator**, now appears in the **Vehicle Text** window. Now, if **Locator** approaches within twenty feet of the shoal, an alarm will sound.

Notice that the waypoint is now displayed in the same color as **Locator**, the vehicle tracking that waypoint. This lets you know which vehicle is tracking which waypoint in the **Graphics** window.

Collecting Data: Events

During a survey, you will want to record information concerning the vehicle's position, speed, heading, course made good/course over ground, water depth, etc. This information can be recorded **automatically** at a set time or distance downline interval or **manually** at the click of a button. Regardless of how the collection of data is initiated (automatically or manually), the actual instant that data is recorded is termed an “**event**.”

When **Eventing** is activated, WinFrog writes various types of information to files. In hydrographic surveying, the term **fix** is used to represent the same event. In seismic operations the term **shotpoint** is used. The three terms are used interchangeably in WinFrog.

The following sections detail **Automatic** and **Manual Eventing** in WinFrog.

Automatic Eventing

WinFrog can be configured to **Automatically** generate an **Event** at a given **Time** or **Distance** interval, recording the following information:

- Event Number
- Vehicle Name
- Position
- Time and Date
- Height
- Depth
- Layback
- Speed

Heading
Course Made Good/Course Over Ground
Offset
QC - Quality Control value
Alongline Distance
Offline Distance
KP value

Raw Data

In addition to the above-mentioned **Event** information, WinFrog can be configured to automatically record “**Raw**” data from interfaced peripheral **I/O Devices**.

There is an important difference between event data and raw data. The data recorded in **Automatic** or **Manual Event** files may have geodetic offsets, positional offsets, tracking offsets, and positional filtering applied, whereas, **Raw** data has **no** offsets or filtering applied.

Raw data allows you more freedom in processing because you have better knowledge of the status of the data. **Raw I/O Device** data is written to a **.raw** file, which is distinctly different from **Automatic** or **Manual Event** data files. The **.raw** ASCII files contain a line-by-line list of all of the data from each individual device that is interfaced to WinFrog, logged record-by-record, and preceded by an identifying **Device Code**, the **Name** of the device, and a **Time-Stamp**.

You have the ability to record **raw** data at varying intervals: **With Events**, **At Events**, and **Always**.

Recording raw data “**With Events**” means that raw data will be recorded for the entire time that **Automatic Eventing** is active. In other words, it does not matter what kind of recording interval has been set, raw data will be collected from the instant that eventing is made **Active** to the moment you disable **Automatic** data collection.

Recording raw data “**At Events**” means that raw data will be recorded only at those instants when an **Automatic Event** is taken. In other words, if you have set WinFrog to record an event every 10 seconds, raw data will also be recorded only at those same 10 second intervals.

Recording **raw** data “**Always**” means that **raw** data will be recorded from the instant that you select **OK** to close the **Event Configuration** window. Recording **raw** data **Always** does not require **Automatic Eventing** to be enabled.

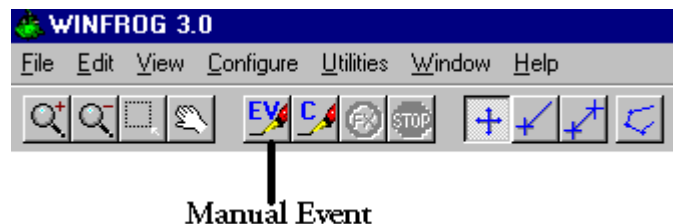
Note: It is strongly suggested that you record **raw** data during a project as a backup to automatic or manual event data.

Manual Fixing

You can manually tell WinFrog to record an **event** by clicking on a button, recording the following information:

- User-Entered Comment
- Vehicle Name
- Position
- Time and Date
- Height
- Depth (of water)
- Layback
- Speed
- Heading
- Course Made Good/Course Over Ground
- Offset
- Quality Control value
- Alongline Distance
- Offline Distance
- KP - (Kilometer Post value. The distance downline in kilometers)

Both **Automatic** and **Manual Eventing** can be used together. For example, you can configure WinFrog to record **Automatic Events** at a set time or distance interval while you also simultaneously record **Manual Events** by clicking a button. There are three ways to generate a **Manual Event**: select **Configure | Manual Event**, hit the **F10** key, or click on the **Manual Event** button, as seen below.



Regardless of which method is chosen to initiate a **Manual Event**, the same **Manual Event** dialog box opens, as seen below.

Manual Event

Comment: [Empty text box]

Vehicle: [Locator] ☐ Only selected vehicle

Position: N243414.90ft E1732899.99ft ☐ Lat/Lon ☒ Grid

Time: 02-09-05 16:36:34.3
Month-Day-Year Hour:Minute:Second

Height: 0.00ft Depth: 142.2m Layback: 0.00

Speed: 0.00 Heading: 000.00 CMG: 074.68

Offset: Echo Sndr QC: 0.00

Downline: 0.00ft Offline: 0.00ft KP: 0.000

Cable Count (m): 0.000 ☒ Print when close w/OK

OK Cancel Help

Type in a **Comment** to describe the **Manual Event**. This should be a unique comment to help easily identify this event. If you want to record only one vehicle's position, select that vehicle name from the dropdown menu, then select the **Only selected vehicle** checkbox. Select **OK** to close this window and save the **Manual Event**. **Manual Events** are recorded in the **Working Logs** (.log) file.

You can access the contents of the **Working Logs File** at any time by selecting the main menu item **File | Edit Working Files... > Logs**. Highlight any entry and select **Edit** to review the information recorded for that particular **Manual Event**.

Configuring a Vehicle for Automatic Events

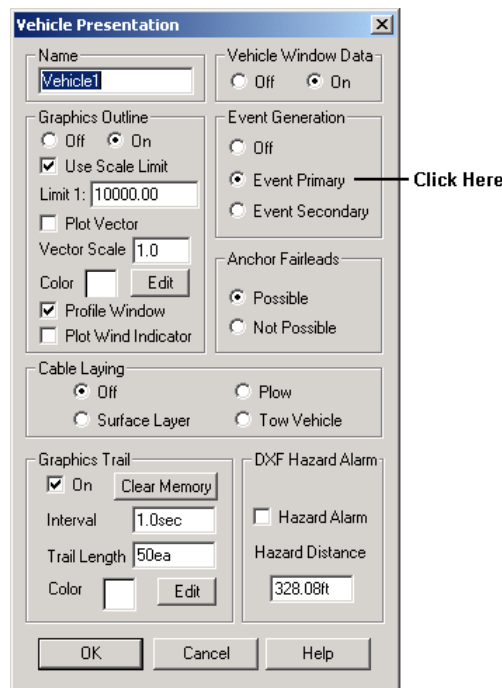
In order to configure WinFrog to automatically record event data, you must define one vehicle as the **Event Primary** vehicle. The information for any number of vehicles can be recorded using automatic events, however, only one vehicle (the **Event Primary** vehicle) can **trigger** them. If you want to record information for any other configured vehicles, the additional vehicles must be configured as **Event Secondary** vehicles.

When the **Event Primary** vehicle triggers an event, information for that vehicle (along with all **Event Secondary** vehicles) will be recorded to one of three **Record types**, as defined by the user. Regardless of the **Record Type** chosen (be it **.DAT**, **.SRC**, or **.RCV**), this file will contain the following information:

Event Number
Vehicle Name
Position
Time and Date
Height
Water Depth
Layback
Speed
Heading
Course Made Good/Course Over Ground
Offset
Quality Control value
Alongline Distance
Offline Distance
KP (Kilometer Post) value

To Define the Event Primary Vehicle

- 1 Select the main menu item **Configure | Vehicles** then click the **Vehicle Presentation** button.
- 2 In the **Event Generation** area, click the **Event Primary** radio button.



- 3 Click **OK** to close the **Vehicle Presentation** dialog box.

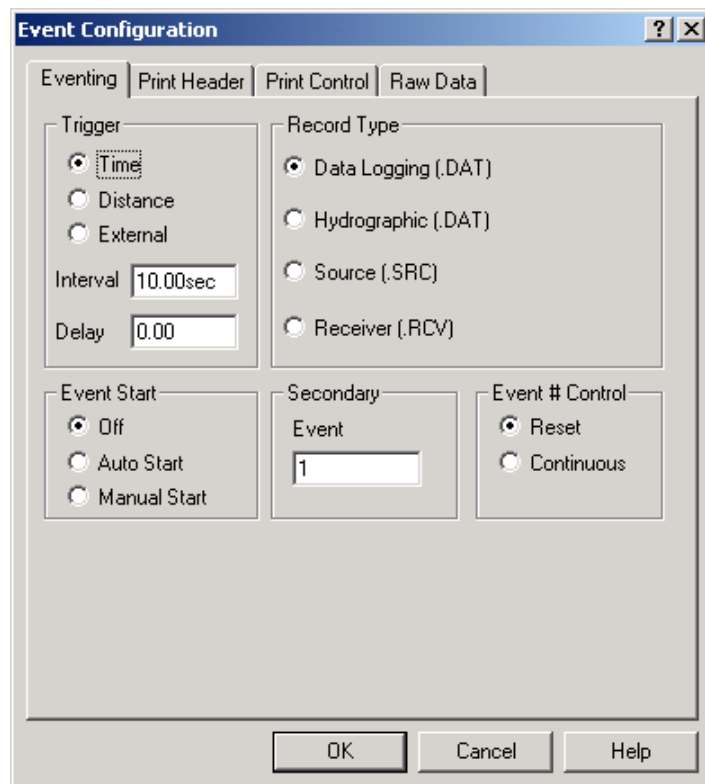
Configuring Automatic Events

Now that you've notified WinFrog that **Locator** is the vehicle that will trigger events, you need to tell WinFrog how you want the events to be triggered. In our sample project, we will record data at the client-specified interval of 20 feet along the survey line.

Before we start eventing, we should move the boat outside of the survey line area, somewhere near to N244500, E1734000. This will ensure that eventing will not inadvertently start before we are ready. (See the section above for details on moving the vessel).

To Configure Automatic Events

- 1 Select the main menu item **Configure | Data Events > Setup**, or right click in the **Vehicle Text** window and select the **Setup Data Events** option.
- 2 In the **Trigger** area of the **Event Configuration** window, click the **Distance** radio button.



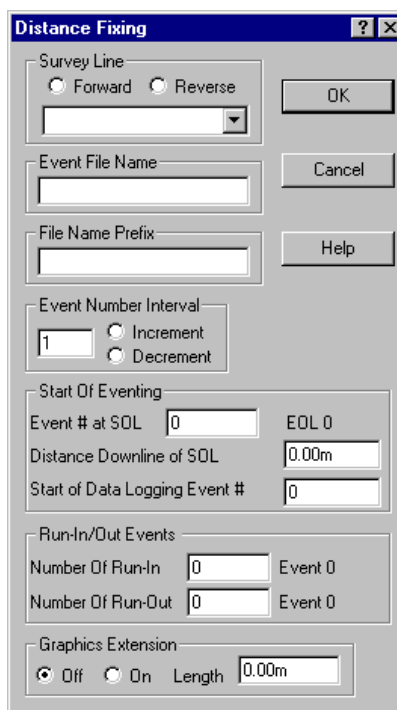
- 3 Highlight the value in the **Interval** window and type in **20.0** feet.

- 4 In the **Record Type** area, select the **Hydrographic (.DAT)** radio button to create a data file with a **.DAT** file extension. The **Hydrographic Record Type** is chosen because it (as well as **Source (.SRC)** and **Receiver (.RCV)** record types) automatically requests that a **Survey Line** be subsequently selected, which is what we require for our sample project.
- 5 At the bottom of the **Event Configuration** dialog box, in the **Event Start** area, click the **Auto Start** radio button. This instructs WinFrog to go directly to **Eventing Active**, as opposed to going to **Eventing Enabled** first. If you chose **Manual Start**, you must manually activate eventing. (More details on this in the **Data Collection** section below.) With **Eventing Active**, our data recording will start when the vehicle crosses the beginning of the survey line.
- 6 In **Event #Control**, click **Line**. This tells WinFrog that we desire the **Event Numbers** along every line to default to the same number at their respective **SOLs**. Remember that this is just a default which can be changed when we configure eventing, as you'll see shortly.
- 7 Select the **Raw Data** tab, then in the **Logging Control** section of the window, click the **With Events** radio button. This instructs WinFrog to record all raw data received from peripheral devices for the duration of automatic event data recording.
- 8 In the **Raw File Control** section, click the **Use Julian Date/Time** radio button and leave the **Max File Size in KB** set to **200**. These settings tell WinFrog to store the raw data in a file named after the Julian date (1 through 365 Julian days in a year) and time. For example, a **.raw** file recorded at 9:00am on September 27, 1999, would be written as **270-0900.raw** and would be a maximum of 200KB in size. Once the specified file size has been reached, another **.raw** file would be automatically created by WinFrog, again reflecting the date/time in its name.

Creating multiple **.raw** files offers a degree of safety in that if all **.raw** data were recorded to a single file and that file was somehow corrupted, all data would be lost. Also, depending on the number of devices and the amount of data collection undertaken, a single **.raw** file may reach an unwieldy size. For example, in a typical survey (using just a GPS receiver, gyro, and an echosounder) a new 200 KB file is created every two minutes when either **raw with events** or **raw always** is used.

- 9 The **Raw Navigation Record (Type 300)** window refers to the generation of a data record that is not typically required. (This record compiles raw data from some of the I/O devices to a new, single **Type 300** record in the **.raw** file). For this sample project (and most “real” projects) the **Logging Interval** can be left at the **0.00** sec default value.

- 10 Click **OK** to close the **Event Configuration** window. As mentioned previously, the **Distance Fixing** dialog box now opens automatically because we had chosen the **Hydrographic Record Type**.

The image shows the 'Distance Fixing' dialog box. It has a title bar with a question mark and a close button. The dialog is organized into several sections. The 'Survey Line' section has radio buttons for 'Forward' and 'Reverse', and a dropdown menu. The 'Event File Name' section has a text input field. The 'File Name Prefix' section has a text input field. The 'Event Number Interval' section has a text input field with '1' and radio buttons for 'Increment' and 'Decrement'. The 'Start Of Eventing' section has three input fields: 'Event # at SDL' (0), 'EOL' (0), and 'Distance Downline of SDL' (0.00m). The 'Start of Data Logging Event #' section has an input field with '0'. The 'Run-In/Out Events' section has two rows: 'Number Of Run-In' (0) and 'Event 0', and 'Number Of Run-Out' (0) and 'Event 0'. The 'Graphics Extension' section has radio buttons for 'Off' (selected) and 'On', and a 'Length' input field with '0.00m'. On the right side, there are three buttons: 'OK', 'Cancel', and 'Help'.

- 11 You must now select which **survey line** to track. As mentioned above, **Eventing on Distance** requires that a survey line be tracked.

Important: The **Event Distance Interval** is not necessarily the distance that the vessel travels, but is the **downline distance** of the tracked **survey line**. For example, if the vessel travels at a right angle to the direction of the survey line, no events will take place. Also, note that no events will take place until the vessel's **Tracked Point** crosses the start of the Survey Line.

Select **Line1** and **Forward**. **Forward** means that the **Start of Line** is the point that was entered first when you created the **survey line**.

- 12 The **Event Filename** entry is used to define the name of the **.dat** file that will be created. WinFrog uses the survey line name by default. You would typically leave this as is.

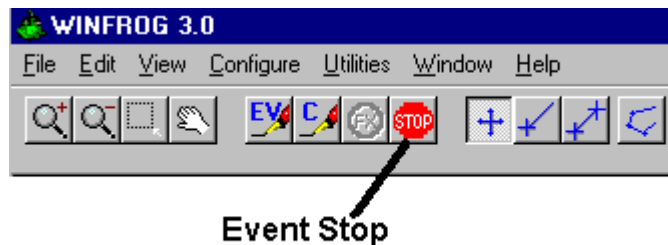
Enter a **Filename Prefix** if you are re-shooting the line and do not want to overwrite or append an existing file of the same name.

- 13 In the **Event Number Interval** grouping, type **1** and select the **Increment** option.

- 14 In the **Start of Eventing > Event #at SOL** window you will see **100**, which is the value that you entered as the **SOL Event Number** when you created the survey lines. Ensure that the **Distance Downline of SOL** is **0.00** and that the **Start of Data Logging Event #** is **100**. This means that data logging will start at the beginning of the line with event number **100**. These options are for those situations when you want to start data recording at some point other than the start of the survey line.
- 15 In the **Run-In / Run Out Events** window, set both values to **0**. This defines additional events at the start and end of the survey line.
- 16 In the **Graphics Extension** window, select **On** and enter a length of **500** feet. This instructs WinFrog to draw a 500 foot long dashed line before the actual (defined) start of the **Survey Line**. This extra distance gives the pilot a chance to get the boat lined up and steady on the survey line before data recording begins.
- 17 Click **OK** data to close the **Distance Fixing** dialog box. **Eventing** is now **Active**.

Eventing is Active

Several things are different on your screen. In the button toolbar, the **Event Stop** button is now highlighted in red.



In the **Graphics** window, the survey line that you are tracking, **Line1**, is now the color of the vehicle that is tracking that line.

In addition to the general navigation data that was previously displayed, the first line on the **Vehicle Text** window indicates that **Eventing Status (EVT ACTIVE)**, the **Active Fix Number (FIX 100)**, and the **File Name (File Line1.DAT)**.

The second line shows the **Raw Record Status (Raw With Events)**.

The fifth line indicates which **Survey Line** is being tracked (**Line1**), the (downline) distance **Locator** is from the **Start of Line**, the (downline) distance **Locator** is from the **End of Line**, and the perpendicular distance **Locator** is off the survey line to Port or Starboard.

Although the **Eventing mode** is **Active**, we are not actually recording data yet. We must be between the **Start of Line** and the **End of Line** for this to happen.

Before we start eventing, we'll enable and modify some WinFrog features to help the pilot keep the Locator on line.

Tracking up the Screen

It's a lot easier for the helmsman to keep the boat on course if the **Graphics** display is configured so that the outline of the vehicle tracks straight “up” the screen, instead of constantly trying to refer to which way is North and which way the boat is heading.

You can change the orientation of the **Graphics** display by changing its **Rotation**. You can tell WinFrog to rotate to the active survey line segment or you can enter any rotation you wish (measured in degrees clockwise from North).

To Change the Rotation of the Graphics Display

- 1 From the **Configure** window, choose **Graphics**.
- 2 Select the **Rotation** tab and choose **Survey Line** in the **Rotate to** area.
- 3 In this case, since the survey line coordinates were entered from North to South and we are tracking the survey line in this forward direction, the **Graphics** screen will now flip the graphics to have South at the top of the screen.
- 4 Click **OK**. Notice the shift in the **Graphics** window, including the direction of the **North arrow**.

Attitude

Another display that your helmsman can find useful for keeping the vehicle on course is the **Attitude** window.

To View the Attitude Display

- 1 From the **View** menu, choose **Attitude**.



This window provides a graphical representation of the vessel's navigation parameters with comparisons of the **Vehicle's Heading** (green), the **Vehicle's Course Made Good** (blue), and the **Bearing** of the **Survey Line** (red).

There is also a horizontal bar graph indicating the **Offtrack Distance**. The slider bar at the bottom of the screen can be used to change the **Scale**. A vertical bar graph in the left portion of the **Attitude** window indicates **Vessel Speed**.

The **Attitude** window is very useful for **Survey Line** tracking operations. It often proves to be a better tool for the helmsman to maintain tracking rather than trying to find the information in the **Vehicle Text** window.

Starting to Record Automatic Events with Autostart

With **Autostart** activated (as it is now in your sample project), automatic eventing commences when the vehicle crosses the beginning of the **Survey Line**.

To Record Automatic Events with Autostart Activated

- 1 Using the menu bar **Simulated Heading** button, turn the **Locator's** heading to **180.0** to match the survey line's heading.

Click on the menu bar **Simulated Speed Increase** button to start the **Locator** moving downline at approximately. 4 knots.

In the **Graphics** display, **Zoom in** to a scale to make it easy to navigate the **Locator** along **Line1** (ratio of approximately 1:2000).

Note: the **SOL** value is currently a negative value and is getting closer to zero as you approach the Start of Line. Regardless of how far offtrack you are, when the **SOL** value reaches **0.0**, eventing will start.

All displayed position and survey line tracking information refers to the **Vehicle Offset** point being tracked. As detailed above, for our exercise we have configured WinFrog to track an offset called **Echo Sndr**. This means that eventing will not start until that point on the ship crosses over the **SOL**.

- 2 Watch the **Graphics** window while **Locator** automatically records events. You can **zoom in** or **zoom out** to obtain a clearer view of the data. The individual **Data Events** will be discernible as yellow, fix-number-labeled squares.

Keep the **Locator** within a reasonable offtrack distance by watching the **Graphics** screen, **Attitude** window, and the **Vehicle text** window and adjusting the vehicle's **Heading** to suit. Continue down to pass the end of the survey line.

Stopping/Re-starting Eventing

To Stop Eventing

- 1 You can click the red **Event Stop** button (in the toolbar) to cease recording events at any time, but for our example, wait until the vehicle has crossed the **EOL** to stop data collection.

To Re-start Eventing

By default, WinFrog will return you directly to the **Distance Fixing** dialog box. This is done under the assumption that you will want to collect data using the same parameters used on the line just completed. In our case, we had eventing based on a **Distance** of every 20 feet and collection of **Raw Data with Events**. If you do not wish to record any more data, you would select the **Cancel** button at this point. For our example, we will setup the vessel to collect data going down another survey line, this time in the opposite direction.

- 1 Select a different survey line from the one last used. You will have to configure the survey line tracking to be **Reverse** to now track it in the opposite direction. When you select **Reverse**, WinFrog automatically calculates the appropriate **Starting Event Number** and also selects the **Decrement** option. These are calculated to make the event numbers for all survey lines match up. In other words, all of the event numbers on each of the survey lines will line up across the **Graphics** screen.

Note: as you select **OK** to close the **Distance Fixing** window, **Eventing Status** is now **Enabled**, not **Active**. You must now press the green **Event Start** button (just to the left of the **Event Stop** button) to change the status to **Event Active**. Failure to do so will result in no data being collected.

Notice that the **SOL** is now the South end of the survey line. Navigate the **Locator** to the **SOL** and beyond, collecting data while navigating along the survey line.

Checking the Survey Data

It is wise to check early on in the survey that data are in fact being recorded, that the files contain the desired information, and that data are being recorded at the desired rate. Remember that we had configured WinFrog to record both automatic event (**.DAT**) and raw (**.RAW**) data during eventing. You should check to ensure that both types of data are being recorded and at the rate of recording that you intended.

To Check the Recorded (.DAT) Data

- 1 Select **File | Edit Working Files.... > Data**. This will bring up a display showing you the contents of the **Working Data (.ALG)** file. The **.ALG** file is basically just a directory listing the names of the recorded **.DAT** files.
- 2 Highlight any one of the **.DAT** file names in the **.ALG** file and select **Edit**. You will now see the contents (i.e. the individual events) contained in that individual **.DAT** file.
- 3 Highlight any one of the individual events and select the **Edit** button. You now see the information for that specific event including Position, Time, Speed, Heading, CMG, and Survey Line tracking information.

To Check the Raw (.RAW) Data

Earlier in this exercise, you specified where the **.raw** data would be written to on the hard drive. This was done under **File | Select Working Directories > Raw Data Directory**. In order to check this data:

- 1 Navigate to the **Raw Data Directory**.
- 2 Open one of the **.raw** files using an editing program. The easiest way to do this is to associate the raw file with the program **WordPad** or **NotePad**.

Once you open a **.raw** file (which is simple a comma delimited ASCII text file), read the individual lines to ensure that a record exists for each type of device that was added to the vehicle, and that the data being received from the device are realistic. In particular, look out for “zero data.” Occasionally certain I/O devices output data containing nothing but zeros, which obviously isn’t what you want. The **.raw** files are admittedly rather cryptic in nature, but you should be able to figure out if the correct number of devices are there and if the data from each device is more than just “zero data.”

Completing the Survey

Essentially, you repeat these data collection steps until your survey is complete. The most common mistake made is forgetting to select the correct tracking direction each time a new survey line is selected. In other words, making sure that if the currently selected survey line is being tracked in the **Forward** direction, the next survey line must be tracked in the **Reverse** direction.

APPENDIX A: USEFUL GEODETIC/DGPS REFERENCE STATION INFORMATION

CONTENTS:

- Table of Geodetic Formulae
- Ellipsoidal Parameters
- Geodetic Datums and Reference Ellipsoids
- Geodetic Datum Shift
- Universal Transverse Mercator Constants
- Universal Transverse Mercator Zone Table
- Defining Constants for the 1927 State Plane Coordinate System
- Defining Constants for the 1983 State Plane Coordinate System
- NOAA Technical Publications

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TABLE OF GEODETIC FORMULAE

Listed below are the various Geodetic Formulae used in the computation to define the Fundamental Constants and Spheroidal Parameters:

Flattening:	f	$=$	$\frac{(a-b)}{a}$
Semi Minor Axis:	b	$=$	$a(1-f)$
	b	$=$	$\sqrt{(1-e^2)}a$
	b	$=$	$\frac{a(1-e^2)}{2}$
Major Eccentricity squared:	e^2	$=$	$\frac{a^2-b^2}{a^2}$
Minor Eccentricity squared:	e'^2	$=$	$\frac{a^2-b^2}{b^2}$
Polar Radius of Curvature:	c	$=$	$\frac{a^2}{b}$

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ELLIPSOIDAL PARAMETERS

Tabulated below are the Fundamental Constants for the various defined shapes of the Earth.

Listed in alphabetical order of Spheroids.

Spheroid	Semi Major Axis - a (m)	Semi Minor Axis - b (m)	e²	1/f
Airy 1830	6377563.396	6356256.912	.006670539	299.325
Airy 1858	6377563.000	6356256.873	.006670428	299.330
Airy (Modified)	6377340.189	6356034.448	.006670540	299.324959
Andrea	6377105.000	6355847.982	.006655556	300.000
A.P.L. ³ (N.N.S.S.) ⁵	6378144.000	6356757.339	.006694990	298.230
Australian National	6378160.000	6356774.719	.006694542	298.250
Bessel 1841	6377397.155	6356078.963	.006674372	299.152815
Bessel (Modified)	6377492.018	6356173.508	.006674372	299.152813
Bouguer Maupertus 1738	6397300.000	6367792.159	.009203817	216.800
Carte de France	6376985.000	6356323.436	.006469544	308.640
Clarke 1858 (Original)	6378293.000	6356620.241	.006784241	294.300
Clarke 1858 (Corrected)	6378293.645	6356617.938	.006785162	294.260
Clarke 1866	6378206.400	6356583.800	.006768658	294.978698
Clarke 1880	6378249.145	6356514.967	.006803481	293.466316
Clarke 1880F.	6378249.200	6356514.998	.006803488	293.465994
Clarke 1880 (Modified)	6378249.145	6356514.870	.006803511	293.464993
Clarke 1885	6378360.706	6356684.771	.006785162	294.260
Danish	6377103.965	6355846.952	.006655556	300.000
Danish (Degree)	6377019.260	6355762.528	.006655556	300.000
Delambre 1800	6375653.000	6356564.218	.005979060	334.000
Duplessis (Reconstituted)	6376523.340	6355863.271	.006469544	308.640
Everest 1830	6377276.345	6356075.414	.006637847	300.801698
Everest (Modified)	6377304.068	6356103.046	.006637846	300.8017
Fisher 1960	6378166.000	6356784.283	.006693422	298.300
Fisher 1960 S. Asia	6378155.000	6356773.320	.006693422	298.300
Fisher 1968	6378150.000	6356768.337	.006693422	298.300
Ghana National	6378295.000	6356746.706	.006745343	296.000
Hayford 1906	6378283.000	6356864.991	.006704641	297.800
Hayford 1910	6378388.000	6356909.000	.006723591	296.959263
Hayford 1910 (Modified) (also International)	6378388.000	6356911.946	.006722670	297.000
Heiskanen 1926	6378397.000	6356920.916	.006722670	297.000
Helmert 1906	6378200.000	6356818.170	.006693422	298.300
Hough 1956	6378270.000	6356794.343	.006722670	297.000
International (also Hayford 1910mod)	6378388.000	6356911.946	.006722670	297.000
I.R.G.G. ⁷ 1967	6378206.400	6356583.800	.006768658	294.978698
I.U.G.G. ⁷ 1967	6378160.000	6356774.719	.006694542	298.250
Jeffreys 1948	6378099.000	6356631.148	.006720411	297.100
Kaula 1961	6378165.000	6356783.287	.006693422	298.300
Kaula 1964	6378160.000	6356774.719	.006694542	298.245
Krasovsky 1936	6378210.000	6356849.635	.006686703	298.600
Krasovsky 1942	6378245.000	6356863.019	.006693422	298.300
Ledersteger 1951	6378298.000	6356822.249	.006722670	297.000

Spheroid	Semi Major Axis - a (m)	Semi Minor Axis - b (m)	e²	1/f
Malayan	6377304.063	6356103.039	.006637847	300.8017
N.N.S.S. ⁵ Guier 65	6378166.000	6356784.284	.006693422	298.300
N.W.L. ² 8D/9D	6378145.000	6356759.769	.006694542	298.250
N.W.L. ² 10D (WGS 72)	6378135.000	6356750.520	.006694318	298.260
Pratt 1863	6378245.000	6356645.798	.006761305	295.300
South American 1969ans	6378160.000	6356774.719	.006694542	298.250
S.A.O. ¹ C-5	6378165.000	6356779.702	.006694542	298.250
S.A.O. ¹ C-6	6378155.000	6356769.736	.006694542	298.250
S.A.O. ¹ C-7	6378142.000	6356757.138	.006694430	298.255
S.A.O. ¹ SE 111	6378140.400	6356755.616	.006694407	298.256
Stowe	6378297.000	6356655.847	.006774360	294.730
Struve	6378298.300	6356657.143	.006774360	294.730
Veis 1964	6378169.000	6356783.689	.006694542	298.250
Walbeck 1819	6376896.000	6355834.847	.006594548	302.780
W.D. Spheroid	6378300.000	6356751.690	.006745343	296.000
W.G.S. ⁴ 72 (NWL 10D)	6378135.000	6356750.520	.006694318	298.260
*W.G.S. ⁴ 84 (GRS 1980)	6378137.000	6356752.314	.006694380	298.257222

*Reference: W.G.S. 84 (GRS 1980) The Fundamental Constants and Geodetic Values are defined as follows:

a = 6 378 137.000 (exact)
 b = 6 356 752.314140347
 e² = 0.006694380022903416
 e = 0.08181919104283185
 1/f = 298.2572221008827
 f = 0.003352810681183637

1. Smithsonian Astrophysical Observatory
2. Naval Weapons Laboratory
3. Applied Physics Laboratory
4. World Geodetic System
5. Navy Navigation Satellite System
6. Geodetic Reference System
7. International Union of Geodesy and Geophysics

GEODETIC DATUMS AND REFERENCE ELLIPSOIDS

Datum	Spheroid	Origin	Latitude	Longitude (E)
Adindan (Ethiopia)	Clarke 1880 Mod.	Station 15 Adindan	22°10'07.110"	31°29'21.608"
American Samoa 1962	Clarke 1866	Betty 13 ECC	-14°20'08.340"	189°17'07.750"
African Arc-Cape S.Afr. 1950	Clarke 1880 Mod.	Buffelsfontein	-33°59'32.000"	25°30'44.622"
Aratu (Petrobras)				
Argentina	International	Campo Inchauste	-35°58'17"	297°49'48"
Ascension Island 1958	International	Mean of three stations	-07°57'	345°37'
Australian Geodetic	Australian National Ellipsoid 1967	Johnston Memorial Cairn	-25°56'54.55"	133°12'30.08"
Bermuda 1957	Clarke 1866	Ft. George B 1937	32°22'44.360"	295°19'01.890"
Berne 1898	Bessel	Berne Observatory	46°57'08.660"	07°26'22.335"
Betio Island, 1966 Secor Astro	International	1966 Secor Astro	01°21'42.03"	172°55'47.90"
Bogota				
Camp Area Astro, 1961-62				
Campo Inchaupé				
Canton Island, Astro 1966	International	1966 Canton Secor Astro	-02°46'28.99"	188°16'43.47"
Christmas Island, Astro 1967	-----	-----	-----	-----
Chua Astro (Brazil-Geodetic)	International	Chua	-19°45'41.16"	311°53'52.44"
Corrego Alegre (Brazil-Mapping)	International	Corrego Alegre	-19°50'15.140"	311°02'17.250"
Djakarta				
Dutch Datum				
Easter Island Astro. 1967				
Eftate				
European 1950	International	Helmert Tower	52°22'51.45"	13°03'58.74"
Gizo, Provisional DOS	International	GUX 1	-09°27'05.272"	159°58'31.752"
Graciosa Island (Azores)	International	SW Base	39°03'54.934"	331°57'36.118"
Guam 1963	Clarke 1866	Togcha Lee No. 7	13°22'38.49"	144°45'51.56"
Heard Astro. 1969				
Hu-Tzu-Shan				
Iben Astro, Navy 1947 (Truk)	Clarke 1866	Iben Astro	07°29'13.05"	151°49'44.42"
Indian	Everest	Kalianpur	24°07'11.26"	77°39'17.57"
Isla Socorra Astro	Clarke 1866	Station 038	18°43'44.93"	249°02'39.28"
Johnston Island 1961	International	Johnston Island 1961	16°44'49.729"	190°29'04.781"

Datum	Spheroid	Origin	Latitude	Longitude (E)
Kusaie, Astro 1962, 1965	International	Allen Sodano Light	05°21'48.80"	162°58'03.28"
Liberia 64 (Revised 78)				
Luzon 1911 (Philippines)	Clarke 1866	Balanacan	13°33'41.000"	121°52'03.000"
Merchich				
Mercury 1960	Fisher 1960	Geocentric		
Mercury - Modified 1968	Fisher 1968	Geocentric		
Midway Astro 1961	International	Midway Astro 1961	28°11'34.50"	182°36'24.28"
M'Poraloko				
Nahrwan Datum 1976				
Nanking 1960	International			
Naparima				
New French				
New Zealand	International	Papatahi	-14°19'08.900"	175°02'51.000"
Nigerian				
North American 1927	Clarke 1866	Meades Ranch	39°13'26.686"	261°27'29.494"
*NAD 1927 (Cape Canaveral)	Clarke 1866	Central	28°29'32.364"	279°25'21.230"
*NAD 1927 (White Sands)	Clarke 1866	Kent 1909	32°30'27.079"	253°31'01.306"
NAD 83	GRS 80	Geocentric		
Old Bavarian	Bessel	Munich	48°08'20.000"	11°34'26.483"
Old Hawaiian	Clarke 1866	Oahu West Base	21°18'13.89"	202°09'04.20"
Ordnance Survey G.B. 1936	Airy	Herstmonceux	50°51'55.271"	00°20'45.882"
Ordnance Survey G.B. 1970				
Pico de las Nieves (Canaries)	International	Pico de las Nieves	27°57'41.273"	344°25'49.476"
Pitcairn Island Astro	-----	-----	-----	-----
Potsdam	Bessel	Helmert Tower	52°22'53.954"	13°04'01.153"
Provisional S. American 1956	International	Lacamoia	08°34'17.17"	296°08'25.12"
Provisional S. Chile 1963	International	Hito XVIII	-64°67'07.76"	291°23'28.76"
Pulkovo 1942	Krassovski 42	Pulkovo Observatory	59°46'18.55"	30°19'42.09"
Qornoq (kornak)				
Russian 1938	Krassovski 38	Pulkovo Observatory		
S.A.O. C-5				
S.A.O. C-6				
S.A.O. C-7				
South American 1969	IUGG 1967	Geocentric	-----	-----
South Asia	Fisher 1960	Geocentric		
Southeast Island (Mahe)				
South Georgia Astro.				
Strasbourg Observatory	-----	-----	-----	-----
Swallow Islands (Solomons)	International	1966 Secor Astro	-10°18'21.42"	166°17'56.79"

Datum	Spheroid	Origin	Latitude	Longitude (E)
Tananarive	International	Tananarive Observatory	-18°55'02.10"	47°33'06.75"
Tokyo	Bessel	Tokyo Observatory (Old)	35°39'17.51"	139°44'40.50"
Trinidad Re (Old)				
Tristan Astro. 1968				
Viti Levu 1961 (Fiji)	Clarke 1880	Monavatu (Lat. Only)	-17°53'28.285"	
		Suva (Long. Only)		178°25'35.835"
Wake-Eniwetok 1960	Hough 1956			
Wake Island, Astronomic 1952	International	Astro 1952	19°16'48.7"	166°38'46.8"
WGS 66				
WGS 72	WGS 72	Geocentric		
WGS 84	GRS 80	Geocentric		
Yacare				
Yof Astro 1967 (Dakar)	Clarke 1880 Mod.	Yof Astro 1967	14°44'41.62"	342°30'52.98"

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GEODETIC DATUM SHIFT WORKING GEODETIC DATUM TO WGS 84

Listed below are the Datum Shift Parameters used in conversion from the Geodetic Datum to WGS 84.

NOTE: These values are not definitive and should be checked/changed in accordance with the local requirements and/or client approval.

Listed in alphabetical order of Datum.

The user should refer to the important notes following this table before using the data.

Geodetic Datum	Spheroid	diff X m.	diff Y m.	diff Z m.	Country/Area
Adindan	Clarke 1880 Mod.	-162	-12	206	Sudan
Aratu (Petrobras)*	International	-181	294	-149	Brazil (offshore)
ARC (Cape) 1950	Clarke 1880 Mod.	-143	-90	-294	Africa
Ascension Island Astro. 1958*	International	-214	91	48	
Austral. Geodetic	Austral. National	-133	-48	148	Australia
Bogota*	International	277	291	-328	Columbia
Bukit Rimpah	Bessel	-384	664	-48	**
Camp Area Astro	International	-104	-129	239	**
Campo Inchaupé	International	-148	136	90	Argentina
Canton Island Astro. 1966*	International	294	-288	-382	
Djakarta	Bessel	-377	681	-50	Indonesia
Eur. Datum 1950	International	-87	-98	-121	Europe
Geod. Datum 1949	International	84	-22	209	
Ghana	WGS 84	0	0	0	
Guam 1963	Clarke 1866	-100	-248	259	
G.Segara	Bessel	-403	684	41	**
G.Serindung	WGS 84	0	0	0	
Herat North	International	-333	-222	114	**
Hjorsey 1955	International	-73	46	-86	
Hu-Tzu-Shan	International	-634	-549	-201	Taiwan **
Indian	Everest 1830	173	750	264	India **
Indian	Everest 1830	208	841	295	Thailand Area**
Ireland (EIRE) 1965	Airy Mod.	506	-122	611	
Johnston Island Astro. 1961*	International	192	-59	-211	
Kertau (Malayan Rev. Triangulat.)	Everest Mod.	-11	851	5	
Liberia 64 (Rev78)	Clarke 1880 Mod.	-90	40	88	Liberia
Local Astro	?	0	0	0	?
Luzon	Clarke 1866	-133	-77	-54	
Luzon*	Clarke 1866	-129	-136	-39	S.Palawan Only
Luzon*	Clarke 1866	-95	-113	-60	NW.Palawan Only
Merchich	Clarke 1880 Mod.	31	146	47	Morocco
Mercury 1960*	Fisher 1960	-25	46	-49	NAD 27 Area
Mercury 1960*	Fisher 1960	13	-88	-5	ED Area
Mercury 1960*	Fisher 1960	18	-132	60	TD Area
Montjong Lowe	WGS 84	0	0	0	
Mod. Mercury 1968*	Fisher 1968	-4	12	-7	NAD 27 Area
Mod. Mercury 1968*	Fisher 1968	-3	1	-6	ED Area
Mod. Mercury 1968*	Fisher 1968	22	34	2	TD Area
M'Poraloko*	Clarke 1880 Mod.	-52	-155	27	Gabon
Nahrwan Datum*	Clarke 1880 Mod.	-	-	378.9	Middle East
Nanking 1960*	International	225.4	158.7	0	
		-131	-347		

Geodetic Datum	Spheroid	diff X m.	diff Y m.	diff Z m.	Country/Area
Naparima	International	-2	374	172	Trinidad
New French*	Clarke 1880 Mod.	-166	-66	313	France
Nigerian (Minna)	Clarke 1880 Mod.	-92	-93	122	Nigeria
N.A.D. 27 (Old)*	Clarke 1866	-22	157	176	North & Central
N.A.D. 27 (New)*	Clarke 1866	-22.5	154	173.4	America
N.A.D. 27	Clarke 1866	-5	135	172	Alaska
N.A.D. 27	Clarke 1866	-4	154	178	Bahamas (excluding San Salvador Island)
N.A.D. 27	Clarke 1866	1	140	165	San Salvador Island
N.A.D. 27	Clarke 1866	-10	158	187	Canada (including Newfoundland)
N.A.D. 27	Clarke 1866	0	125	201	Canal Zone
N.A.D. 27	Clarke 1866	-7	152	178	Caribbean (Barbados, Caicos Islands, Cuba, Dominican Republic, Grand Cayman, Jamaica, Leeward Islands, and Turks Islands)
N.A.D. 27	Clarke 1866	0	125	194	Central America (Belize, Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua)
N.A.D. 27	Clarke 1866	-9	152	178	Cuba
N.A.D. 27	Clarke 1866	11	114	195	Greenland (Hayes Peninsula)
N.A.D. 27	Clarke 1866	-12	130	190	Mexico
N.A.D. 27	Clarke 1866	-8	160	176	Conus (Mean Value)
Old Hawaiian	Airy	210	-230	-357	Maui **
Old Hawaiian	International	201	-224	-349	Oahu **
Old Hawaiian	International	190	-230	-341	Kauai **
Ordnance Survey G.B. 1936	International	375	-111	431	Gt.Britain-Land
P.S.A.D. 1956 (Old)*	WGS 84	-294	104	-366	S. America
P.S.A.D. 1956 (New)*	International	-288	175	-375	S. America
Qornoq (Kornak)	International	164	138	-189	Greenland
Sierra Leone 1960	Fisher 1960 S.Asia (155)	0	0	0	
S. American (Corrego Alegre)	International	-206	172	-6	
S. American (Chua Astro)	Bessel	-134	229	-29	
South Asia*	Bessel	21	-61	-15	
Tananarive Observatory 1925	?	-189	-242	-91	**
Timbalai	Clarke 1858 corr.	-639	583	-55	
Tokyo	Bessel	-128	481	664	Japan
Tokyo Special	Hough 1956	-128	491	664	?
Trinidad Re (Old)*	Hough 1956	-87	276	462	Trinidad
Voirol	Hough 1956	0	0	0	
Wake-Eniwetok 1960*	International	112	68	-44	Kwajalein Atoll
Wake-Eniwetok 1960*	International	121	62	-22	Wake Island
Wake-Eniwetok 1960*	WGS 72	144	62	-38	Eniwetok Atoll
Wake Island Astro. 1952*		283	-44	141	
Yacare		-155	171	37	Uruguay **
WGS 72		0	0	4.5	***

* Marion Speidel Keen Listed Transformation parameter are referenced to the WGS 72 geodetic datum and not WGS 84.

** Listed Transformation parameters were determined utilizing previously developed WGS 72 to local Geodetic Datum Transformation Parameters. These Parameters are of questionable accuracy due to lack of adequate doppler stations (if any) and/or appropriate information on either Geodetic connections or the local Geodetic System itself.

*** The Transformation achieved using these Parameters is not precise and is an approximation only.

**** No determined Transformation Parameters to date.

UNIVERSAL TRANSVERSE MERCATOR CONSTANTS

The Universal Transverse Mercator grid has the following specifications:

- a. Projection: Transverse Mercator (Gauss-Kruger type), in zones 6° wide.
- b. Spheroid: See Index to Spheroids.
- c. Longitude of origin: Central meridian of each zone.
- d. Latitude of origin: 0° (the Equator).
- e. Unit: Meter.
- f. False northing: 0 meters (10,000,000 for Southern Hemisphere).
- g. False easting: 500,000 meters.
- h. Scale factor at the central meridian: 0.9996.
- i. Zone numbering: Starting with 1 on the zone from 180°W. to 174° W., and increasing eastward to 60 on the zone from 174° E. to 180° E.
- j. Latitude limits of system:
 - North: 84° N.
 - South: 80° S.
- k. Limits of zones and overlap: The zones are bounded by meridians whose longitudes are multiples of 6°W. or E. of Greenwich. On large-scale maps and in trig lists an overlap of approximately 25 miles on either side of the junction is provided for engineer surveyors and for artillery survey and firing. This overlap is never used, however, in giving a grid reference.

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UNIVERSAL TRANSVERSE MERCATOR ZONE TABLE

The following tables show the U.T.M. Zone - Central Meridian (C.M.) and Longitudinal borders of the zones:

West of Greenwich Meridian		Longitudinal Borders	
U.T.M. Zone	Central Meridian (C.M.)	From	To
30	3 Degrees West	0 Degrees West	006 Degrees West
29	9 --- West	006 --- West	012 --- West
28	15 --- West	012 --- West	018 --- West
27	21 --- West	018 --- West	024 --- West
26	27 --- West	024 --- West	030 --- West
25	33 --- West	030 --- West	036 --- West
24	39 --- West	036 --- West	042 --- West
23	45 --- West	042 --- West	048 --- West
22	51 --- West	048 --- West	054 --- West
21	57 --- West	054 --- West	060 --- West
20	63 --- West	060 --- West	066 --- West
19	69 --- West	066 --- West	072 --- West
18	75 --- West	072 --- West	078 --- West
17	81 --- West	078 --- West	084 --- West
16	87 --- West	084 --- West	090 --- West
15	93 --- West	090 --- West	096 --- West
14	99 --- West	096 --- West	102 --- West
13	105 --- West	102 --- West	108 --- West
12	111 --- West	108 --- West	114 --- West
11	117 --- West	114 --- West	120 --- West
10	123 --- West	120 --- West	126 --- West
9	129 --- West	126 --- West	132 --- West
8	135 --- West	132 --- West	138 --- West
7	141 --- West	138 --- West	144 --- West
6	147 --- West	144 --- West	150 --- West
5	153 --- West	150 --- West	156 --- West
4	159 --- West	156 --- West	162 --- West
3	165 --- West	162 --- West	168 --- West
2	171 --- West	168 --- West	174 --- West
1	177 --- West	174 --- West	180 --- West

See accompanying Index to spheroids.

West of Greenwich Meridian		Longitudinal Borders	
U.T.M. Zone	Central Meridian (C.M.)	From	To
31	3 Degrees East	0 Degrees East	006 Degrees East
32	9 --- East	006 --- East	012 --- East
33	15 --- East	012 --- East	018 --- East
34	21 --- East	018 --- East	024 --- East
35	27 --- East	024 --- East	030 --- East
36	33 --- East	030 --- East	036 --- East
37	39 --- East	036 --- East	042 --- East
38	45 --- East	042 --- East	048 --- East
39	51 --- East	048 --- East	054 --- East
40	57 --- East	054 --- East	060 --- East
41	63 --- East	060 --- East	066 --- East
42	69 --- East	066 --- East	072 --- East
43	75 --- East	072 --- East	078 --- East
44	81 --- East	078 --- East	084 --- East
45	87 --- East	084 --- East	090 --- East
46	93 --- East	090 --- East	096 --- East
47	99 --- East	096 --- East	102 --- East
48	105 --- East	102 --- East	108 --- East
49	111 --- East	108 --- East	114 --- East
50	117 --- East	114 --- East	120 --- East
51	123 --- East	120 --- East	126 --- East
52	129 --- East	126 --- East	132 --- East
53	135 --- East	132 --- East	138 --- East
54	141 --- East	138 --- East	144 --- East
55	147 --- East	144 --- East	150 --- East
56	153 --- East	150 --- East	156 --- East
57	159 --- East	156 --- East	162 --- East
58	165 --- East	162 --- East	168 --- East
59	171 --- East	168 --- East	174 --- East
60	177 --- East	174 --- East	180 --- East

See accompanying Index to spheroids.

NOAA TECHNICAL PUBLICATIONS

The United States National Geodetic Survey (NGS), Office of Charting and Geodetic Services, National Ocean Service (NOS), and NOAA work together to maintain the basic national horizontal, vertical, and gravity control networks. These agencies also provide Government-wide leadership in the improvement of geodetic surveying methods and instrumentation, coordinate operations to assure network development, and provide specifications and criteria for survey operations undertaken by Federal, State, and other agencies.

NGS engages in research and development for the improvement of knowledge of the shape of the Earth and its gravity field. The NGS also has the responsibility to procure geodetic data from all sources, process these data, and make them generally available to users through a central data base.

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State Plane Lambert Conformal Conic Projection

Zone	First Standard Parallel	Second Standard Parallel	Longitude of Origin	Latitude of Origin	False North	False East (US Survey Feet)
Alaska 10	N51 50	N53 50	W176 00	N51 00	0	3,000,000
Arkansas North	N34 56	N36 14	W 92 00	N34 20	0	2,000,000
Arkansas South	N33 18	N34 46	W 92 00	N32 40	0	2,000,000
California 1	N40 00	N41 40	W122 00	N39 20	0	2,000,000
California 2	N38 20	N39 50	W122 00	N37 40	0	2,000,000
California 3	N37 04	N38 26	W120 30	N36 30	0	2,000,000
California 4	N36 00	N37 15	W119 00	N35 20	0	2,000,000
California 5	N34 02	N35 28	W118 00	N33 30	0	2,000,000
California 6	N32 47	N33 53	W116 15	N32 10	0	2,000,000
California 7	N33 52	N34 25	W118 20	N34 08	4,160,926.74	4,186,692.58
Colorado North	N39 43	N40 47	W105 30	N39 20	0	2,000,000
Colorado Central	N38 27	N39 45	W105 30	N37 50	0	2,000,000
Colorado South	N37 14	N38 26	W105 30	N36 40	0	2,000,000
Connecticut	N41 12	N41 52	W 72 45	N40 50	0	600,000
Florida North	N29 35	N30 45	W 84 30	N29 00	0	2,000,000
Iowa North	N42 04	N43 16	W 93 30	N41 30	0	2,000,000
Iowa South	N40 37	N41 47	W 93 30	N40 00	0	2,000,000
Kansas North	N38 43	N39 47	W 98 00	N38 20	0	2,000,000
Kansas South	N37 16	N38 34	W 98 30	N36 40	0	2,000,000
Kentucky North	N37 58	N38 58	W 84 15	N37 30	0	2,000,000
Kentucky South	N36 44	N37 56	W 85 45	N36 20	0	2,000,000
Louisiana North	N31 10	N32 40	W 92 30	N30 40	0	2,000,000
Louisiana South	N29 18	N30 42	W 91 20	N28 40	0	2,000,000
Louisiana Offshore	N26 10	N27 50	W 91 20	N25 40	0	2,000,000
Maryland	N38 18	N39 27	W 77 00	N37 50	0	800,000
Massachusetts						
Mainland	N41 43	N42 41	W 71 30	N41 00	0	600,000
Island	N41 17	N41 29	W 70 30	N41 00	0	200,000
Michigan (current)						
North	N45 29	N47 05	W 87 00	N44 47	0	2,000,000
Central	N44 11	N45 42	W 84 20	N43 19	0	2,000,000

State Plane Lambert Conformal Conic Projection						
Zone	First Standard Parallel	Second Standard Parallel	Longitude of Origin	Latitude of Origin	False North	False East (US Survey Feet)
South	N42 06	N43 40	W 84 20	N41 30	0	2,000,000
Minnesota North	N47 02	N48 38	W 93 06	N46 30	0	2,000,000
Minnesota Central	N45 37	N47 03	W 94 15	N45 00	0	2,000,000
Minnesota South	N43 47	N45 13	W 94 00	N43 00	0	2,000,000
Montana North	N47 00	N49 00	W109 30	N41 15	0	2,000,000
Montana Central	N46 27	N47 53	W109 30	N45 50	0	2,000,000
Montana South	N44 52	N46 24	W109 30	N44 00	0	2,000,000
Nebraska North	N41 51	N42 49	W100 00	N41 20	0	2,000,000
Nebraska South	N40 17	N41 43	W 99 30	N39 40	0	2,000,000
New York						
Long Island	N40 40	N41 02	W 74 00	N40 10	100,000	2,000,000
North Carolina	N34 20	N36 10	W 79 00	N33 45	0	2,000,000
North Dakota North	N47 26	N48 44	W100 30	N47 00	0	2,000,000
North Dakota South	N46 11	N47 29	W100 30	N45 40	0	2,000,000
Ohio North	N40 26	N41 42	W 82 30	N39 40	0	2,000,000
Ohio South	N38 44	N40 02	W 82 30	N38 00	0	2,000,000
Oklahoma North	N35 34	N36 46	W 98 00	N35 00	0	2,000,000
Oklahoma South	N33 56	N35 14	W 98 00	N33 20	0	2,000,000
Oregon North	N44 20	N46 00	W120 30	N43 40	0	2,000,000
Oregon South	N42 20	N44 00	W120 30	N41 40	0	2,000,000
Pennsylvania North	N40 53	N41 57	W 77 45	N40 10	0	2,000,000
Pennsylvania South	N39 56	N40 58	W77 45	N39 20	0	2,000,000
Puerto Rico & Virgin Islands 1	N18 02	N18 26	W 66 26	N17 50	0	
2 (St. Croix)	N18 02	N18 26	W 66 26	N17 50		
Samoa	N14 16		W170 00		0	2,000,000
South Carolina						
North	N33 46	N34 58	W 81 00	N33 00	0	2,000,000
South	N32 20	N33 40	W 81 00	N31 50	0	2,000,000
South Dakota North	N44 25	N45 41	W100 00	N43 50	0	2,000,000
South Dakota South	N42 50	N44 24	W100 20	N42 20	0	2,000,000

State Plane Lambert Conformal Conic Projection

Zone	First Standard Parallel	Second Standard Parallel	Longitude of Origin	Latitude of Origin	False North	False East (US Survey Feet)
Tennessee	N35 15	N36 25	W 86 00	N34 20	100,000	2,000,000
Texas North	N34 39	N36 11	W101 30	N34 00	0	2,000,000
Texas North Central	N32 08	N33 58	W 98 30	N31 40	0	2,000,000
Texas Central	N30 07	N31 53	W100 20	N29 40	0	2,000,000
Texas South Central	N28 23	N30 17	W 99 00	N27 50	0	2,000,000
Texas South	N26 10	N27 50	W 97 30	N25 40	0	2,000,000
Utah North	N40 43	N41 47	W111 30	N40 20	0	2,000,000
Utah Central	N39 01	N40 39	W111 30	N38 20	0	2,000,000
Utah South	N37 13	N38 21	W111 30	N36 40	0	2,000,000
Virginia North	N38 02	N39 12	W 78 30	N37 40	0	2,000,000
Virginia South	N36 46	N37 58	W 78 30	N36 20	0	2,000,000
Washington North	N47 30	N48 44	W120 50	N47 00	0	2,000,000
Washington South	N45 50	N47 20	W120 30	N45 20	0	2,000,000
West Virginia North	N39 00	N40 15	W 79 30	N38 30	0	2,000,000
West Virginia South	N37 29	N38 53	W 81 00	N37 00	0	2,000,000
Wisconsin North	N45 34	N46 46	W 90 00	N45 10	0	2,000,000
Wisconsin Central	N44 15	N45 30	W 90 00	N43 50	0	2,000,000
Wisconsin South	N42 44	N44 04	W 90 00	N42 00	0	2,000,000

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State Plane Transverse Mercator Projection

State Zone	Central Meridian	False Northing (ft)	False Easting (ft)	Scale Factor @ CM	Latitude of Origin
Alabama					
East	85°50'	0	500,000	0.9929960	30°30'
West	87°30'	0	500,000	0.999933	30°00'
Alaska					
Zone 1	---	0			
Zone 2	142°00'	0	500,000	0.999900	54°00'
Zone 3	146°00'	0	500,000	0.999900	54°00'
Zone 4	150°00'	0	500,000	0.999900	54°00'
Zone 5	154°00'	0	500,000	0.999900	54°00'
Zone 6	158°00'	0	500,000	0.999900	54°00'
Zone 7	162°00'		500,000	0.999900	54°00'
Zone 8	166°00'	0	500,000	0.999900	54°00'
Zone 9	170°00'	0	500,000	0.999900	54°00'
Zone 10	---				
Arizona					
East	110°10'	0	500,000	0.999900	31°00'
Central	111°55'	0	500,000	0.999900	31°00'
West	113°45'	0	500,000	0.999933	31°00'
Delaware	75°25'	0	500,000	0.999995	38°00'
Florida					
East	81°00'	0	500,000	0.999941	24°20'
West	82°00'	0	500,000	0.999941	24°20'
Georgia					
East	82°10'	0	500,000	0.999900	30°00'
West	84°10'	0	500,000	0.999900	30°00'
Hawaii					
Zone 1	155°30'	0	500,000	0.999966	18°50'
Zone 2	156°40'	0	500,000	0.999966	20°20'
Zone 3	158°00'	0	500,000	0.999990	21°10'
Zone 4	159°30'	0	500,000	0.999990	21°50'
Zone 5	160°10'	0	500,000	1.0	21°40'

State Plane Transverse Mercator Projection

State Zone	Central Meridian	False Northing (ft)	False Easting (ft)	Scale Factor @ CM	Latitude of Origin
Idaho					
East	112°10'	0	500,000	0.999947	41°40'
Central	114°00'	0	500,000	0.999947	41°40'
West	115°45'	0	500,000	0.999933	41°40'
Illinois					
East	88°20'	0	500,000	0.999975	36°40'
West	90°10'	0	500,000	0.999941	36°40'
Indiana					
East	85°40'	0	500,000	0.999966	37°30'
West	87°05'	0	500,000	0.999966	37°30'
Maine					
East	68°30'	0	500,000	0.999900	43°40'
West	70°10'	0	500,000	0.999966	42°50'
Michigan					
East (1934)	83°40'	0	500,000	0.999943	41°30'
Central (1934)	85°45'	0	500,000	0.999909	41°30'
West (1934)	88°45'	0	500,000	0.999909	41°30'
Mississippi					
East	88°50'	0	500,000	0.999960	29°30'
West	90°20'	0	500,000	0.999941	29°30'
Missouri					
East	90°30'	0	500,000	0.999933	35°50'
Central	92°30'	0	500,000	0.999933	35°50'
West	94°30'	0	500,000	0.999941	36°10'
Nevada					
East	115°35'	0	500,000	0.999900	34°45'
Central	116°40'	0	500,000	0.999900	34°45'
West	118°35'	0	500,000	0.999900	34°45'
New Hampshire	71°40'	0	500,000	0.999966	42°30'
New Jersey	74°30'	0	2,000,000	0.999975	38°50'
New Mexico					

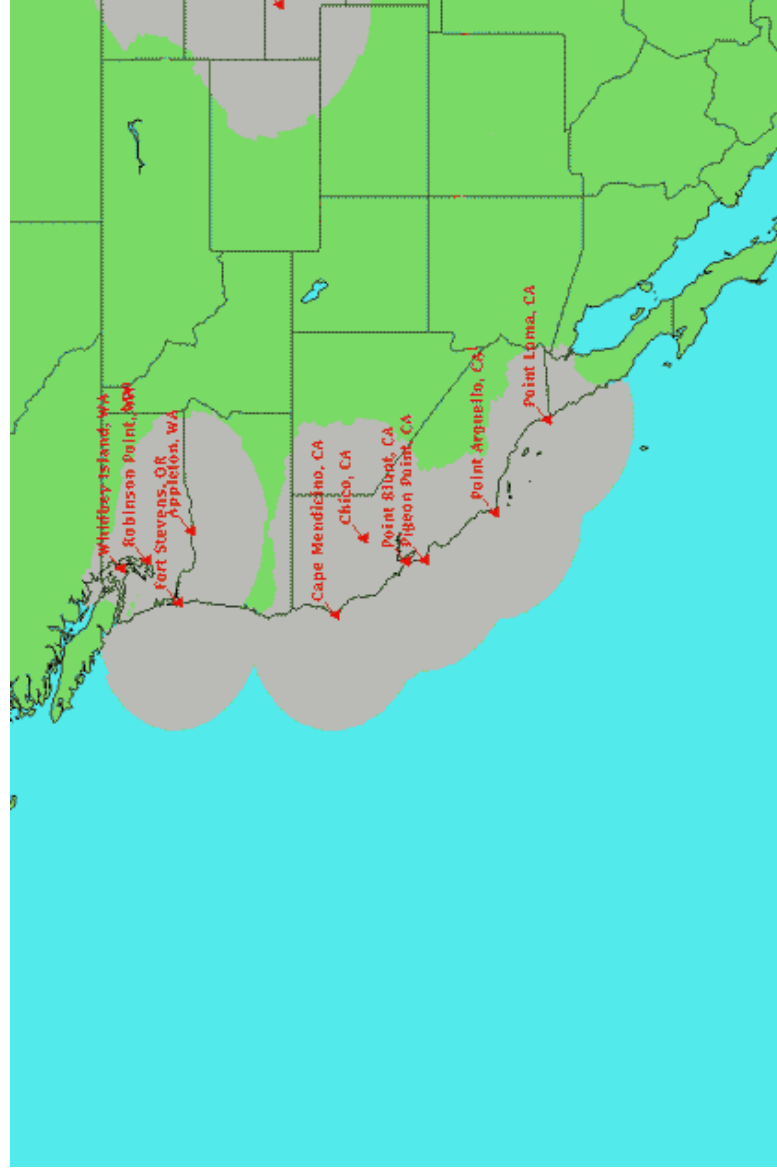
State Plane Transverse Mercator Projection

State Zone	Central Meridian	False Northing (ft)	False Easting (ft)	Scale Factor @ CM	Latitude of Origin
East	104°20'	0	500,000	0.999909	31°00'
Central	106°15'	0	500,000	0.999900	31°00'
West	107°50'	0	500,000	0.999916	31°00'
New York					
East	74°30'	0	500,000	0.999966	38°50'
Central	76°35'	0	500,000	0.999938	40°00'
West	78°35'	0	500,000	0.999938	40°00'
Rhode Island	71°30'	0	500,000	0.999994	41°05'
Vermont	72°30'	0	500,000	0.999964	42°30'
Wyoming					
Zone I	105°10'	0	500,000	0.999941	40°30'
Zone II	107°20'	0	500,000	0.999941	40°30'
Zone III	108°45'	0	500,000	0.999941	40°30'
Zone IV	110°05'	0	500,000	0.999941	40°30'

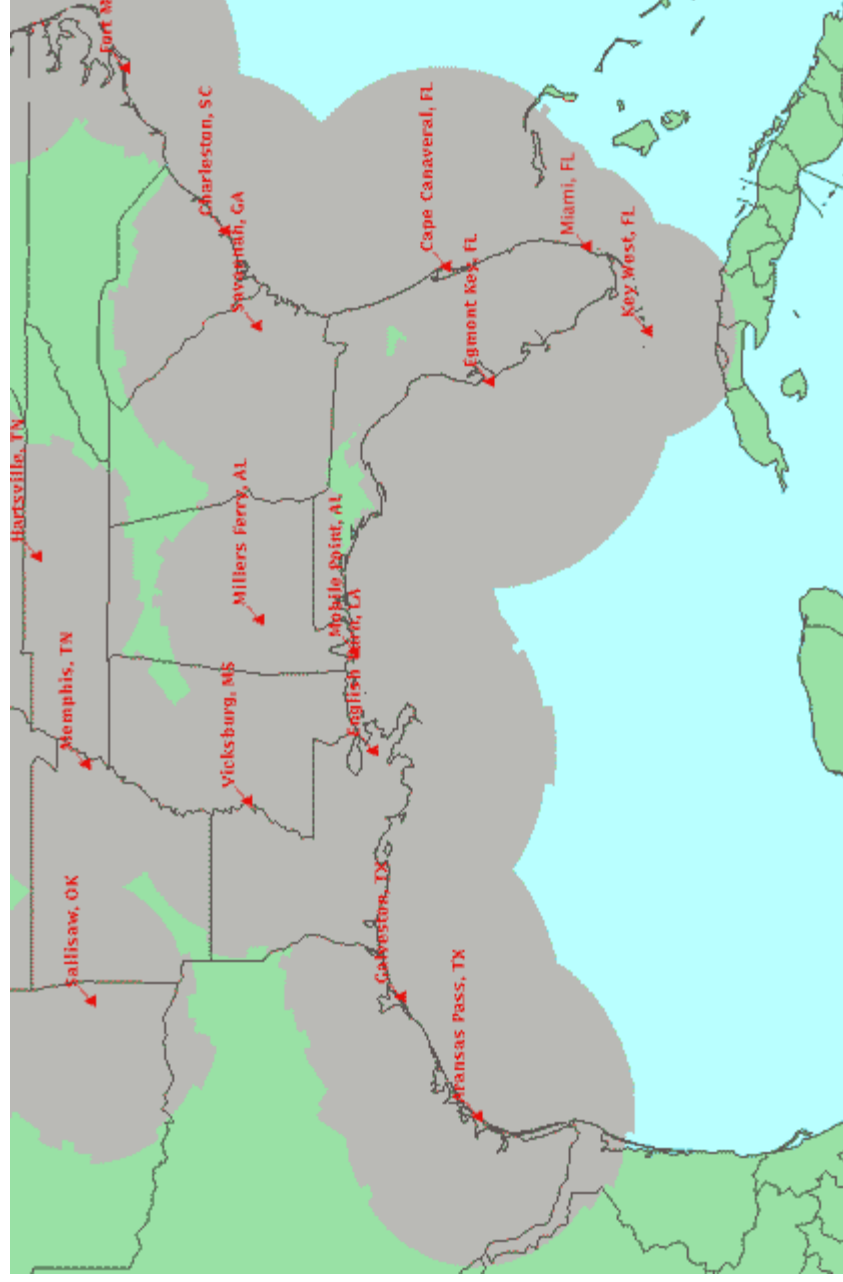
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United States Coast Guard DGPS Reference Station Coverage Maps

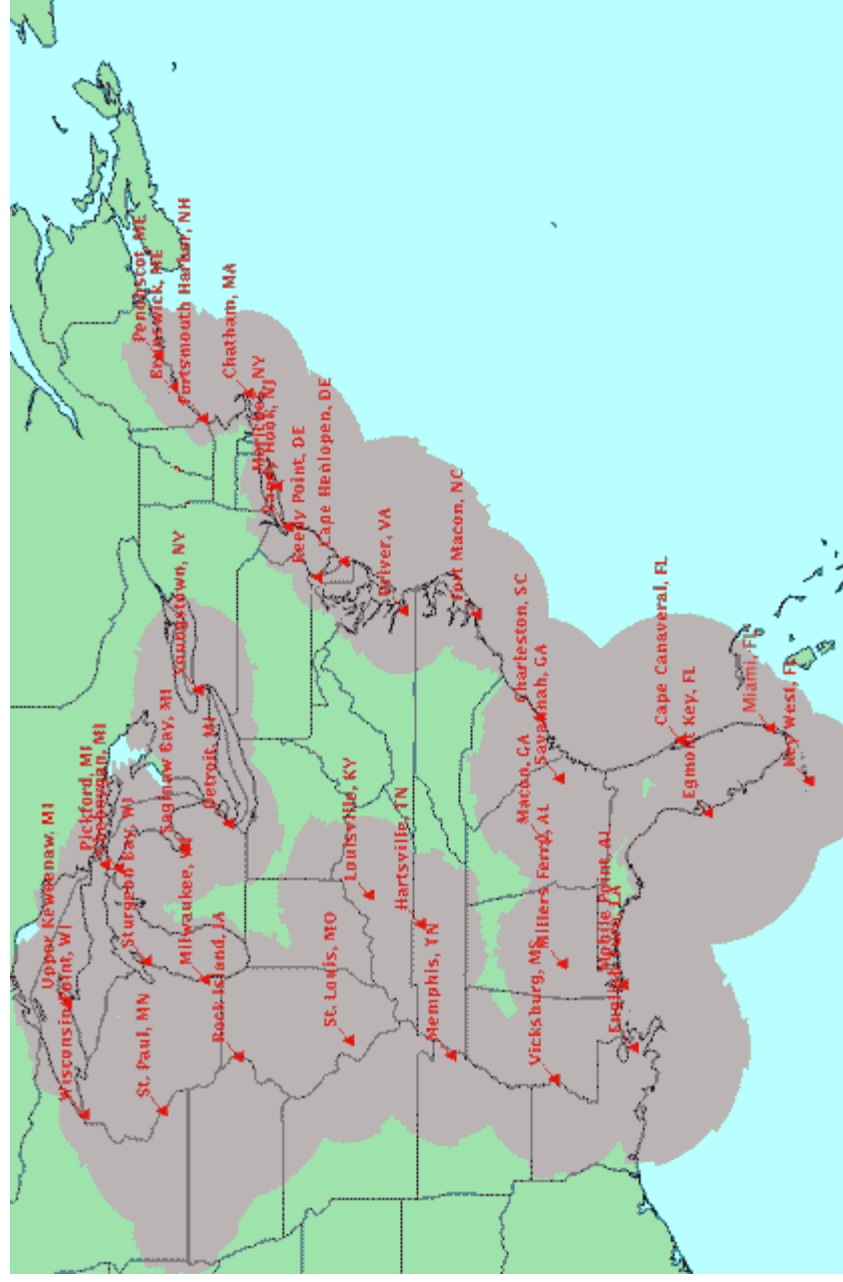
West Coast of United States



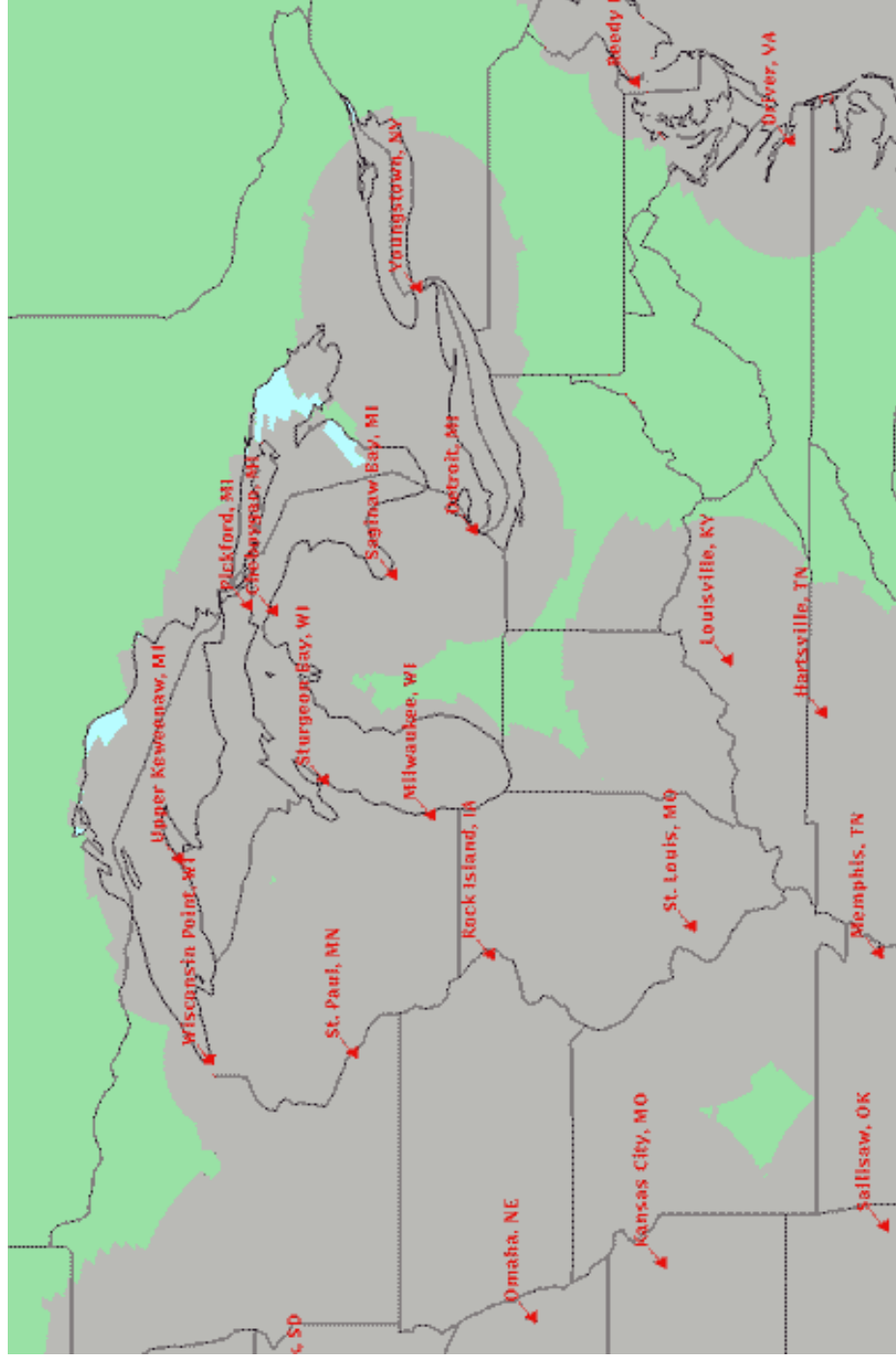
United States Gulf Coast



East Coast of the United States



Great Lakes Region of the United States



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DGPS BROADCAST SITE STATUS & OPERATING SPECIFICATIONS STATUS AS OF 4/24/00

Users should notify the NIS watchstander at (703)-313-5900 of any observed outages, problems or requests. The Coast Guard DGPS service is available for positioning and navigation. Users may experience service interruptions with out advance notice. Coast Guard DGPS broadcasts should not be used under any circumstances where a sudden system failure or inaccuracy could constitute a safety hazard.

Note: Differential corrections are based on the NAD83 position of the reference station (REFSTA) antenna. Positions obtained using DGPS should be referenced to NAD83 coordinate system only. All sites are broadcasting RTCM Type 9-3 correction messages.

All stations are listed in alphabetical order by city name.

ALEXANDRIA, VA

Status: Engineering Test Site
RBn Antenna Location: 38,45.2N;77, 7.7W
REFSTA Ant Location (A): 38,45.1863N;77, 7.6948W
REFSTA Ant Location (B): 38, 45.1872N;77, 7.6968W
REFSTA RTCM SC-104 ID (A): 40
REFSTA RTCM SC-104 ID (B): 41
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 820
Transmission Frequency: 305 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 35 NM

Users should note that transmissions from this site may be intermittent and turned off without warning.

ANNETTE ISLAND, AK

Status: Operational
RBn Antenna Location: 55,4.1N;131, 36W
REFSTA Ant Location (A): 55,4.1441N;131, 35.97093W
REFSTA Ant Location (B): 55, 4.13276N;131, 35.95144W
REFSTA RTCM SC-104 ID (A): 278
REFSTA RTCM SC-104 ID (B): 279
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 889
Transmission Frequency: 323 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 170 NM

APPLETON, WA

Status: Operational
RBn Antenna Location: 45,46.53N;121, 19.33W
REFSTA Ant Location (A): 45,46.95769N;121, 19.65281W
REFSTA Ant Location (B): 45, 46.95741N;121, 19.63429W
REFSTA RTCM SC-104 ID (A): 172
REFSTA RTCM SC-104 ID (B): 173
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 871
Transmission Frequency: 300 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 250 SM

ARANSAS PASS, TX

Status: Operational
RBn Antenna Location: 27,50.3N;97, 3.5W
REFSTA Ant Location (A): 27,50.30083N;97, 3.53698W
REFSTA Ant Location (B): 27, 50.30169N;97, 3.55349W
REFSTA RTCM SC-104 ID (A): 32
REFSTA RTCM SC-104 ID (B): 33
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 816
Transmission Frequency: 304 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

BIORKA ISLAND, AK

Status: Operational
RBn Antenna Location: 56,51.5N;135, 32.13W
REFSTA Ant Location (A): 56,51.26931N;135, 32.35636W
REFSTA Ant Location (B): 56, 51.25868N;135, 32.37328W
REFSTA RTCM SC-104 ID (A): 280
REFSTA RTCM SC-104 ID (B): 281
REFSTA FIRMWARE VERSION:
Broadcast Site ID: 890
Transmission Frequency: 305 KHZ
Transmission Rate: 100 BPS
Signal Strength:

BRUNSWICK, ME

Status: Operational
RBn Antenna Location: 43,53.4N;69, 56.8W
REFSTA Ant Location (A): 43,53.38844N;69, 56.79444W
REFSTA Ant Location (B): 43, 53.38191N;69, 56.7981W
REFSTA RTCM SC-104 ID (A): 42
REFSTA RTCM SC-104 ID (B): 43
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 800
Transmission Frequency: 316 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 200 NM

C2CEN, PORTSMOUTH, VA

Status: Engineering Test Site
RBn Antenna Location: 36,52.9N;76, 21.7W
REFSTA Ant Location (A): 36,52.93998N;76, 21.70412W
REFSTA Ant Location (B): 36, 52.94035N;76, 21.72466W
REFSTA RTCM SC-104 ID (A): 42
REFSTA RTCM SC-104 ID (B): 43
REFSTA FIRMWARE VERSION: RC00-IC19
Broadcast Site ID: 821
Transmission Frequency: 313 KHZ
Transmission Rate: 200 BPS
Signal Strength: 75uV at 75 NM

**Users should note that transmissions from this site
may be intermittent and turned off without warning.**

CAPE CANAVERAL, FL

Status: Operational
RBn Antenna Location: 28,27.6N;80, 32.6W
REFSTA Ant Location (A): 28,27.59506N;80, 32.59693W
REFSTA Ant Location (B): 28, 27.62215N;80, 32.57255W
REFSTA RTCM SC-104 ID (A): 18
REFSTA RTCM SC-104 ID (B): 19
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 809
Transmission Frequency: 289 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 200 NM

CAPE HENLOPEN, DE

Status: Operational
RBn Antenna Location: 38,46.6N;75, 5.3W
REFSTA Ant Location (A): 38,46.60679N;75, 5.26105W
REFSTA Ant Location (B): 38, 46.6115N;75, 5.23496W
REFSTA RTCM SC-104 ID (A): 10
REFSTA RTCM SC-104 ID (B): 11
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 805
Transmission Frequency: 298 KHZ
Transmission Rate: 200 BPS
Signal Strength: 75uV at 180 NM

CAPE HINCHINBROOK, AK

Status: Operational
RBn Antenna Location: 60,14.3N;146, 38.8W
REFSTA Ant Location (A): 60,14.24813N;146, 38.81767W
REFSTA Ant Location (B): 60, 14.24604N;146, 38.80669W
REFSTA RTCM SC-104 ID (A): 288
REFSTA RTCM SC-104 ID (B): 289
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 894
Transmission Frequency: 292 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 120 NM

CAPE MENDOCINO, CA

Status: Operational
RBn Antenna Location: 40,26.4N;124, 24.4W
REFSTA Ant Location (A): 40,26.506N;124, 23.77909W
REFSTA Ant Location (B): 40, 26.48393N;124, 23.77879W
REFSTA RTCM SC-104 ID (A): 270
REFSTA RTCM SC-104 ID (B): 271
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 885
Transmission Frequency: 292 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

CHARLESTON, SC

Status: Operational
RBn Antenna Location: 32,45.4N;79, 50.5W
REFSTA Ant Location (A): 32,45.45357N;79, 50.57225W
REFSTA Ant Location (B): 32, 45.44787N;79, 50.5904W
REFSTA RTCM SC-104 ID (A): 16
REFSTA RTCM SC-104 ID (B): 17
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 808
Transmission Frequency: 298 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 150 NM

CHATHAM, MA

Status: Operational
RBn Antenna Location: 41,40.3N;69, 57W
REFSTA Ant Location (A): 41,40.27164N;69, 57.0027W
REFSTA Ant Location (B): 41, 40.26596N;69, 56.98455W
REFSTA RTCM SC-104 ID (A): 4
REFSTA RTCM SC-104 ID (B): 5
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 802
Transmission Frequency: 325 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 95 NM

CHEBOYGAN, MI

Status: Operational
RBn Antenna Location: 45,39.2N;84, 27.9W
REFSTA Ant Location (A): 45,39.2091N;84, 27.93836W
REFSTA Ant Location (B): 45, 39.22135N;84, 27.95027W
REFSTA RTCM SC-104 ID (A): 112
REFSTA RTCM SC-104 ID (B): 113
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 836
Transmission Frequency: 292 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 110 SM

CHICO, CA

Status: Operational
RBn Antenna Location: 39,25.8N;121, 36W
REFSTA Ant Location (A): 39,25.95802N;121, 39.89677W
REFSTA Ant Location (B): 39, 25.97251N;121, 39.89205W
REFSTA RTCM SC-104 ID (A): 256
REFSTA RTCM SC-104 ID (B): 257
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 878
Transmission Frequency: 318 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 250SM

CLARK, SD

Status: Operational
RBn Antenna Location: 44,55.8N;97, 57.6W
REFSTA Ant Location (A): 44,56.13681N;97, 57.640662W
REFSTA Ant Location (B): 44, 56.12209N;97, 57.64124W
REFSTA RTCM SC-104 ID (A): 146
REFSTA RTCM SC-104 ID (B): 147
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 850
Transmission Frequency: 309 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75 uV

COLD BAY, AK

Status: Operational
RBn Antenna Location: 55,5.5N;162, 31.9W
REFSTA Ant Location (A): 55,11.41638N;162, 42.42832W
REFSTA Ant Location (B): 55, 11.42518N;162, 42.40463W
REFSTA RTCM SC-104 ID (A): 296
REFSTA RTCM SC-104 ID (B): 297
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 898
Transmission Frequency: 289 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

DETROIT, MI

Status: Operational
RBn Antenna Location: 42,17.8N;83, 5.7W
REFSTA Ant Location (A): 42,17.84042N;83, 5.7175W
REFSTA Ant Location (B): 42, 17.83364N;83, 5.73171W
REFSTA RTCM SC-104 ID (A): 116
REFSTA RTCM SC-104 ID (B): 117
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 838
Transmission Frequency: 319 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 100 SM

DRIVER, VA

Status: Operational
RBn Antenna Location: 36,57N;76, 33W
REFSTA Ant Location (A): 36,57.51893N;76, 33.39837W
REFSTA Ant Location (B): 36, 57.50929N;76, 33.38688W
REFSTA RTCM SC-104 ID (A): 12
REFSTA RTCM SC-104 ID (B): 13
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 806
Transmission Frequency: 289 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 130 NM

EGMONT KEY, FL

Status: Operational
RBn Antenna Location: 27,36N;82, 45.6W
REFSTA Ant Location (A): 27,36.02475N;82, 45.61913W
REFSTA Ant Location (B): 27, 36.05126N;82, 45.63576W
REFSTA RTCM SC-104 ID (A): 24
REFSTA RTCM SC-104 ID (B): 25
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 812
Transmission Frequency: 312 KHZ
Transmission Rate: 200 BPS
Signal Strength: 75uV at 210 NM

ENGLISH TURN, LA

Status: Operational
RBn Antenna Location: 29,52.7N;89, 56.5W
REFSTA Ant Location (A): 29,52.73743N;89, 56.50329W
REFSTA Ant Location (B): 29, 52.75074N;89, 56.52474W
REFSTA RTCM SC-104 ID (A): 28
REFSTA RTCM SC-104 ID (B): 29
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 814
Transmission Frequency: 293 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 170 NM

FORT MACON, NC

Status: Operational
RBn Antenna Location: 34,41.8N;76, 41W
REFSTA Ant Location (A): 34,41.84333N;76, 40.98706W
REFSTA Ant Location (B): 34, 41.85661N;76, 40.99206W
REFSTA RTCM SC-104 ID (A): 14
REFSTA RTCM SC-104 ID (B): 15
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 807
Transmission Frequency: 294 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 130 NM

FORT STEVENS, OR

Status: Operational
RBn Antenna Location: 46,12.3N;123, 57.4W
REFSTA Ant Location (A): 46,12.29295N;123, 57.36477W
REFSTA Ant Location (B): 46, 12.30947N;123, 57.35981W
REFSTA RTCM SC-104 ID (A): 272
REFSTA RTCM SC-104 ID (B): 273
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 886

Transmission Frequency: 287 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

GALVESTON, TX

Status: Operational
RBn Antenna Location: 29,19.8N;94, 44.2W
REFSTA Ant Location (A): 29,19.79254N;94, 44.20809W
REFSTA Ant Location (B): 29, 19.80391N;94, 44.2005W
REFSTA RTCM SC-104 ID (A): 30
REFSTA RTCM SC-104 ID (B): 31
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 815
Transmission Frequency: 296 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

GUSTAVUS, AK

Status: Operational
RBn Antenna Location: 58,25.1N;135, 41.8W
REFSTA Ant Location (A): 58,25.049N;135, 41.83917W
REFSTA Ant Location (B): 58, 25.06524N;135, 41.8217W
REFSTA RTCM SC-104 ID (A): 284
REFSTA RTCM SC-104 ID (B): 285
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 892
Transmission Frequency: 288 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 170 NM

HARTSVILLE, TN

Status: Operational
RBn Antenna Location: 36,24.61N;86, 5.37W
REFSTA Ant Location (A): 36,21.46215N;86, 5.36999W
REFSTA Ant Location (B): 36, 21.4561N;86, 5.38478W
REFSTA RTCM SC-104 ID (A): 144
REFSTA RTCM SC-104 ID (B): 145
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 858
Transmission Frequency: 317 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75 uV

ISABELA, PR

Status: Operational
RBn Antenna Location: 18,27.7N;67, 4W
REFSTA Ant Location (A): 18,27.77837N;67, 4.01759W
REFSTA Ant Location (B): 18, 27.7913N;67, 4.01031W
REFSTA RTCM SC-104 ID (A): 34
REFSTA RTCM SC-104 ID (B): 35
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 817
Transmission Frequency: 295 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 125 NM

KANSAS CITY, MO

Status: Operational
RBn Antenna Location: 39,7.04N;95, 24.53W
REFSTA Ant Location (A): 39,7.55229N;95, 24.12556W
REFSTA Ant Location (B): 39, 7.55268N;95, 24.08916W
REFSTA RTCM SC-104 ID (A): 164
REFSTA RTCM SC-104 ID (B): 165
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 867
Transmission Frequency: 305 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 100SM

KENAI, AK

Status: Operational
RBn Antenna Location: 60,40.1N;151, 21W
REFSTA Ant Location (A): 60,40.50477N;151, 21.00955W
REFSTA Ant Location (B): 60, 40.48834N;151, 21.00847W
REFSTA RTCM SC-104 ID (A): 292
REFSTA RTCM SC-104 ID (B): 293
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 896
Transmission Frequency: 310 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 170 NM

KEY WEST, FL

Status: Operational
RBn Antenna Location: 24,34.94N;81, 39.18W
REFSTA Ant Location (A): 24,34.93608N;81, 39.18175W
REFSTA Ant Location (B): 24, 34.93819N;81, 39.1675W
REFSTA RTCM SC-104 ID (A): 22
REFSTA RTCM SC-104 ID (B): 23
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 811
Transmission Frequency: 286 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 110 NM

KODIAK, AK

Status: Operational
RBn Antenna Location: 57,37.1N;152, 11.6W
REFSTA Ant Location (A): 57,37.06143N;152, 11.60436W
REFSTA Ant Location (B): 57, 37.05542N;152, 11.6315W
REFSTA RTCM SC-104 ID (A): 294
REFSTA RTCM SC-104 ID (B): 295
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 897
Transmission Frequency: 313 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

KOKOLE POINT, HI

Status: Operational
RBn Antenna Location: 21,59N;159, 45.5W
REFSTA Ant Location (A): 21,59.00909N;159, 45.48866W
REFSTA Ant Location (B): 21, 59.02585N;159, 45.49402W
REFSTA RTCM SC-104 ID (A): 260
REFSTA RTCM SC-104 ID (B): 261
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 880
Transmission Frequency: 300 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 300 NM

LOUISVILLE, KY

Status: Operational
RBn Antenna Location: 38,0.6N;85, 17.9W
REFSTA Ant Location (A): 38,0.61772N;85, 17.92857W
REFSTA Ant Location (B): 38, 0.6318N;85, 17.92233W
REFSTA RTCM SC-104 ID (A): 168
REFSTA RTCM SC-104 ID (B): 169
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 869
Transmission Frequency: 290 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 150 SM

MACON, GA

Status: Operational
RBn Antenna Location: 32,41.67371N;83, 33.61953W
REFSTA Ant Location (A): 32,41.71904N;83, 33.63296W
REFSTA Ant Location (B): 32, 41.72335N;83, 33.61694W
REFSTA RTCM SC-104 ID (A): 48
REFSTA RTCM SC-104 ID (B): 49
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 822
Transmission Frequency: 301 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100 uV at 186 SM

MEMPHIS, TN

Status: Operational
RBn Antenna Location: 35,27.9N;90, 12.3W
REFSTA Ant Location (A): 35,27.9459N;90, 12.34071W
REFSTA Ant Location (B): 35, 27.94205N;90, 12.36248W
REFSTA RTCM SC-104 ID (A): 152
REFSTA RTCM SC-104 ID (B): 153
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 861
Transmission Frequency: 310 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 130 SM

MIAMI, FL

Status: Operational
RBn Antenna Location: 25,44N;80, 9.6W
REFSTA Ant Location (A): 25,43.96829N;80, 9.61001W
REFSTA Ant Location (B): 25, 43.96653N;80, 9.63006W
REFSTA RTCM SC-104 ID (A): 20
REFSTA RTCM SC-104 ID (B): 21
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 810
Transmission Frequency: 322 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 75 NM

MILLERS FERRY, AL

Status: Operational
RBn Antenna Location: 32,5.4N;87, 23.5W
REFSTA Ant Location (A): 32,5.41528N;87, 23.50842W
REFSTA Ant Location (B): 32, 5.43106N;87, 23.5329W
REFSTA RTCM SC-104 ID (A): 160
REFSTA RTCM SC-104 ID (B): 161
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 865
Transmission Frequency: 320 KHZ
Transmission Rate: 200 BPS
Signal Strength: 75uV at 150 SM

MILWAUKEE, WI

Status: Operational
RBn Antenna Location: 43,0.1N;87, 53.3W
REFSTA Ant Location (A): 43,0.1517N;87, 53.30645W
REFSTA Ant Location (B): 43, 0.14138N;87, 53.29264W
REFSTA RTCM SC-104 ID (A): 106
REFSTA RTCM SC-104 ID (B): 107
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 833
Transmission Frequency: 297 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 140 SM

MOBILE POINT, AL

Status: Operational
RBn Antenna Location: 30,13.7N;88, 1.4W
REFSTA Ant Location (A): 30,13.65077N;88, 1.44588W
REFSTA Ant Location (B): 30, 13.65101N;88, 1.45433W
REFSTA RTCM SC-104 ID (A): 26
REFSTA RTCM SC-104 ID (B): 27
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 813
Transmission Frequency: 300 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 170 NM

MORICHES, NY

Status: Operational
RBn Antenna Location: 40,47.4N;72, 44.7W
REFSTA Ant Location (A): 40,47.37101N;72, 44.77734W
REFSTA Ant Location (B): 40, 47.36376N;72, 44.79783W
REFSTA RTCM SC-104 ID (A): 6
REFSTA RTCM SC-104 ID (B): 7
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 803
Transmission Frequency: 293 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 130 NM

OMAHA, NE

Status: Operational
RBn Antenna Location: 41,46.7N;95, 55.7W
REFSTA Ant Location (A): 41,46.69653N;95, 55.67836W
REFSTA Ant Location (B): 41, 46.71005N;95, 55.68953W
REFSTA RTCM SC-104 ID (A): 166
REFSTA RTCM SC-104 ID (B): 167
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 868
Transmission Frequency: 298 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 150 SM

PENOBSCOT, ME

Status: Operational
RBn Antenna Location: 44,27.1N;68, 46.3W
REFSTA Ant Location (A): 44,27.102975N;68, 46.33059W
REFSTA Ant Location (B): 44, 27.120789N;68, 46.332671W
REFSTA RTCM SC-104 ID (A): 44
REFSTA RTCM SC-104 ID (B): 45
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 799
Transmission Frequency: 290 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 65 SM

PICKFORD, MI

Status: Operational
RBn Antenna Location: 46,3.9N;84, 21.7W
REFSTA Ant Location (A): 46,3.88482N;84, 21.71027W
REFSTA Ant Location (B): 46, 3.89792N;84, 21.71806W
REFSTA RTCM SC-104 ID (A): 110
REFSTA RTCM SC-104 ID (B): 111
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 835
Transmission Frequency: 309 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 60 SM

PIGEON POINT, CA

Status: Operational
RBn Antenna Location: 37,11.2N;122, 23.4W
REFSTA Ant Location (A): 37,11.22469N;122, 23.39607W
REFSTA Ant Location (B): 37, 11.20933N;122, 23.38592W
REFSTA RTCM SC-104 ID (A): 266
REFSTA RTCM SC-104 ID (B): 267
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 883
Transmission Frequency: 287 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

POINT BLUNT, CA

Status: Operational
RBn Antenna Location: 37,51.1899N;122, 25.1439W
REFSTA Ant Location (A): 37,51.1829N;122, 25.13582W
REFSTA Ant Location (B): 37, 51.19319N;122, 25.16276W
REFSTA RTCM SC-104 ID (A): 268
REFSTA RTCM SC-104 ID (B): 269
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 884
Transmission Frequency: 310 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 60 NM

POINT LOMA, CA

Status: Operational
RBn Antenna Location: 32,39.9N;117, 14.6W
REFSTA Ant Location (A): 32,39.92483N;117, 14.58074W
REFSTA Ant Location (B): 32, 39.93658N;117, 14.58965W
REFSTA RTCM SC-104 ID (A): 262
REFSTA RTCM SC-104 ID (B): 263
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 881
Transmission Frequency: 302 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

PORTSMOUTH HARBOR, NH

Status: Operational
RBn Antenna Location: 43,4.3N;70, 42.6W
REFSTA Ant Location (A): 43,4.25693N;70, 42.59104W
REFSTA Ant Location (B): 43, 4.26058N;70, 42.57152W
REFSTA RTCM SC-104 ID (A): 2
REFSTA RTCM SC-104 ID (B): 3
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 801
Transmission Frequency: 288 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 100 NM

POTATO POINT, AK

Status: Operational
RBn Antenna Location: 61,3.4N;146, 41.8W
REFSTA Ant Location (A): 61,3.38794N;146, 41.83412W

REFSTA Ant Location (B): 61, 3.38057N;146, 41.79811W
REFSTA RTCM SC-104 ID (A): 290
REFSTA RTCM SC-104 ID (B): 291
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 895
Transmission Frequency: 298 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 100 NM

REEDY POINT, DE

Status: Operational
RBn Antenna Location: 39,33.68N;75, 34.19W
REFSTA Ant Location (A): 39,33.68662N;75, 34.19873W
REFSTA Ant Location (B): 39, 33.70062N;75, 34.19702W
REFSTA RTCM SC-104 ID (A): 170
REFSTA RTCM SC-104 ID (B): 171
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 870
Transmission Frequency: 309 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 70 SM

ROBINSON POINT, WA

Status: Operational
RBn Antenna Location: 47,23.3N;122, 22.5W
REFSTA Ant Location (A): 47,23.25008N;122, 22.48503W
REFSTA Ant Location (B): 47, 23.23194N;122, 22.49946W
REFSTA RTCM SC-104 ID (A): 274
REFSTA RTCM SC-104 ID (B): 275
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 887
Transmission Frequency: 323 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 60 NM

ROCK ISLAND, IL

Status: Operational
RBn Antenna Location: 42,0.3N;90, 14.11W
REFSTA Ant Location (A): 42,0.73636N;90, 13.53673W
REFSTA Ant Location (B): 42, 0.73806N;90, 13.50136W
REFSTA RTCM SC-104 ID (A): 156
REFSTA RTCM SC-104 ID (B): 157
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 863
Transmission Frequency: 311 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 150 SM

SAGINAW BAY, MI

Status: Operational
RBn Antenna Location: 43,37.7N;83, 50.3W
REFSTA Ant Location (A): 43,37.71816N;83, 50.26568W
REFSTA Ant Location (B): 43, 37.70178N;83, 50.26467W
REFSTA RTCM SC-104 ID (A): 114
REFSTA RTCM SC-104 ID (B): 115
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 837
Transmission Frequency: 301 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 85 SM

SALLISAW, OK

Status: Operational
RBn Antenna Location: 35,22N;94, 49W
REFSTA Ant Location (A): 35,22.02434N;94, 48.99516W
REFSTA Ant Location (B): 35, 22.03651N;94, 48.97999W
REFSTA RTCM SC-104 ID (A): 162
REFSTA RTCM SC-104 ID (B): 163
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 866
Transmission Frequency: 299 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100 uV at 100 SM

SANDY HOOK, NJ

Status: Operational
RBn Antenna Location: 40,28.3N;74, 0.7W
REFSTA Ant Location (A): 40,28.28903N;74, 0.69571W
REFSTA Ant Location (B): 40, 28.29046N;74, 0.71141W
REFSTA RTCM SC-104 ID (A): 8
REFSTA RTCM SC-104 ID (B): 9
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 804
Transmission Frequency: 286 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 100 NM

SAVANNAH, GA

Status: Operational
RBn Antenna Location: 32,8.4N;81, 42W
REFSTA Ant Location (A): 32,8.3156N;81, 41.77983W
REFSTA Ant Location (B): 32, 8.3227N;81, 41.79519W
REFSTA RTCM SC-104 ID (A): 36
REFSTA RTCM SC-104 ID (B): 37
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 818
Transmission Frequency: 319 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 185 SM

ST LOUIS, MO

Status: Operational
RBn Antenna Location: 38,36.7N;89, 45.5W
REFSTA Ant Location (A): 38,36.67847N;89, 45.53318W
REFSTA Ant Location (B): 38, 36.66488N;89, 45.5209W
REFSTA RTCM SC-104 ID (A): 154
REFSTA RTCM SC-104 ID (B): 155
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 862
Transmission Frequency: 322 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 115 SM

ST PAUL, MN

Status: Operational
RBn Antenna Location: 44,18.2N;91, 54.2W
REFSTA Ant Location (A): 44,18.23647N;91, 54.19788W
REFSTA Ant Location (B): 44, 18.22143N;91, 54.19248W
REFSTA RTCM SC-104 ID (A): 158
REFSTA RTCM SC-104 ID (B): 159
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 864
Transmission Frequency: 317 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 150 SM

STURGEON BAY, WI

Status: Operational
RBn Antenna Location: 44,47.7N;87, 18.9W
REFSTA Ant Location (A): 44,47.72863N;87, 18.85942W
REFSTA Ant Location (B): 44, 47.72345N;87, 18.86648W
REFSTA RTCM SC-104 ID (A): 104
REFSTA RTCM SC-104 ID (B): 105
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 832
Transmission Frequency: 322 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 110 SM

UPOLU POINT, HI

Status: Operational
RBn Antenna Location: 20,14.8N;155, 53W
REFSTA Ant Location (A): 20,14.75277N;155, 53.02759W
REFSTA Ant Location (B): 20, 14.77183N;155, 53.01227W
REFSTA RTCM SC-104 ID (A): 258
REFSTA RTCM SC-104 ID (B): 259
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 879
Transmission Frequency: 286 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 170 NM

UPPER KEWEENAW, MI

Status: Operational
RBn Antenna Location: 47,13.6N;88, 37.4W
REFSTA Ant Location (A): 47,13.62344N;88, 37.45902W
REFSTA Ant Location (B): 47, 13.63748N;88, 37.44625W
REFSTA RTCM SC-104 ID (A): 102
REFSTA RTCM SC-104 ID (B): 103
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 831
Transmission Frequency: 298 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 130 SM

VANDENBERG AFB, CA

Status: Operational
RBn Antenna Location: 34,49.517N;120, 33.867W
REFSTA Ant Location (A): 34,49.596434N;120, 33.80945W
REFSTA Ant Location (B): 34, 49.587103N;120, 33.796526W

REFSTA RTCM SC-104 ID (A): 264
REFSTA RTCM SC-104 ID (B): 265
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 882
Transmission Frequency: 321 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 180 NM

VICKSBURG, MS

Status: Operational
RBn Antenna Location: 32,19.9N;90, 55.2W
REFSTA Ant Location (A): 32,19.8848N;90, 55.18705W
REFSTA Ant Location (B): 32, 19.87481N;90, 55.17626W
REFSTA RTCM SC-104 ID (A): 150
REFSTA RTCM SC-104 ID (B): 151
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 860
Transmission Frequency: 313 KHZ
Transmission Rate: 200 BPS
Signal Strength: 100uV at 115 SM

WHIDBEY ISLAND, WA

Status: Operational
RBn Antenna Location: 48,18.8N;122, 41.8W
REFSTA Ant Location (A): 48,18.76266N;122, 41.76763W
REFSTA Ant Location (B): 48, 18.74625N;122, 41.76766W
REFSTA RTCM SC-104 ID (A): 276
REFSTA RTCM SC-104 ID (B): 277
REFSTA FIRMWARE VERSION: RD00-1C19

Broadcast Site ID: 888
Transmission Frequency: 302 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 90 NM

WHITEFISH POINT, MI

Status: Decommissioned
RBn Antenna Location: 46,46.3N;84, 57.5W
REFSTA Ant Location (A): 46,46.2772N;84, 57.48152W
REFSTA Ant Location (B): 46, 46.28634N;84, 57.46617W
REFSTA RTCM SC-104 ID (A): 108
REFSTA RTCM SC-104 ID (B): 109
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 834
Transmission Frequency: 318 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 80 SM

**THE COAST GUARD INTENDS TO DECOMMISSION THE WHITEFISH POINT
DGPS SITE ON OR ABOUT 1600Z 24 SEP 99. COVERAGE FOR THE
WHITEFISH AREA WILL BE PROVIDED BY THE RECENTLY
COMMISSIONED PICKFORD, MI DGPS SITE.**

WHITNEY, NE

Status: Operational
RBn Antenna Location: 42,44N;103, 19W
REFSTA Ant Location (A): 42,44.35847N;103, 19.72616W
REFSTA Ant Location (B): 42, 44.36916N;103, 19.71349W

REFSTA RTCM SC-104 ID (A): 148
REFSTA RTCM SC-104 ID (B): 149
REFSTA FIRMWARE VERSION: RC00-1C19
Broadcast Site ID: 859
Transmission Frequency: 310 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 280 SM

WISCONSIN POINT, WI

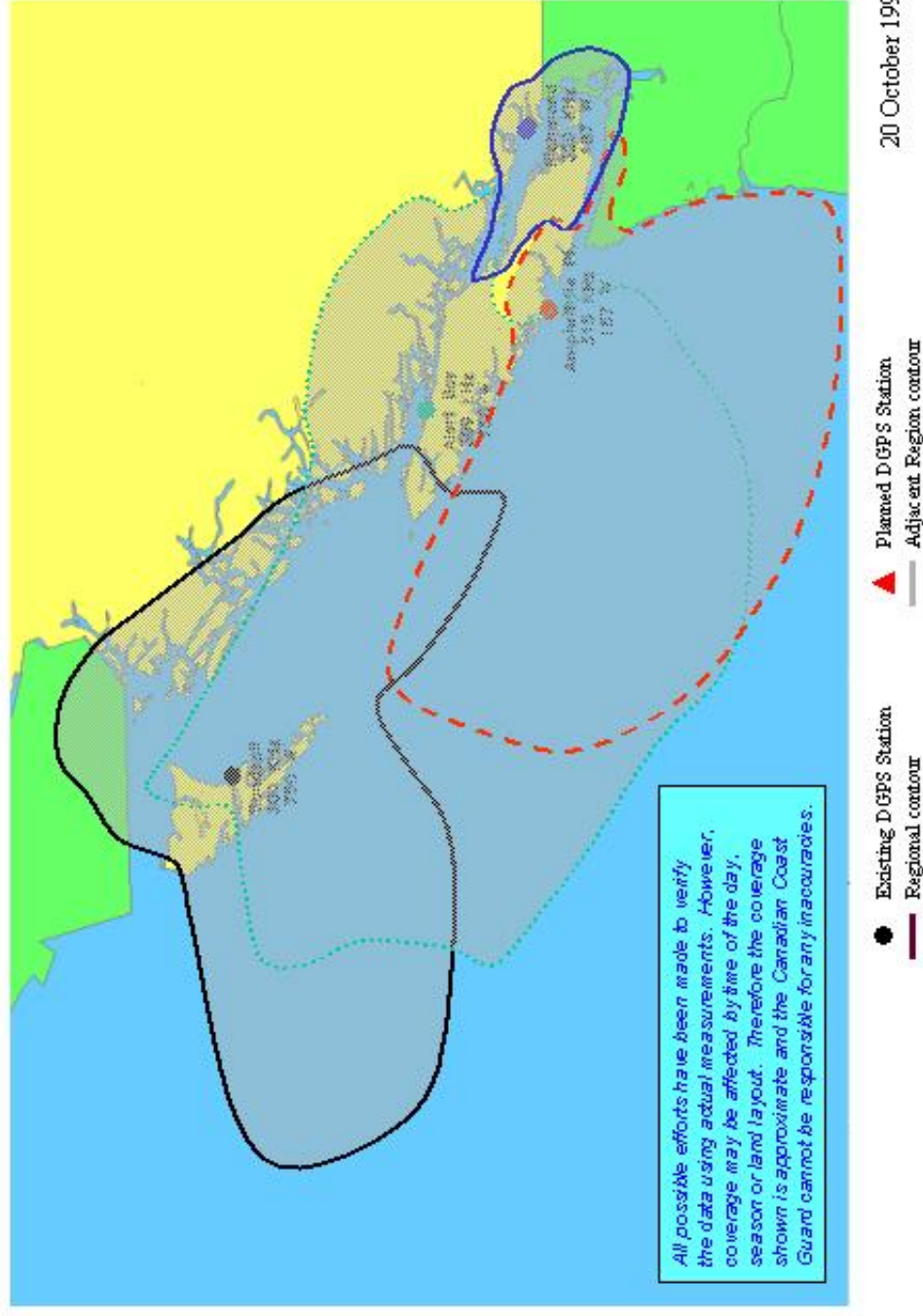
Status: Operational
RBn Antenna Location: 46,42.3N;92, 0.9W
REFSTA Ant Location (A): 46,42.30287N;92, 0.91224W
REFSTA Ant Location (B): 46, 42.3061N;92, 0.93574W
REFSTA RTCM SC-104 ID (A): 100
REFSTA RTCM SC-104 ID (B): 101
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 830
Transmission Frequency: 296 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 40 SM

YOUNGSTOWN, NY

Status: Operational
RBn Antenna Location: 43,13.8N;78, 58.2W
REFSTA Ant Location (A): 43,13.8748N;78, 58.20992W
REFSTA Ant Location (B): 43, 13.87466N;78, 58.18778W
REFSTA RTCM SC-104 ID (A): 118
REFSTA RTCM SC-104 ID (B): 119
REFSTA FIRMWARE VERSION: RD00-1C19
Broadcast Site ID: 839
Transmission Frequency: 322 KHZ
Transmission Rate: 100 BPS
Signal Strength: 75uV at 150 SM

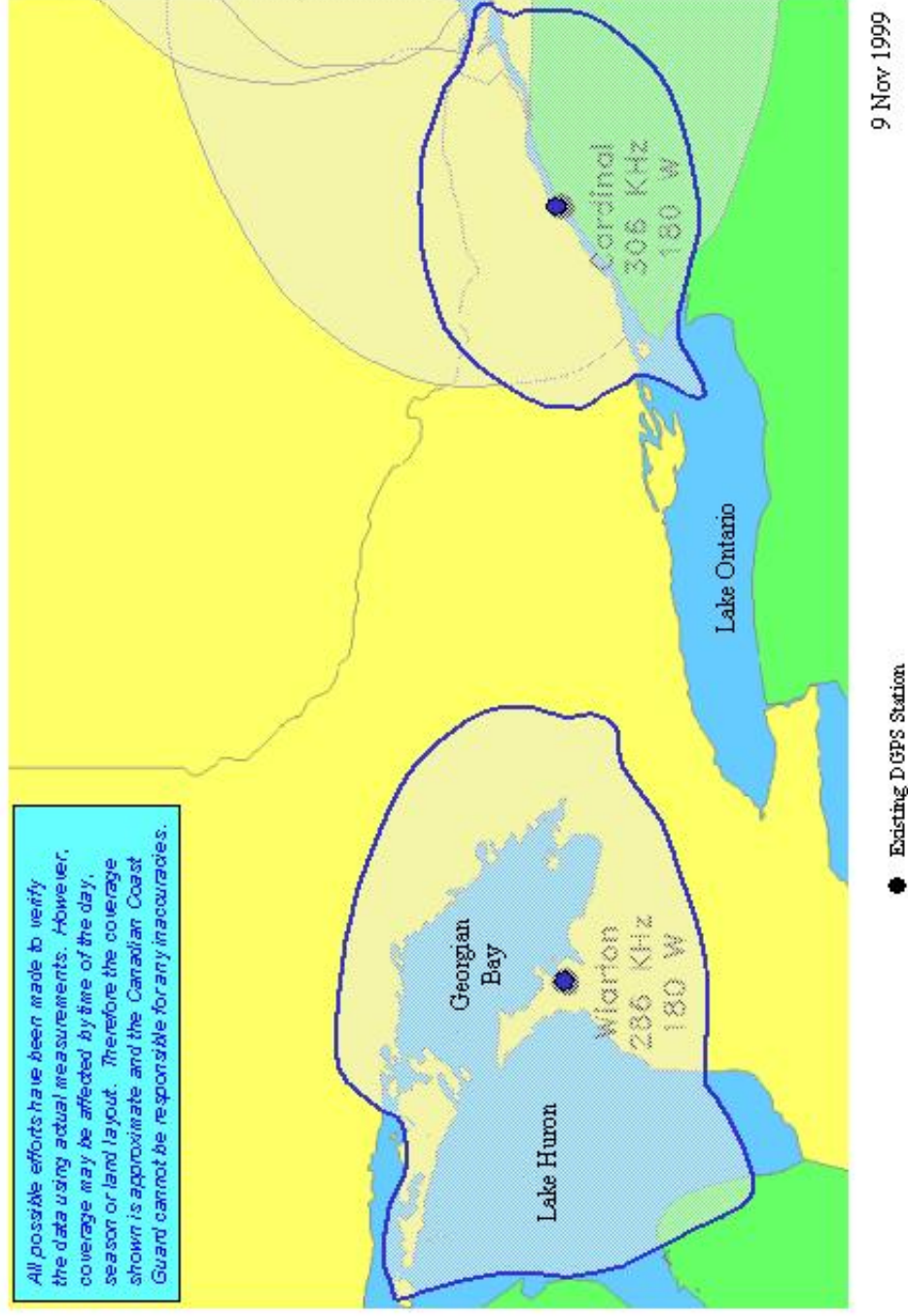
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Pacific Region Stations



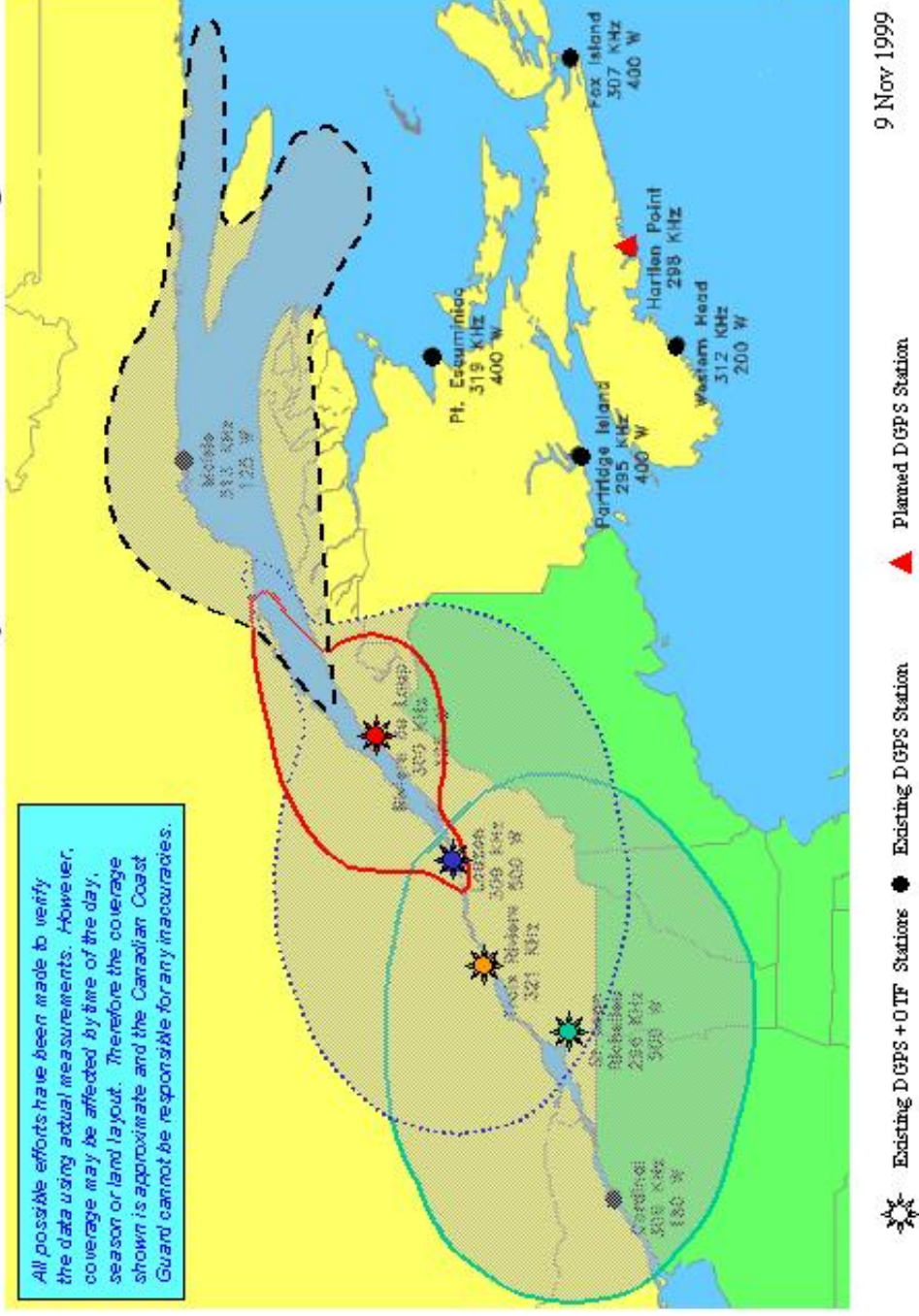
Frequency and Transmission rate	Nominal Range	IALA Identification, Ref. Station numbers & Transmitter number	Status
SANDSPIT, BC 53 14N , 131 49W 300khz & 200bps	350km	306,307 & 906	Initial operational service
ALERT BAY, BC 50 35N , 126 55W 309khz & 200bps	450km	300,301 & 909	Initial operational service
RICHMOND, BC 49 11N , 123 07W 320khz & 200bps	170km	304,305 & 907	Initial operational service
AMPHITRITE PT., BC 48 55N , 125 33W 315khz & 200bps	350km	302,303 & 908	Initial operational service.

Central/Arctic Region Stations



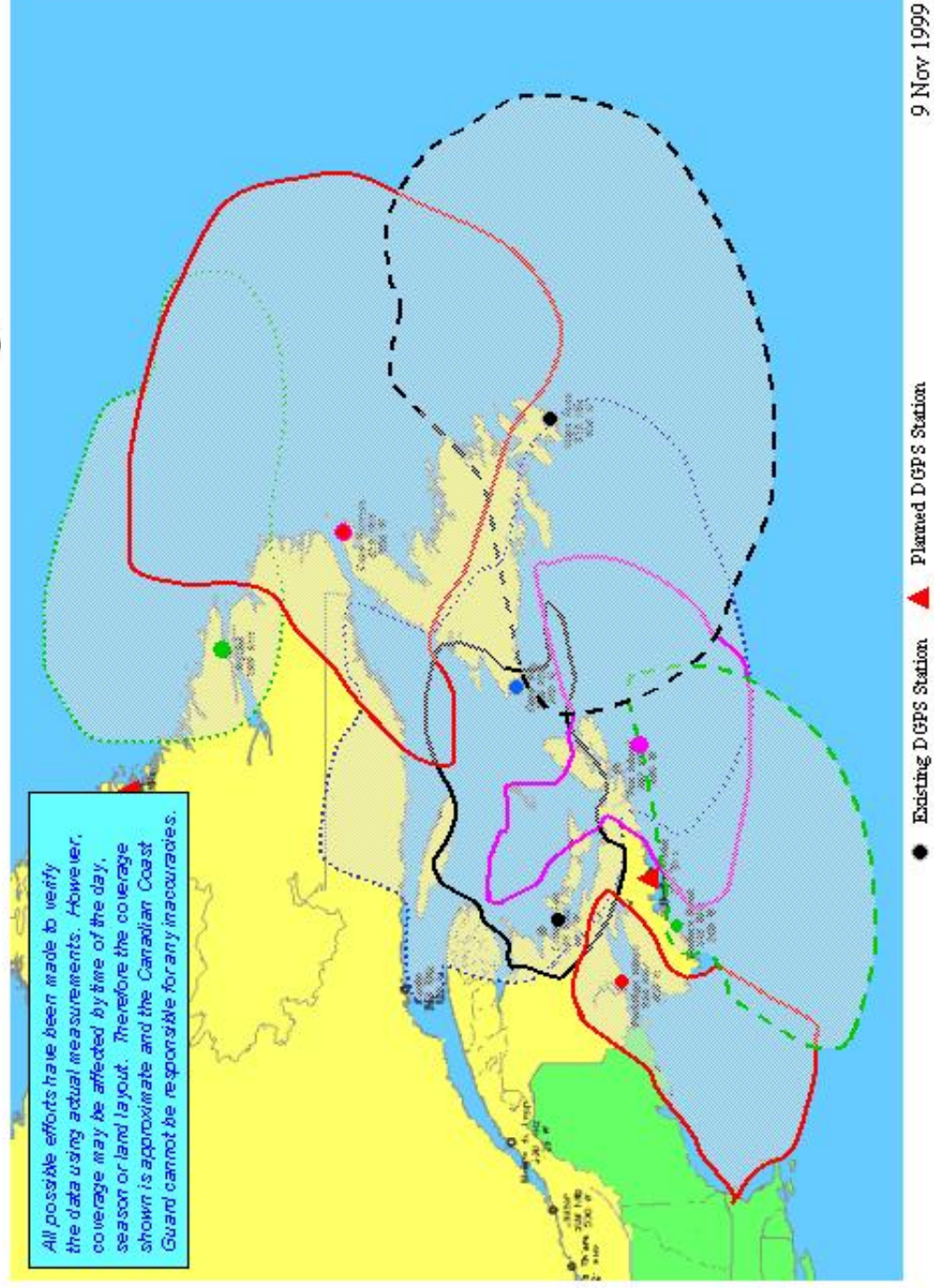
Frequency and Transmission rate	Nominal Range	IALA Identification, Ref. Station numbers & Transmitter number	Status
CARDINAL, ONT 44 47N 75 25W 306khz & 200bps	300km	308, 309 & 919	Initial operational service.
WIARTON, ONT 44 45N - 81 07W 286khz & 200bps	250km	310, 311 & 918	Initial operational service.

Canadian St. Lawrence Seaway DGPS Coverage



Frequency and Transmission rate	Nominal Range	IALA Identification, Ref. Station numbers & Transmitter number	Status
MOISIE, QUE 50 12N - 66 07W 313khz & 200bps	300km	320, 321 & 925	Initial operational service.
RIVIÈRE DU LOUP, QUE 47 46N - 69 36W 300khz & 200bps	300km	318, 319 & 926	Initial operational service.
LAUZON, QUE 46 49N - 71 10W 309khz & 200bps	330km	316, 317 & 927	Initial operational service.
TROIS-RIVIÈRES, QUE 46 23N - 72 27W 321khz & 200bps	170km	314 & 928	Initial operational service. (no backup capability)
ST. JEAN SUR RICHELIEU, QUE 45 19N - 73 19W 296khz & 200bps	330km	312, 313 & 929	Initial operational service.

East Coast DGPS Coverage

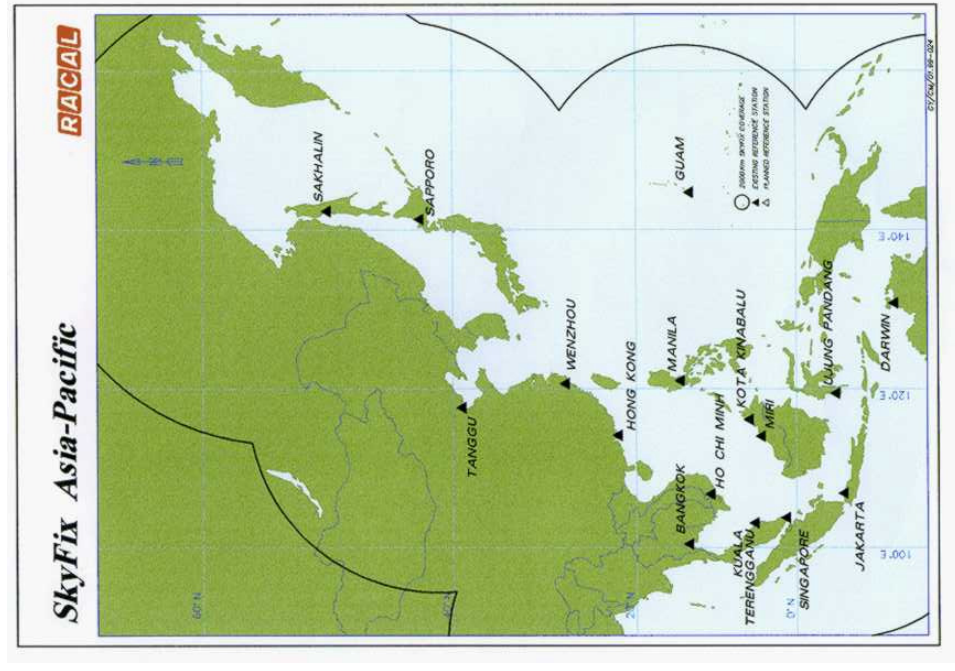


Frequency and Transmission rate	Nominal Range	IALA Identification, Ref. Station numbers & Transmitter number	Status
RIGOLET, NFLD 54 15N - 58 30W 299khz & 200bps	300km	344, 345 & 946	Initial operational service
CAPE NORMAN NFLD 51 30N - 55 49W 310khz & 200bps	350km	342, 343 & 944	Initial operational service.
CAPE RAY, NFLD 47 38N - 59 14W 290khz & 200bps	350km	340, 341 & 942	Initial operational service.
CAPE RACE, NFLD 46 46N - 53 11W 315khz & 200bps	525km	338, 339 & 940	Initial operational service.
POINT ESCUMINAC, NB 47 04N - 64 48W 319khz & 200bps	300km	332, 333 & 936	Initial operational service

Frequency and Transmission rate	Nominal Range	IALA Identification, Ref. Station numbers & Transmitter number	Status
FOX ISLAND, NS 45 20N - 61 05W 307khz & 200bps	300km	336, 337 & 934	Initial operational service.
PARTRIDGE ISLAND, NB 45 14N - 66 03W 295khz & 200hns	300km	326, 327 & 939	Initial operational service
WESTERN HEAD, NS 43 59N - 64 40W 312khz & 200bps	300km	334, 335 & 935	Initial operational service

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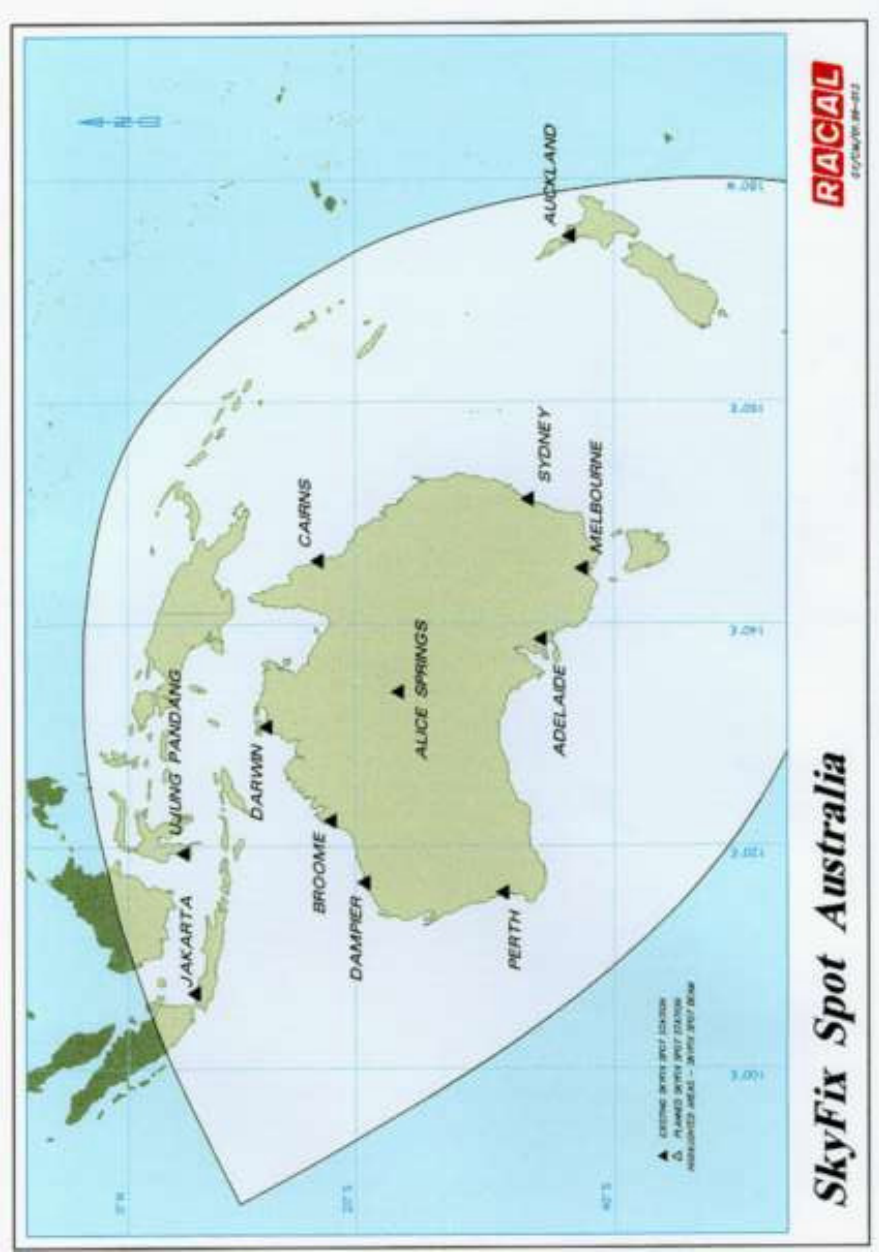
SkyFix and SkyFix Spot Reference Stations



Asia

Station Name	Station ID	Latitude	Longitude
Singapore	0100	01°19' N	103° 40' E
Terengganu	0101	05° 20' N	103° 09' E
Miri	0102	04° 26' N	114° 01' E
Kota Kinabalu	0105	05° 48' N	116° 03' E
Manila	0110	14° 34' N	121° 00' E
Ho Chi Minh City	0115	10° 48' N	106° 41' E
Hong Kong	0120	22° 18' N	114° 10' E
Wenzhou	0135	27° 58' N	120° 45' E
Tanggu	0138	39° 02' N	117° 39' E
Sapporo	0140	43° 05' N	141° 23' E
Ujung Pandang	0150	05° 08' N	119° 25' E
Jakarta	0160	06° 14' N	106° 51' E
Guam	0170	13° 31' N	144° 49' E
Bangkok	0180	13° 43' N	100° 31' E
Shakalin Island	0300	51° 48' N	143° 09' E

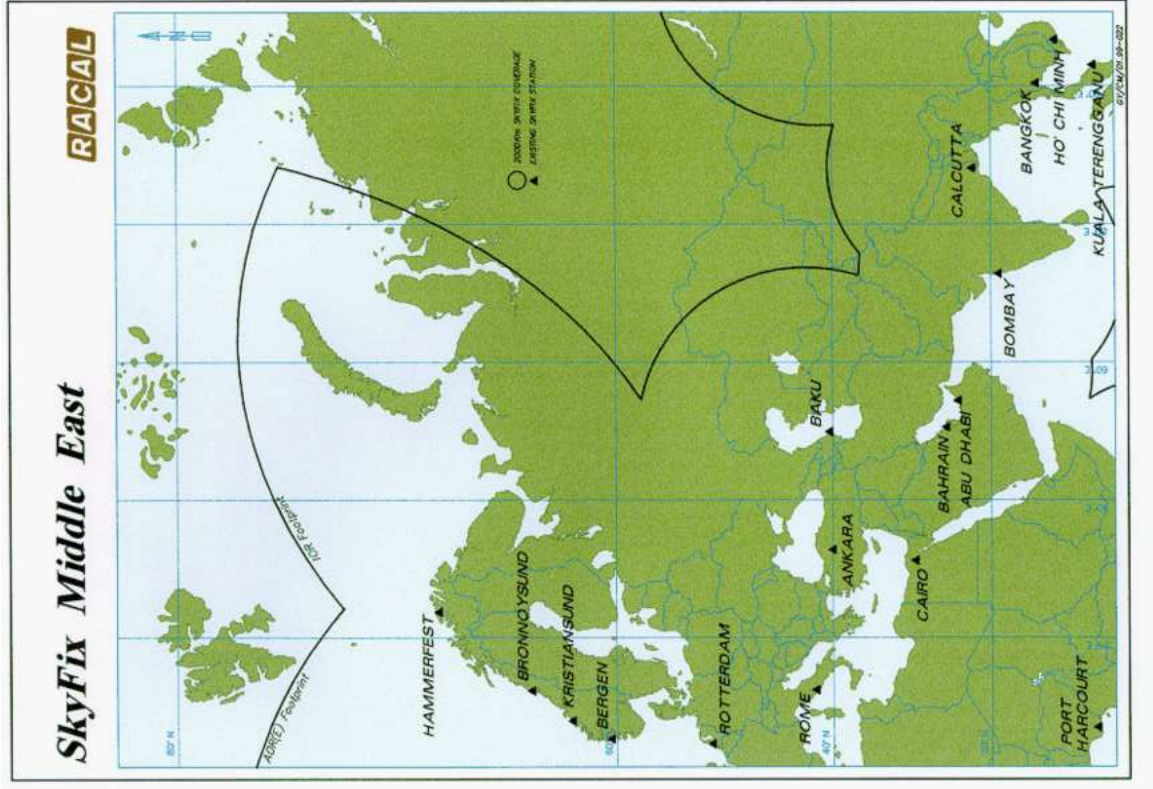




Australia\New Zealand

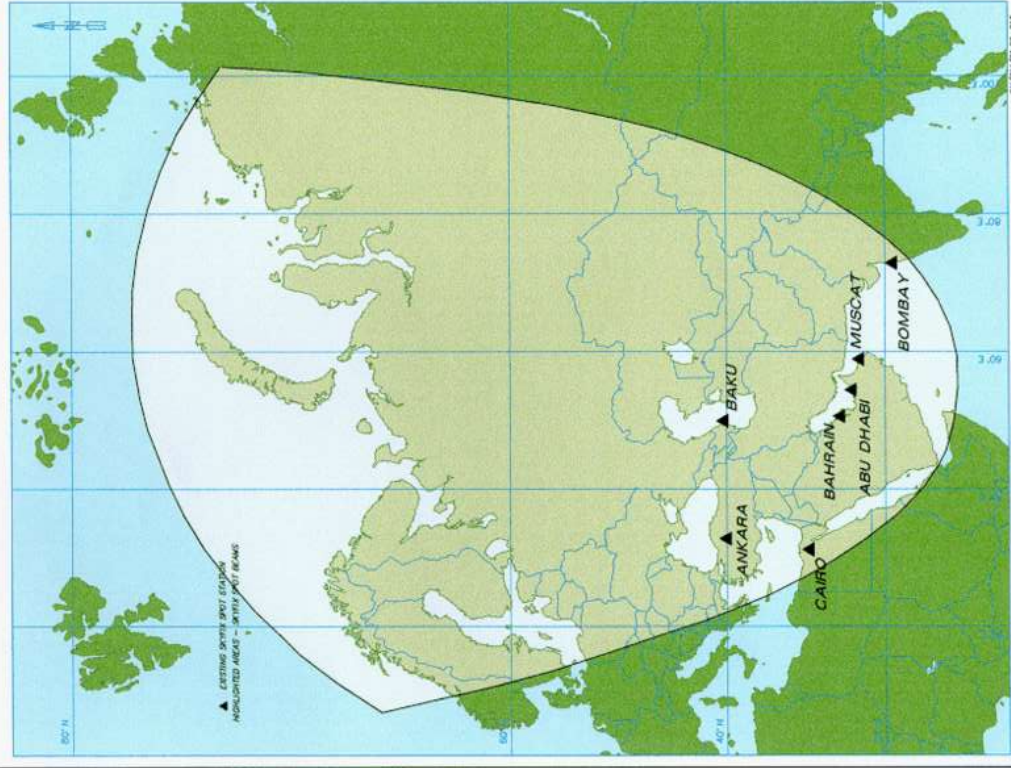
Station Name	Station ID	Latitude	Longitude
Cairns	0201	16° 54' S	145° 46' E
Darwin	0202	12° 26' S	130° 50' E
Dampier	0203	20° 40' S	116° 42' E
Perth	0204	31° 49' S	115° 53' E
Adelaide	0205	35° 18' S	138° 35' E
Sydney	0206	33° 59' S	151° 14' E
Broome	0207	17° 57' S	122° 13' E
Melbourne	0208	38° 28' S	144° 55' E
Wellington	0250	41° 16' S	174° 46' E

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SkyFix Spot Middle East

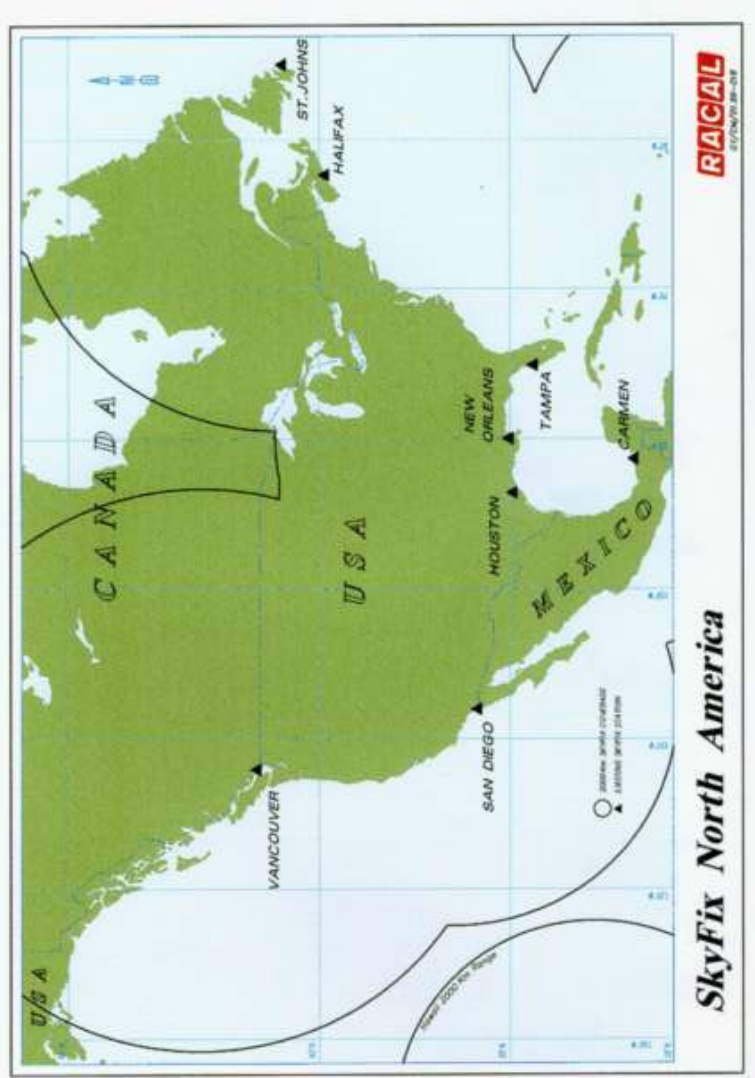
RACAL



Middle East and CIS

Station Name	Station ID	Latitude	Longitude
Abu Dhabi	0400	24° 23' N	54° 31' E
Baku	0410	40° 23' N	49° 50' E
Bahrain	0420	26° 12' N	50° 36' E
Muscat	0430	23° 35' N	58° 15' E
Bombay	0450	18° 55' N	72° 49' E
Calcutta	0480	22° 34' N	88° 26' E
Cairo	0960	29° 58' N	31° 16' E

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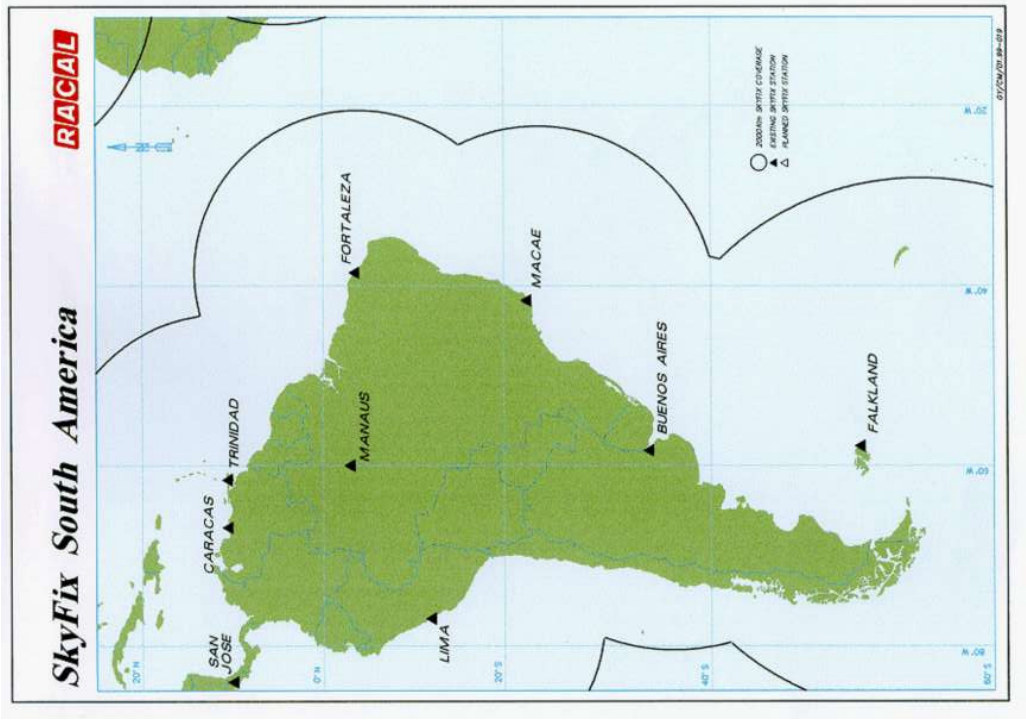


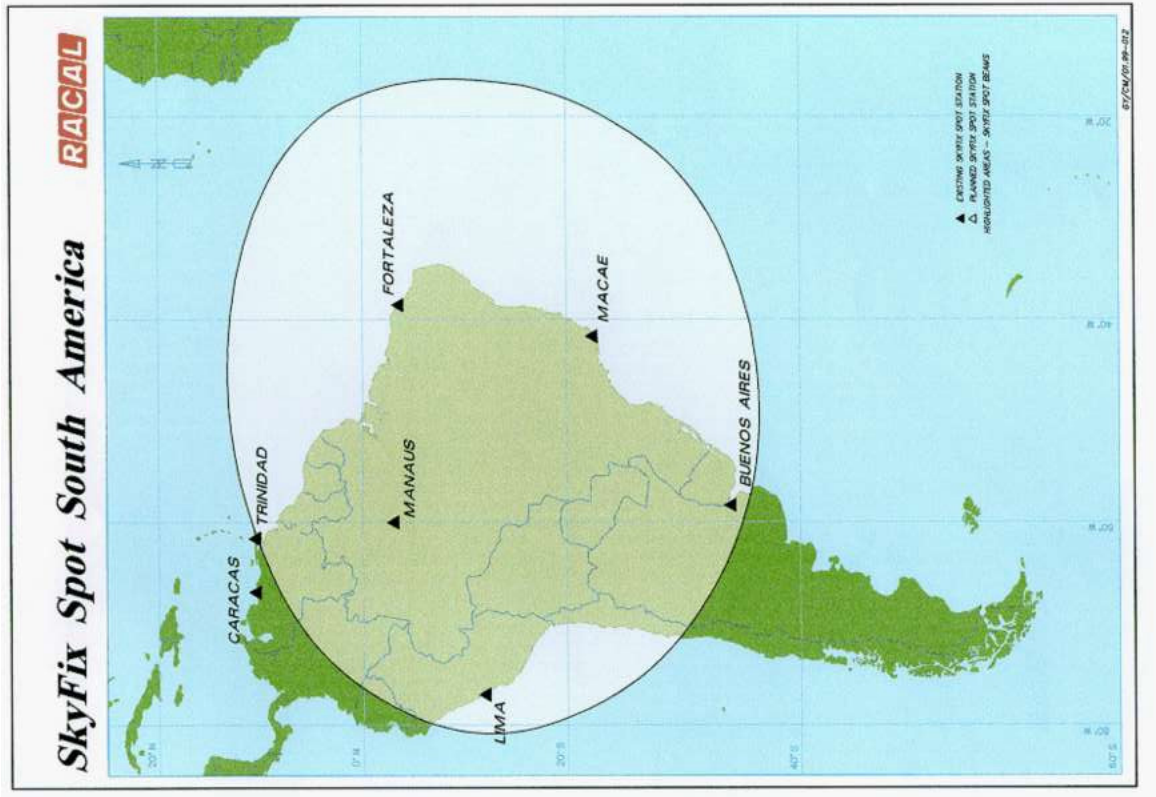


North America and Mexico

Station Name	Station ID	Latitude	Longitude
Houston	0500	29° 44' N	95° 33' E
Vancouver	0505	49° 16' N	123° 04' W
Tampa	0520	27° 57' N	82° 27' W
Halifax	0530	44° 51' N	63° 33' W
San Diego	0535	32° 50' N	117° 08' W
New Orleans	0540	30° 01' N	90° 15' W
St. Johns	0545	47° 34' N	52° 42' W
Carmen	0550	18° 39' N	91° 49' W
Hawaii	0560	21° 18' N	157° 52' W

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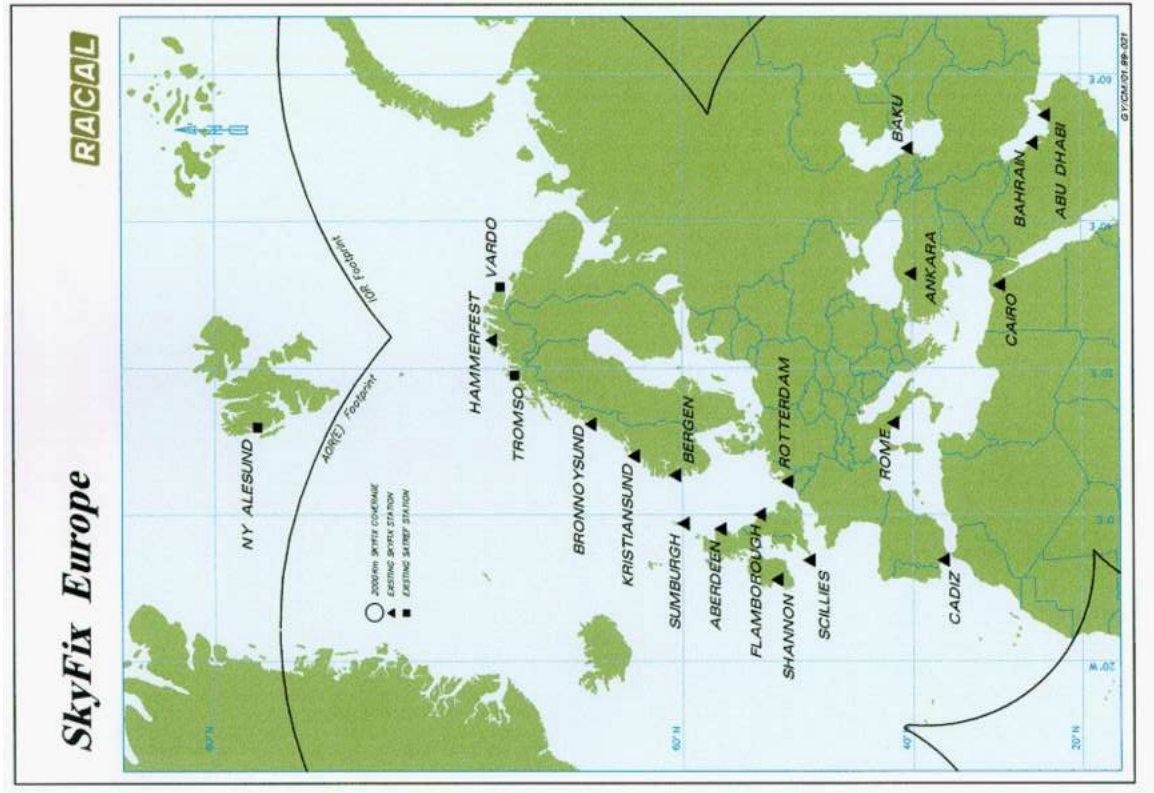


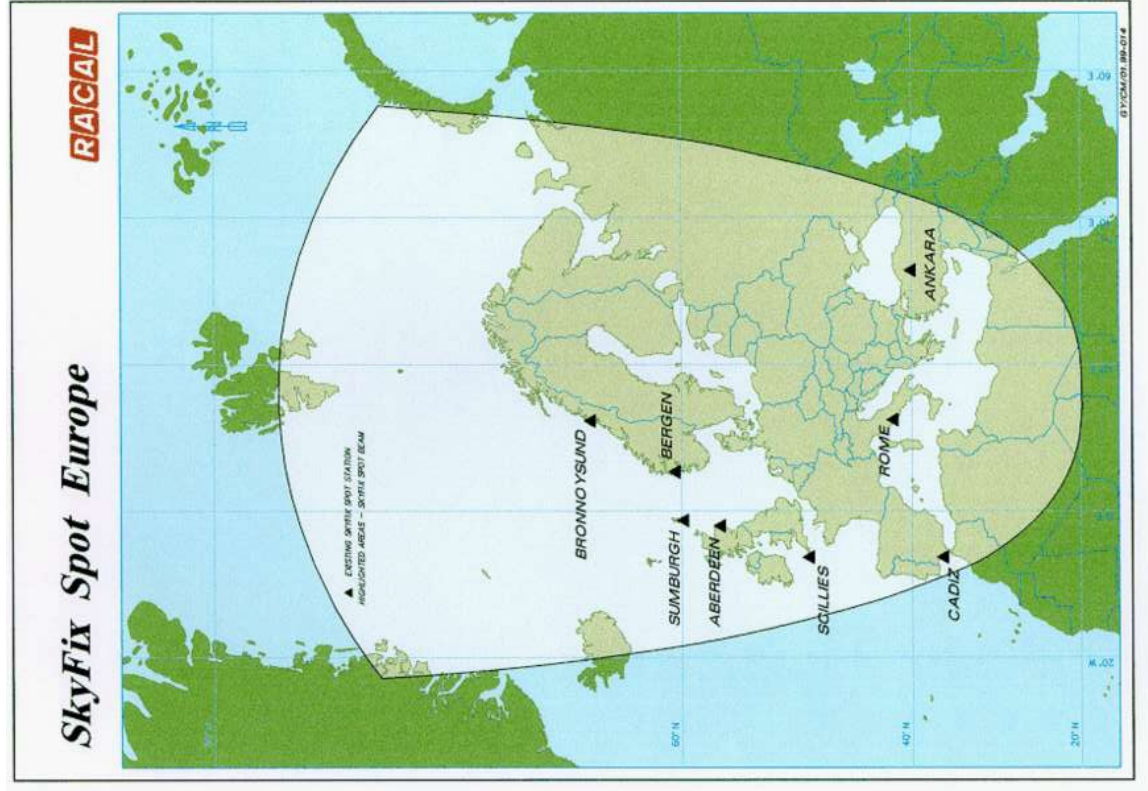


South America

Station Name	Station ID	Latitude	Longitude
Falklands	0600	51° 41' S	57° 52' W
San Jose	0610	09° 56' N	84° 04' W
Macaoe	0620	22° 24' S	41° 49' W
Lima	0630	12° 04' S	77° 02' W
Trinidad	0640	10° 41' N	61° 02' W
Fortaleza	0650	03° 43' S	38° 33' W
Caracas	0660	10° 30' N	66° 51' W
Buenos Aires	0670	34° 36' S	58° 22' W
Manaus	0680	03° 08' S	60° 01' W

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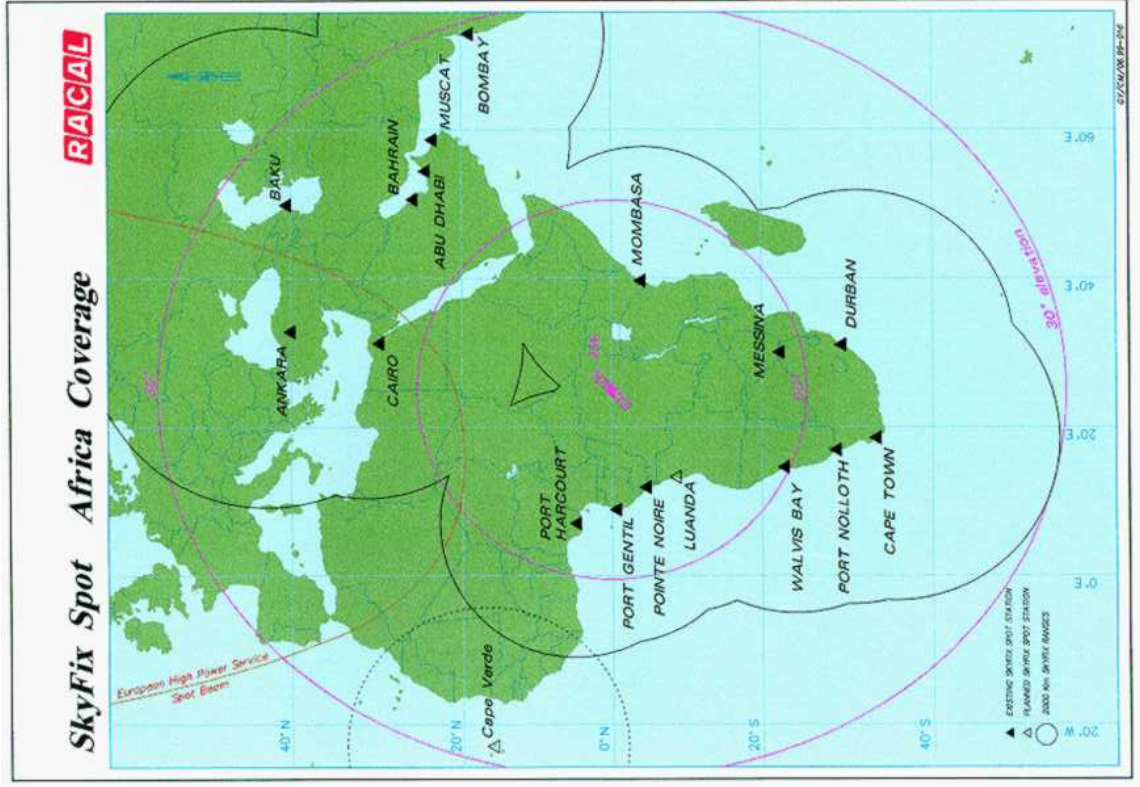


North Sea and Mediterranean

Station Name	Station ID	Latitude	Longitude
Aberdeen	0700	57° 08' N	02° 04' W
Sumburgh	0710	59° 51' N	01° 16' W
Hammerfest	0720	70° 42' N	23° 43' E
Shannon	0725	52° 42' N	08° 55' W
Tromsø (SATREF)	0726	69° 40' N	18° 56' E
Vardo (SATREF)	0730	70° 20' N	31° 02' E
Ny Alesund (SATREF)	0733	78° 56' N	11° 52' E
Rotterdam	0740	51° 57' N	04° 25' E
Flambourough	0750	54° 07' N	00° 05' W
Scillies	0760	49° 55' N	06° 17' W
Bronnoysund	0770	65° 28' N	12° 13' E
Bergen	0780	60° 23' N	05° 16' E
Kristiansund	0790	63° 07' N	07° 50' E
Rome	0800	41° 56' N	12° 28' E
Cadiz	0810	36° 32' N	06° 17' W
Ankara	0830	39° 55' N	32° 51' E

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Africa

Station Name	Station ID	Latitude	Longitude
Port Gentil	0900	00° 41' S	08° 46' E
Luanda	0905	08° 49' S	13° 14' E
Port Harcourt	0910	04° 50' N	07° 00' E
Walvis Bay	0920	22° 57' S	14° 30' E
Cape Town	0930	34° 01' S	18° 30' E
Pointe Noire	0940	04° 47' S	11° 52' E
Port Nolloth	0950	28° 46' S	16° 40' E
Durban	0970	29° 53' S	31° 17' E
Messina	0980	22° 21' S	30° 02' E
Mombassa	0990	04° 04' S	39° 40' E

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APPENDIX B: WINFROG FILE FORMATS

WINFROG WORKING FILE FORMATS

All WinFrog data are stored in ASCII format for ease of reading with a text editor, such as Windows Notepad™, or printed as an ASCII text file. Since data storage costs are greatly reduced, compressing data into binary format is not necessary and would be time consuming for the system. Data recovery is much easier from a user-readable file in ASCII rather than an attempt to recover data from a binary file.

In the following format descriptions, the following format terms are used:

d	integer value
f.ff	double value, the number of decimal places is indicated by the number of <i>f</i> characters following the decimal point
[-]	if a negative value, the term is preceded by a negative sign. Note that this is not shown in all cases a negative may be present.
[N/S]dd mm.mmmm	a latitude or longitude in degrees, minutes, decimal of minutes format, preceded by the hemisphere character designation
mm-dd-yy	date in month-day-year format, note that the order of the <i>m</i> , <i>d</i> and <i>y</i> characters indicate the actual order
hh:mm:ss.s	time in hour:minute:seconds format, note that the number of decimal places of seconds are indicated by the number of <i>s</i> characters following the decimal point
s	character string of no fixed length

SURVEY LINE FILE (*.PTS)

Survey line file data records are stored as ASCII, free formatted, comma-delimited fields as follows.

SURVEY LINE CONTROL RECORDS

Field	Data	Format	Comment
1	Type	0	Survey Line control record
2	Name	s	Name of survey line
3	Fix#	[-]d	Starting fix number
4	Dist Down Ln	[-]f.fff	Distance down line of first fix/shotpoint (m)
5	Starting KP (m)	[-]f.fff	Starting KP (m)
6	Kp Direction	[-]d	1 = Increasing -1 = Decreasing
7	# of Nodes	d	Number of nodes ¹
8	# of Color	d	Line Color
9	Scalable Line flag	d	Scalable KP Line flag, 0 = Off, 1=On
10	KP ScaleLimits	f.fff	Line Scale Limits
11	KP/FP	d	Line KP/FP Mode (0 =KP, 1= FP)
12	Line approach alarm	d	0 = true, on 1 = false, off
13	Alarm Tolerance	f.fff	Approach distance to trigger the line alarm

¹ The number of line segments is equal to the number of nodes - 1

SURVEY LINE POINT RECORDS

Field	Data	Format	Comment
1	Type	1	Survey Line point record
2	SOL Lat	[-]f.ffffffff	Latitude of point, decimal of degrees
3	SOL Lon	[-]f.ffffffff	Longitude of point, decimal of degrees
4	Depth	[-]f.fff	Depth of point ²
5	Radius	[-]f.fff	Radius of curvature ²
6	Northing	[-]f.ff	Grid Northing of point ³
7	Easting	[-]f.ff	Grid Easting of point ³
8	KP	f.fff	KP ⁴ (m)

¹ The coordinates for a given node define the end of a given segment. Whether it is the starting or ending node depends upon the current segment.

² Units are included in field and are based upon selected distance units and the number of decimal places specified for the same, default is metres.

³ Units are not included in the field and are based upon Map Projection units, default is metres.

⁴ If the line is set to Scalable KP, the KP values are those specified for the given node. If the line is not set to scalable, the KP values are calculated based on the starting KP value and KP direction.

OVERAGE LOOP POINT RECORDS

Field	Data	Format	Comment
1	Type	2	Overage Loop point record
2	Start Lat	[-]f.ffffffff	Latitude of point that the overage loop starts, decimal of degrees
3	Start Lon	[-]f.ffffffff	Longitude of point that the overage loop starts, decimal of degrees
4	Start Northing	[-]f.ffff	Northing of point that the overage loop starts, metres
5	Start Easting	[-]f.ffff	Easting of point that the overage loop starts, metres
6	Range	f.ffff	Range from previous node to start of overage loop
7	Excess	f.ffff	Amount of excess pipe to be laid, metres
8	Max Deviation	f.ffffffff	Maximum deflection at any node in the overage loop, decimal of degrees
9	Mode	d	0=Off; 1=1/2 loop to the right; 2=1/2 loop to the left; 3=full loop to the right; 4=full loop to the left
10	Node0	d	Number of first node added ¹
11	Node1	d	Number of second node added ¹
12	Node2	d	Number of third node added ¹
13	Node3	d	Number of fourth node added ¹
14	PrevNode	d	Number of node preceding the first node

¹ If a node has not been added, this value is -1.

WAYPOINT (*.WPT)

Waypoint file data records are stored as ASCII, free formatted, comma-delimited fields as follows:

WAYPOINT RECORDS

Field	Data	Format	Comment
1	Name	s	Name of waypoint
2	Lat	[N/S]dd mm.mmmm	Latitude of point
3	Lon	[W/E]ddd mm.mmmm	Longitude of point
4	Icon	d	See Icon List Below
5	Radius	f.fff	Radius of watch circle (m)
6	Northing	[-]f.ff	Grid Northing of point ¹
7	Easting	[-]f.ff	Grid Easting of point ¹
8	Color	d	Color
9	Elevation	f.fff	Elevation of point (m)

¹ Units are not included in the field and are based upon Map Projection units, default is metres.

ICON LIST

Value	Description
0	Anchor
1	Beacon-Radio/Radar
2	Beacon-Square
3	Beacon-Triangular
4	Bullseye
5	Circle
6	Light Directional
7	Light-General
8	Marker-Barrel Buoy
9	Marker-BiColor
10	Marker-General Buoy
11	Marker-Special Buoy
12	Mine
13	Point
14	Post/Pile
15	Rock
16	Sewer Pipeline
17	Square
18	Triangle
19	Wreck

PICTURE FILES

Picture file data records are stored as ASCII, free formatted, comma-delimited fields as follows:

PICTURE POINT RECORDS

Field	Data	Format	Comment
1	Type	d	1 = Pen Up 0 = Pen Down
2	Lat	[-]f.ffffff	Latitude of point (degrees)
3	Lon	[-]f.ffffff	Longitude of point (degrees)

PICTURE CONTROL RECORDS

Field	Data	Format	Comment
1	Type	d	2 = Picture Control Record
2	Name	s	Name of picture segment
3	Color	d	
4	Green	d	
5	Blue	d	
6	Line Style	d	0 = Solid 1 = Dashed

PICTURE TEXT RECORDS

Field	Data	Format	Comment
1	Type	d	3 = Picture Text Record
2	Text	s	Text string (80 characters or less)
3	Color	d	
4	Lat	[-]f.ffffff	Latitude of text
5	Lon	[-]f.ffffff	Longitude of text
6	Size	f.ffffff	Size of text
7	Rotation	f.ffffff	Rotation of text
8	Justification	d	0 = Center 1 = Left 2 = Right

This format utilizes the Pen Up/Pen Down method to enable picture data (e.g. coastline) to be drawn. It allows free-format of data entry. On encountering the first picture file record, WinFrog moves the pen to that location. All following '1' records are then plotted in yellow with the pen down. On encountering a '2' record, the pen is raised and set down again at the next '1' record, allowing gaps to be introduced in picture data. Multiple control point record sequences can also be stored in a picture file.

SEISMIC SOURCE FILES

Seismic Source file data and Source data records are stored as ASCII, free formatted, comma-delimited fields as follows:

SEISMIC SOURCE FILE LIST (*.ASC) RECORDS

The Seismic Source data file list contains the directory and file name of all current Source (.SRC) files, in the following format: drive:\path\filename.SRC.

For example: C:\NEWPROJ\TEST1.SRC

SOURCE (*.SRC) RECORDS

The Source (.SRC) data file contains the actual event data, as follows. Note that the data logged is that for the time of the shotpoint (SP) and that positional and tracking information is for the vehicle's tracking (offset) point.

Field	Data	Format	Comment
1	Fix#	d	Shotpoint (SP) number
2	Date/Time	mm-dd-yy hh:mm:ss.s	Date and time of SP
Fields 3 to 22 are repeated for all vehicles configured as either Primary or Secondary Event vehicles.			
3	Lat	[N/S]dd mm.mmmm	Latitude ¹
4	Lon	[W/E]ddd mm.mmmm	Longitude ¹
5	Height	f.ff	Height relative to sea level. In case of sub-surface vehicle, depth is given as a negative.
6	Northing	[-]f.ff	Northing ²
7	Easting	[-]f.ff	Easting ²
8	Depth	f.ff	Water depth (m)
9	Off-line	[-]f.ff	Distance offline (m)
10	Alongline	[-]f.ff	Distance alongline (m)
11	Heading	f.ff	Vessel's heading (T)
12	CMG	f.ff	Vessel's course made good (Grid)
13	Speed	f.ff	Vessel's speed (knots)
14	QC	f.ff	Not used
15	Offset	s	Name of the vehicle offset being tracked
16	KiloPost	f.fff	Kilometer post
17	Layback	f.ff	The layback of the vehicle in cases of vehicle referenced to another as a Pipe track vehicle
18	HDOP	f.ff	GPS Horizontal Dilution of Precision (if available)
19	DGPS Age	f.ff	Age of DGPS correction (if available)
20	Lat Std Dev	f.ff	Latitude Standard Deviation
21	Lon Std Dev	f.ff	Longitude Standard Deviation
22	Vessel	s	Name of the vessel that preceding data applies to

¹ Working Ellipsoid position

² Working Map Projection position, units are as configured for the Map Projection

SEISMIC RECEIVER FILES

Seismic Receiver file data and Receiver data records are stored as ASCII, free formatted, comma-delimited fields as follows:

SEISMIC RECEIVER LIST (*.ALL) RECORDS

The Seismic Receiver data file list contains the directory and filename of all current Receiver (.RCV) files, as in the following format: drive:\path\filename.RCV.

For Example: C:\NEWPROJ\FILE1.RCV

RECEIVER (.RCV) RECORDS

The Receiver (.RCV) data file contains the actual event data, as follows. Note that the data logged is that for the time of the shotpoint (SP) and that positional and tracking information is for the vehicle's tracking (offset) point.

RECEIVER (*.RCV) RECORDS

Field	Data	Format	Comment
1	Fix#	d	Shotpoint (SP) number
2	Date/Time	mm-dd-yy hh:mm:ss.s	Date and time of SP
Fields 3 to 22 are repeated for all vehicles configured as either Primary or Secondary Event vehicles.			
3	Lat	[N/S]dd mm.mmmm	Latitude ¹
4	Lon	[W/E]ddd mm.mmmm	Longitude ¹
5	Height	f.ff	Height relative to sea level. In case of sub-surface vehicle, depth is given as a negative.
6	Northing	[-]f.ff	Northing ²
7	Easting	[-]f.ff	Easting ²
8	Depth	f.ff	Water depth (m)
9	Off-line	[-]f.ff	Distance offline (m)
10	Alongline	[-]f.ff	Distance alongline (m)
11	Heading	f.ff	Vessel's heading (T)
12	CMG	f.ff	Vessel's course made good (Grid)
13	Speed	f.ff	Vessel's speed (knots)
14	QC	f.ff	Not used
15	Offset	s	Name of the vehicle offset being tracked
16	KiloPost	f.fff	Kilometer post
17	Layback	f.ff	The layback of the vehicle in cases of vehicle referenced to another as a Pipe track vehicle
18	HDOP	f.ff	GPS Horizontal Dilution of Precision (if available)
19	DGPS Age	f.ff	Age of DGPS correction (if available)
20	Lat Std Dev	f.ff	Latitude Standard Deviation
21	Lon Std Dev	f.ff	Longitude Standard Deviation
22	Vessel	s	Name of the vessel that preceding data applies to

¹ Working Ellipsoid position

² Working Map Projection position, units are as configured for the Map Projection

DATA FILES

Data file data and Data point records are stored as ASCII, free formatted, comma-delimited fields as follows:

DATA FILE LIST (*.ALG) RECORDS

The Data file list contains the directory and filename of all Data files, as in the following example: drive:\path\filename.DAT

For Example: C:\NEWPROJ\FILE1.DAT

DATA (.DAT) RECORDS

The Data (.DAT) data file contains the actual event data, as follows. Note that the data logged is that for the time of the event and that positional and tracking information is for the vehicle's tracking (offset) point.

DATA POINT (*.DAT) RECORDS

Field	Data	Format	Comment
1	Fix#	dd	Event number
2	Date/Time	mm-dd-yy hh:mm:ss.s	Date and time of SP
Fields 3 to 22 are repeated for all vehicles configured as either Primary or Secondary Event vehicles.			
3	Lat	[N/S]dd mm.mmmm	Latitude ¹
4	Lon	[W/E]ddd mm.mmmm	Longitude ¹
5	Height	f.ff	Height relative to sea level. In case of sub-surface vehicle, depth is given as a negative.
6	Northing	[-]f.ff	Northing ²
7	Easting	[-]f.ff	Easting ²
8	Depth	f.ff	Water depth (m)
9	Off-line	[-]f.ff	Distance offline (m)
10	Alongline	[-]f.ff	Distance alongline (m)
11	Heading	f.ff	Vessel's heading (T)
12	CMG	f.ff	Vessel's course made good (Grid)
13	Speed	f.ff	Vessel's speed (knots)
14	QC	f.ff	Not used
15	Offset	s	Name of the vehicle offset being tracked
16	KiloPost	f.fff	Kilometer post
17	Layback	f.ff	The layback of the vehicle in cases of vehicle referenced to another as a Pipe track vehicle
18	HDOP	f.ff	GPS Horizontal Dilution of Precision (if available)
19	DGPS Age	f.ff	Age of DGPS correction (if available)
20	Lat Std Dev	f.ff	Latitude Standard Deviation
21	Lon Std Dev	f.ff	Longitude Standard Deviation
22	Vessel	s	Name of the vessel that preceding data applies to

¹ Working Ellipsoid position

² Working Map Projection position, units are as configured for the Map Projection

LOG FILES

Log data records are stored as ASCII, free formatted, comma-delimited fields as follows. Note that the data logged is that for the time of the fix and that positional and tracking information is for the vehicle's tracking (offset) point.

LOG (*LOG) RECORDS

Field	Data	Format	Comment
1	Comment	s	Brief description of log entry
2	Date/Time	mm-dd-yy hh:mm:ss.s	Time of fix
Fields 3 to 18 are repeated for all vehicles configured as either Primary or Secondary Event vehicles			
3	Lat	[N/S]dd mm.mmmm	Latitude ¹
4	Lon	[W/E]ddd mm.mmmm	Longitude ¹
5	Height	f.ff	Height relative to sea level. In case of sub-surface vehicle, depth is given as a negative.
6	Heading	f.ff	Vessel's heading (T)
7	CMG	f.ff	Vessel's course made good (Grid)
8	Speed	f.ff	Vessel's speed (knots)
9	Northing	[-]f.ff	Northing ²
10	Easting	[-]f.ff	Easting ²
11	Depth	f.ff	Water depth (m)
12	QC	f.ff	Not used
13	Offset	text	Name of the offset being tracked
14	Off-line	[-]f.ff	Distance offline (m)
15	Alongline	[-]f.ff	Distance alongline(m)
16	KiloPost	f.fff	Kilometer post
17	Layback	f.ff	The layback of the vessel in cases of vessel referenced to another as a Pipe track vehicle
18	Vessel	s	Name of the vessel that preceding data applies to

¹ Working Ellipsoid position

² Working Map Projection position, units are as configured for the Map Projection

CABLE EVENT FILES

Cable event file data and data point records are stored as ASCII, free formatted, comma-delimited fields as follows:

CABLE EVENT (*.CET) RECORDS

Field	Data	Format	Comment
1	Name	s	Event title
2	Date/Time	f.fff	PC time of event (s)
3	Icon	d	Icon index, see Icon list below
4	CRD	f.fff	Cumulative route distance (m)
5	IRD	f.fff	Incremental route distance (m)
6	CCD	f.fff	Cumulative cable distance (m)
7	ICD	f.fff	Incremental cable distance (m)
8	CumSlack	f.fff	Cumulative slack (%)
9	IncSlack	f.fff	Incremental slack (%)
10	CableTension	f.fff	Cable Tension (tones)
The following fields are repeated for all vehicles			
...	Lat	[N/S]dd mm.mmmm	Latitude of fix
...	Lon	[W/E]ddd mm.mmmm	Longitude of fix
...	Northing	[-]f.ff	Grid Northing of fix ¹
...	Easting	[-]f.ff	Grid Easting of fix ¹
...	Depth	f.fff	Water depth of fix (m)
...	Heading	f.ff	Vessel's heading (T)
...	CMG	f.ff	Vessel's course made good (Grid)
...	Speed	f.ff	Vessel's speed (knots)
...	CRD	f.ff	Cumulative Route Distance (m)
...	IRD	f.ff	Incremental Route Distance (m)
...	Vessel	s	Name of the vessel that the preceding data applies to

¹ Units are not included in the field and are based upon Map Projection units, default is metres.

ICON LIST

Value	Description	Value	Description
0	KM mark	5	Transition-Cable end
1	Splice Box	6	Square
2	Transition	7	Circle
3	Repeater	8	Triangle
4	Branch		

TRANSPONDER FILES

Transponder file data and data point records are stored as ASCII, free formatted, comma-delimited fields as follows:

TRANSPONDER (*.XPT) RECORDS

Field	Data	Format	Comment
1	Name	text	Station name
2	Latitude	s	Latitude of monument in dd mm ss.ssss
3	Longitude	s	Longitude of monument in dd mm ss.ssss
4	Depth	f.fff	Depth of monument (m)
5	Sensor Offset	f.fff	Vertical offset of depth sensor from the transducer
6	Sensor Calibration	f.fff	Depth sensor calibration value to be added to a (negative) depth value (m).
7	Rx Code	s	Receive frequency or command
8	Tx Code	s	Transmit frequency or channel
9	Beacon Code	s	For a USBL beacon, the beacon ID
10	Transponder Type	d	Integer code defining the transponder type/application (see Transponder Types table)
11	Range correction	f.fff	Turn around time not accounted for by the LBL system (ms)
12	TQ Count	d	Transponder temperature sensor count
13	TQ Time	f.fff	Time temperature count was obtained (s)
12	Address	s	Transponder address
13	Model	s	Transponder model (see Transponder Models table)
14	Network	s	Name network transponder is associated with
15	Number Cyclic Commands	d	In case of Cyclic transponder, number of commands uploaded to transponder
16	IIF	s	Individual interrogation frequency or channel
Next field repeated for every cyclic command (Num Cyclic Cmds)			
17...	Cyclic Cmd	s	Command uploaded to the Cyclic transponder, in the order they were uploaded
...	Digiquartz	d	Digiquartz depth sensor flag, 0=non-digiquartz; 1=digiquartz
...	Inclinometer sensor	d	Inclinometer code, 0=no inclinometer; 1= internal inclinometer; 2=external

...	Conductivity sensor	d	inclinometer Conductivity sensor flag, 0=no sensor; 1=sensor
...	Depth Rating for digiquartz	d	Digiquartz sensor depth rating, 0=not deep water rated; 1 deep water rated
...	Quick Measurement	d	Digiquartz short observation period flag
...	Water Density	f.fff	Water density (kg/m ³)
...	Formula Number	d	Formula used index, currently only 1 available so value is always 1
...	Atmospheric Pressure	f.fff	Atmospheric pressure value (mb)
...	Height Of Instrument above monument	f.fff	Height of the transducer above the monument (m)
...	Double Occupancy	d	Double occupancy flag (i.e. multiple transponders located at this station), 0=No; 1=yes
...	Number of Other Occupants	d	Number of transponders located at this station

Next field repeated for every occupant index (5)

...	Occupant	d	Index of transponder(s) in this file of other co-located transponders

The following 14 fields contain the digiquartz depth sensor calibration coefficients

...	Digiquartz calibration coefficients	f.fxxxxx	Digiquartz coefficient fields are in the following order: X0, Y1, Y2, Y3, C1, C2, C3, D1, D2, T1, T2, T3, T4, T5
...	Digiquartz observation period	f.fxxxxx	The digiquartz observation period for the Rovnav MK4 (s)

The following fields contain the statistical data derived from a calibration:

...	Error Ellipse major axis	f.fxxxxx	Absolute station error ellipse semi-major axis (m)
...	Error Ellipse minor axis	f.fxxxxx	Absolute station error ellipse semi-minor (m)
...	Error Ellipse orientation	f.fxxxxx	Absolute station error ellipse orientation (d)
...	A Posteriori baselines only	f.fxxxxx	The a posteriori variance factor for the baseline component only
...	Number of Relative Error Ellipses	d	The number of relative error ellipse associated with this station

The following 7 fields are repeated for each relative error ellipse

...	error ellipse major axis	f.fxxxxxx	Relative station error ellipse semi-major axis (m)
...	error ellipse minor axis	f.fxxxxxx	Relative station error ellipse semi-minor axis (m)

...	error ellipse orientation	f.ffffff	Relative station error ellipse orientation (d)
...	error ellipse easting	f.ffffff	The Easting that the relative error ellipse is to be drawn graphically.
...	error ellipse northing	f.ffffff	The Northing that the relative error ellipse is to be drawn graphically.
...	To X	f.ffffff	The Easting of the station associated with this error ellipse
...	To Y	f.ffffff	The Northing of the station associated with this error ellipse

The following fields contain the status of the transponder determined by querying the unit. Refer to the manufacturers manual for details.

...	Reply channel	s	Individual Reply channel
...	range correction	f.fff	Turn around time (ms)
...	Firmware version	s	Firmware version
...	Jitter on	c	MK3: Jitter suppression flag (J=on, x=off)
...	Tilted	c	MK4: ,not used, set to x MK3: not used, set to x MK4: indicates if transponder is on it side, J=tilted, x=not tilted
...	Lbl Power	d	Power level used to reply to CIF and IIF interrogations
...	First Telemetry Pulse	d	Power level used for the first pulse of a telemetry reply
...	Telemetry data power	d	Power level used for telemetry pulses after the first
...	Battery type	c	Battery type, N= Nickel Cadmium; A=Alkaline; L=Lithium
...	Battery count	d	Battery count
...	Battery override	c	Low battery override flag, O= On; x=off
...	Battery Count Alarm	c	Battery count alarm flag, B=count has exceeded low battery condition; x=count within tolerance
...	Battery voltage	f.fff	Battery voltage (v)
...	Enabled	c	Transponder enabled flag, E=enabled; D=disabled
...	CIF enabled	c	Transponder enabled to respond to CIF, E=enabled; D=disabled
...	IIF enabled	c	Transponder enabled to respond to IIF, E=enabled; D=disabled
...	USBL enabled	c	Transponder enabled to respond to USBL, E=enabled; D=disabled

...	Gain	d	Transponder receiver gain setting
...	IIF reply mode	s	IIF reply mode, CRF, FSI, RLY or Fnn
...	Wait before transmit	f.fff	Wait before transmission (s)
...	Wait before reply	f.fff	Wait during reception (s)
...	Wait between telemetry	f.fff	Wait during cycle (s)
...	Address	s	Transponder address
...	Simultaneous receiver card	d	Simultaneous receiver card flag, 2=installed; 1=not installed; 0=unknown
...	Power lbl	d	Transponder transmit low power level flag, 1=low power; 2=not low power
...	Time of this status data	f.fff	PC time of latest status query, regardless of type
Static Transceiver Parameters			
...	"~WFRG~Static~Tcvr~Start"	s	Start of static transceiver settings indicator
...	CRP Latitude	f.ffffffff	Latitude of the CRP of fixed structure transceivers located on (degrees).
...	CRP Longitude	f.ffffffff	Longitude of the CRP of fixed structure transceivers located on (degrees).
...	CRP Depth	f.fff	Depth of the CRP of fixed structure transceivers located on (m).
...	True Orientation	f.ffffffff	True azimuth of fixed structure transceivers located on ((degrees T).
...	Pitch	f.ffffffff	Pitch of fixed structure transceivers located on (degrees).
...	Roll	f.ffffffff	Roll of fixed structure transceivers located on (degrees).
...	Offset forward	f.fff	Fore/aft offset of transceiver from CRP (m)
...	Offset starboard	f.fff	Port/starboard offset of transceiver from CRP (m)
...	Offset Up	f.fff	Vertical offset of transceiver from CRP (m)
...	Transceiver Latitude	f.ffffffff	Latitude of the transceiver (degrees).
...	Transceiver Longitude	f.ffffffff	Longitude of the transceiver (degrees).
...	Transceiver Depth	f.fff	Depth of the transceiver (m).
...	Scale Offsets To Projection	d	Offset scale flag, 1 = scale offsets to map projection

...	pitchCorrection	f.fff	(absolute positioning); 0 = do not scale offsets to map projectin (relative positioning) Pitch correction determined for the transponders inclinometer (degrees).
...	rollCorrection	f.fff	Roll correction determined for the transponders inclinometer (degrees).
...	inclinometerModel	d	Inclinometer model index, 0= MK4 14.5°; 1=MK3 14.5°; 2=MK4 90°; 3=MK4 5°; 4=other
...	inclinometerFactor	f.fff	Scale factor for <i>other</i> inclinometer type.

TRANSPONDER TYPES

Code	Transponder Type
0	Fixed LBL Transponder
1	Relay LBL Transponder
2	LBL Responder
3	Simultaneous LBL Transponder
4	Cyclic LBL Transponder
5	Sequential LBL Transponder
6	Static LBL Transceiver
7	Static Simultaneous LBL Transponder
8	Dynamic Array LBL Transponder
9	Synchronized LBL Pinger
10	Fixed USBL Transponder
11	Dynamic USBL Transponder
12	Fixed USBL Pinger
13	Dynamic USBL Pinger
14	Fixed USBL Responder
15	Dynamic USBL Responder
16	Unknown

TRANSPONDER MODELS

Term	Transponder Model
Generic	Generic LBL Transponder or USBL beacon
MK-III	Sonardyne MK3 Compatt LBL transponder
MK-IV	Sonardyne MK4 Compatt LBL transponder
SIMRAD 400	Kongsberg-Simrad USBL beacon
SeaFac	SeaFac LBL transponder

SOUND VELOCITY FILES

Sound velocity file data and data point records are stored as ASCII, free formatted, comma-delimited fields as follows:

SOUND VELOCITY (*.VEL) RECORDS

Field	Data	Format	Comment
1	Type	d	Velocity type (not used, default = 0)
2	Depth	f.fff	Depth ¹ (m)
3	Velocity	f.fff	Sound velocity (m/s)

¹ Sign convention for depth in file is negative. Upon loading, all depth values are forced to negative by WinFrog.

WINFROG RAW FILE FORMATS

Raw data files are stored as ASCII, free formatted, comma-delimited fields. Each record begins with a type code and is terminated with a carriage return line feed. The type code consists of three digits, followed by a dash, then the version number for the particular record followed by another dash and the letter W. The three-digit type codes are defined as follows:

TYPE 300 FORMAT

Field	Data	Format	Comment
1	Code	300	Vehicle Navigation Data
2	Vehicle Name	text	
3	Time	Floating point number	GPS time in seconds of the raw data record
4	Center Latitude	Floating point number	Latitude of fix at CRP
5	Center Longitude	Floating point number	Longitude of fix at CRP
6	Center Height	Floating point number	Elevation of fix at CRP in meters
7	Reference Latitude	Floating point number	Latitude of fix at Tracked Offset
8	Reference Longitude	Floating point number	Longitude of fix at Tracked Offset
9	Depth	Floating point number	Water depth including offset and tide if enabled (m)
10	Heading	Floating point number	Vessel's heading – filtering and offsets applied if enabled (deg)
11	Course made good	Floating point number	Vessel's course made good – based on the vessels filtered northerly and easterly velocities (deg)
12	Speed	Floating point number	Vessel's speed - based on the vessels filtered northerly and easterly velocities (knots)
13	Speed North	Floating point number	Vessel's filtered northerly velocity (m/s)
14	Speed East	Floating point number	Vessel's filtered easterly velocity (m/s)
15	Last Data Time	Floating point number	Time of the previous position data (s) (i.e. the last time the PsnData data items were updated)
16	Position Alarm	Integer	Filtered position status indicator: 0 – Position is good 1 – Position is degraded (i.e. position calculation failed for > 15 seconds) 2 – Position is bad (i.e. position calculation failed for > 30 seconds)
17	Cable Count	Floating point number	In meters
18	Cable Tension	Floating point number	In metric tons
19	Cable Count Channel 2	Floating point number	In meters
20	Cable Tension Channel 2	Floating point number	In metric tons
21	Cable Burial Depth	Floating point number	In Centimeters
22	Cable Trench	Floating point number	In Centimeters; includes trench depth

Field	Data	Format	Comment
	Depth		offset
23	Number of Unknowns	Integer	Number of values solved for
24	Matrix[0][0]	Floating point number	Element 0,0 of the current filter covariance matrix
25	Matrix [0][2]	Floating point number	Element 0,2 of the current filter covariance matrix
26	Matrix [1][1]	Floating point number	Element 1,1 of the current filter covariance matrix
27	Matrix [1][3]	Floating point number	Element 1,3 of the current filter covariance matrix
28	Matrix [2][2]	Floating point number	Element 2,2 of the current filter covariance matrix
29	Matrix [3][3]	Floating point number	Element 3,3 of the current filter covariance matrix
30	Distance To Event	Floating point number	Approximate dDistance to the next event (metres)
31	Height	Floating point number	Height above MSL or depth below surface in meters; includes applicable offsets
32	Speed Through Water	Floating point number	In Knots; not filtered
33	Cable Angle	Floating point number	Cable angle provided by cable counter device Degrees
34	Cable speed	Floating point number	Cable speed provided by cable counter (m/s or m/min)
35	Cable speed channel 2	Floating point number	Cable speed provided by cable counter (m/s or m/min)
36	Jet Knife Angle	Floating point number	Degrees
37	Jet Knife Depth	Floating point number	Metres
38	Desired winch speed	Floating point number	Cable model; m/min
39	Desired Tension	Floating point number	Cable model; tonnes
40	Depressor angle	Floating point number	Degrees
41	Stinger angle	Floating point number	Degrees
42	Cable count channel 3	Floating point number	Cable count provided by cable counter device metres
43	Cable tension channel 3	Floating point number	Cable tension provided by cable counter device Tonnes
44	Cable speed channel 3	Floating point number	Cable speed provided by cable counter (m/s or m/min)
45	Cable count channel 4	Floating point number	Cable count provided by cable counter device metres
46	Cable tension channel 4	Floating point number	Cable tension provided by cable counter device Tonnes
47	Cable speed channel 4	Floating point number	Cable speed provided by cable counter (m/s or m/min)
48	Cable count channel 5	Floating point number	Cable count provided by cable counter device metres
49	Cable tension channel 5	Floating point number	Cable tension provided by cable counter device Tonnes

Field	Data	Format	Comment
50	Cable speed channel 5	Floating point number	Cable speed provided by cable counter (m/s or m/min)
51	Pitch	Floating point number	Degrees
52	Roll	Floating point number	Degrees
53	Roll Accuracy	Floating point number	Degrees
54	Pitch Accuracy	Floating point number	Degrees
55	Heave	Floating point number	metres
56	Attitude Status	Integer	0=Good all other numbers=Bad
57	Heading accuracy	Floating point number	Degrees
58	Heading flag	Floating point number	0=no aiding 1=GPS aiding 2=GPS and GAMS aiding
59	Altitude	Floating point number	Metres. Includes offset
60	Raw Altitude	Floating point number	Metres. Observed
61	Acoustic Id	Text	Beacon
62	Acoustic Status	Text	Good or Bad
63	Num LBL Observations	Integer	Number of LBL observations used in record
64	RMS of LBL Residuals	Floating point number	Metres
65	Std. Dev. of LBL Observations	Floating point number	Metres (root of trace of covariance matrix)
66	Depressor Height	Floating point number	m
67	Attitude update time	Floating point number	Time attitude data was received (seconds)

Note: - Above positions are filtered and are referenced to the working ellipsoid. (300 records sent over sockets to a remote computer have positions reference to WGS84)

TYPE 302 FORMAT

Field	Data	Format	Comment
1	Code	302	GPS Data – NMEA GPGSA message: GPS DOP and active satellites
2	name	Text	Device name
3	fixMode	d	1 – Fix not available 2 – 2D fix 3 – 3D fix
4	heightMode	c	A = Automatics 2D/3D M = Manual, forced to operate in 2D or 3D mode
5	prnUsed[0]	d	GPS satellite tracked on channel 1
6	prnUsed[1]	d	GPS satellite tracked on channel 2
7	prnUsed[2]	d	GPS satellite tracked on channel 3
8	prnUsed[3]	d	GPS satellite tracked on channel 4
9	prnUsed[4]	d	GPS satellite tracked on channel 5
10	prnUsed[5]	d	GPS satellite tracked on channel 6
11	prnUsed[6]	d	GPS satellite tracked on channel 7
12	prnUsed[7]	d	GPS satellite tracked on channel 8
13	prnUsed[8]	d	GPS satellite tracked on channel 9
14	prnUsed[9]	d	GPS satellite tracked on channel 10
15	prnUsed[10]	d	GPS satellite tracked on channel 11
16	prnUsed[11]	d	GPS satellite tracked on channel 12
17	pdop	f.d	Position Dilution Of Precision
18	hdop	f.d	Horizontal Dilution Of Precision
19	vdop	f.d	Vertical Dilution Of Precision

TYPE 303 FORMAT

Field	Data	Format	Comment
1	Code	303	GPS Data – NMEA GGA message: Time, GPS fix data, position, and fix related data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	utc	f.dd	UTC time of fix in seconds – read from GGA data string output by the receiver
5	lat*	[-]dd.mmmmmmmm	Latitude of fix
6	lon*	[-]ddd.mmmmmmmm	Longitude of fix
7	status*	d	Fix quality : 0 = invalid 1 = GPS fix 2 = DGPS fix
8	satsUsed*	dd	Number of satellites used
9	hdop*	f.d	Horizontal Dilution Of precision
10	alt*	f.dd	Meters, above mean sea level
11	geoid*	f.dd	Height of geoid in meters (mean sea level) above WGS84 ellipsoid
12	dgpsAge	f.dd	time in seconds since last DGPS update
13	refStn*	d	DGPS station ID number

* data read directly from NMEA GGA string output by the GPS receiver

TYPE 304 FORMAT

Field	Data	Format	Comment
1	Code	304	GPS Data – NMEA GPGSV message: GPS satellites in view
2	name	text	Device name
3	satCount	dd	Number of satellites used
4	prn	d	Unique satellite identification (satellite PRN number)
5	sn	d	Signal to noise ratio
6	elev	d	Of satellite above the horizon, degrees, 90 degree maximum
7	azimuth	d	Of satellite, degrees True, 000 to 359

** prn, sn, elev, and azimuth are repeated for each Satellite used

TYPE 305 FORMAT

Field	Data	Format	Comment
1	Code	305	GPGPS Data
2	name	text	Device name
3	satCount*	dd	Number of satellites used
4	prn*	dd	Unique satellite identification number of a tracked GPS satellite
5	rangeRes*	d	Range residual (m)
6	hres*	f.d	Horizontal position residual (m)
7	vres*	f.d	Vertical position residual (m)

* data read directly from data string output by the GPS receiver

** PRN and RangeRes are repeated for each satellite used

TYPE 306 FORMAT

Field	Data	Format	Comment
1	Code	306	GPS Data – NMEA GPGST message: Position Error Statistics
2	name	text	Device name
3	time	f.dd	PC time in seconds
4	utc	f.dd	Time of fix in seconds – read from GST data string output by the receiver
5	rms*	f.d	RMS value of the pseudorange residuals
6	smjrA*	f.d	Error ellipse semi-major axis 1 sigma error (meters)
7	smjrB*	f.d	Error ellipse semi-minor axis 1 sigma error (meters)
8	smjrOrient*	f.d	Error ellipse orientation (degrees from true north)
9	latStd*	f.d	Latitude 1 sigma error (meters)
10	lonStd*	f.d	Longitude 1 sigma error (meters)
11	altStd*	f.d	Altitude 1 sigma error (meters)

* data read directly from data string output by the GPS receiver

TYPE 307 FORMAT

Field	Data	Format	Comment
1	Code	307	GPS UKO data
2	name	ssss	device name
3	altitudeReferencedDatum*	c	altitude reference datum
4	dataReceivedTime	f.dd	PC time in seconds (GPS time if available) the position data was read
5	dataAge*	f.dd	Data age
6	dataCorrectedTime	f.dd	dataReceivedTime – dataAge
7	utc*	f.dd	UTC time output by the device
8	numberOfRefStns*	d	Number of reference stations used
9	refStnIDs[0]*	d	Reference Station ID
10	refStnIDs[1]*	d	Reference Station ID
11	refStnIDs[2]*	d	Reference Station ID
12	refStnIDs[3]*	d	Reference Station ID
13	refStnIDs[4]*	d	Reference Station ID
14	refStnIDs[5]*	d	Reference Station ID
15	refStnIDs[6]*	d	Reference Station ID
16	refStnIDs[7]*	d	Reference Station ID
17	refStnIDs[8]*	d	Reference Station ID
18	refStnIDs[9]*	d	Reference Station ID
19	unitVariance*	f.ddd	Unit variance
20	fTestResult*	d	1 = Pass 0 = Fail
21	svIDFailedWTest*	ssss	SV W-test status
22	LMDE*	f.dd	LMDE
23	svID_LMDE	ssss	SV used for LMDE calculation

* data read directly from data string output by the device

TYPE 308 FORMAT

Field	Data	Format	Comment
1	Code	308	GPS DTM data
2	name	ssss	device name
3	time	f.d	PC time in seconds (GPS time if available) the position data was read
4	localDatumCode	ssss	W84 or 999
5	localDatumSubdivisionCode	c	
6	latitudeOffset	f.dddddd	
7	longitudeOffset	f.dddddd	
8	altitudeOffset	f.dddddd	
9	referenceDatumCode	ssss	

TYPE 309 FORMAT

Field	Data	Format	Comment
0	Code	309-002-W	USBL Data
1	name	sssss	Operator entered device name
2	usblPitch	f.ff	Pitch of reference vessel in degrees, interpolated from the attitude datatype associated with the same vehicle.
3	usblRoll	f.ff	Roll of reference vessel in degrees, interpolated from the attitude datatype associated with the same vehicle.
4	time	f.fff	WinFrog time (seconds) the USBL data is valid for, currently the same as the data reception time stamp
5	code	ddd	Beacon code
6	x	f.fff	Raw USBL X value (meters)
7	y	f.fff	Raw USBL Y value (meters)
8	z	f.fff	Raw USBL Z value (meters), note this is negative for below hydrophone, positive for above hydrophone (possible when device is a surface rho/theta type)
9	status code	d	Data error code direct from USBL system
10	error condition	d	Error condition, options are no error condition (=0), error condition exists (=1) and warning condition (=2)
11	signal receive time	f.fff	WinFrog timestamp in seconds for the USBL data telegram reception by WinFrog.
12	hydrophone time	f.fff	WinFrog time in seconds that the hydrophone position is to be deskewed to, currently the same as the data reception timestamp.
13	centerEasting	f.ff	Calculated beacon vehicle CRP position map projection Easting (meters)
14	centerNorthing	f.ff	Calculated beacon vehicle CRP position map projection Northing (meters)
15	CenterHeight	f.ff	Calculated beacon vehicle CRP position height relative to water surface, i.e. below water surface is negative (meters)
16	RelativeUSBL EastCorrection	f.ff	The correction applied to the surface navigation derived CRP position Easting to produce a Relative USBL based position (meters)
17	RelativeUSBLNorth	f.ff	The correction applied to the surface

	Correction		navigation derived CRP position Northing to produce a Relative USBL based position (meters)
18	slantRange	f.fff	Slant range from the hydrophone head to the beacon, not corrected for vessel attitude. Note that this is decoded from the USBL telegram, not calculated. If the data is not directly available, this will be '0'.
19	twtt	f.fffff	Two-Way-Travel-Time for signal from hydrophone head to the beacon (ms)
20	heading	f.ff	Heading decoded from the USBL system, relevant to the data epoch. (decimal degrees)
21	pitch	f.fff	Pitch decoded from the USBL system, relevant to the data epoch. (decimal degrees)
22	roll	f.fff	Roll decoded from the USBL system, relevant to the data epoch. (decimal degrees)
23	age	f.fff	Age of data as decoded from the USBL system (s)
24	status	s	Status of data as received from the USBL system, system dependent.

TYPE 313 FORMAT

Field	Data	Format	Comment
1	Code	313	Transponder Data
2	name	text	Device name
3	time	f.dd	GPS time (seconds) the LBL data was read
4	lat	[.]dd.mmmmmmmmm	Latitude of transponder
5	lon	[-]ddd.mmmmmmmmm	Longitude of transponder

TYPE 323 FORMAT

Field	Data	Format	Comment
1	Code	323	Generic Data
2	name	text	Device Name

TYPE 350 FORMAT

Field	Data	Format	Comment
1	Code	350	Vehicle Event Data
2	vehicle	text	Vehicle name
3	evtType	text	"Timed Event On", "Distance Event On", or "Event Off"

TYPE 351 FORMAT

Field	Data	Format	Comment
1	Code	351	Vehicle Event Position Data
2	vehicle	text	Vehicle name
3	event	dd	Event number
4	lat	[-]dd.mmmmmmmm	Latitude of fix at tracked offset
5	lon	[-]ddd.mmmmmmmm	Longitude of fix at tracked offset
6	time	f.dd	Event time (GPS time in seconds)
7	depth	f.dd	Water depth including offset and tide if enabled (m)
8	cmg	f.dd	Vessel's course made good in degrees – based on the vessels filtered northerly and easterly velocities
9	speed	f.dd	Vessel's speed in knots - based on the vessels filtered northerly and easterly velocities

Note: - Above positions are filtered and are referenced to the working ellipsoid.

TYPE 352 FORMAT

Field	Data	Format	Comment
1	Code	352	Event Data
2	vehicle	text	Vehicle name
3	time	f.dd	PC time in seconds (GPS time if available) of the event
4	number	d	Event number
5		d	1
6	lat	[-]dd.mmmmmmmm	Latitude of fix at Tracked Offset
7	lon	[-]ddd.mmmmmmmm	Longitude of fix at CRP
8	height	f.dd	Height above MSL or depth below surface in meters; includes applicable offsets
9	depth	f.dd	Water depth including offset and tide if enabled (m)
10	offLine	f.dd	Offline distance (m)
11	alongLine	f.dd	Alongline distance (m)
12	heading	f.dd	Vessel's heading in degrees – filtering and offsets applied if enabled
13	cmg	f.dd	Vessel's course made good in degrees – based on the vessels filtered northerly and easterly velocities
14	speed	f.dd	Vessel's speed in knots - based on the vessels filtered northerly and easterly velocities
15	rms	f.dd	
16	offsetName	ssss	Current tracked offset
17	vehicle	ssss	vehicle name
18	kP	f.dd	Current kilometer post
19	cableCount	f.dd	Current cable count (m)
20	cableTension	f.dd	Current cable tension (T)
21	cableSpeed	f.dd	Current cable payout speed (m/min)
22	cableAngle	f.dd	Current cable angle (deg)
23	burialDepth	f.dd	Current cable burial depth (cm)

- above positions are filtered

TYPE 353 FORMAT

Field	Data	Format	Comment
1	Code	353	Vehicle Position Data
2	vehicle	text	Vehicle name
3	missEvents	text	"Missed Events dd to dd"

TYPE 372 FORMAT

Field	Data	Format	Comment
1	Code	313	Elevation Data
2	device	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	elev	f.dd	Elevation output from device in meters
5	status	d	0 – invalid data 1 – valid data
6	centerElev	f.dd	Elevation value adjusted by the sensor offsets (in meters)
7	rawData	f.dddddd	Raw pressure reading from device in PSI
8	temperature	f.dd	Temperature reading from device in Celsius
9	relativeHumidity	f.ddd	Relative Humidity reading from device

TYPE 373 FORMAT

Field	Data	Format	Comment
1	Code	373	Wind Data
2	device	text	Device Name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	Speed	f.dd	Wind speed in specified units (field 6)
5	Direction	f.d	Wind direction (relative or true specified in field 7)
6	Units		Wind speed units
7	Type		Wind direction type (relative or true)
8	Status	Character	Status ('A' or 'V')

TYPE 374 FORMAT

Field	Data	Format	Comment
1	Code	374	Wind Data
2	Device	Text	Device Name
3	Time	f.dd	PC time in seconds (GPS time if available) the data was read
4	Ship speed	f.dd	Ship Speed in Knots
5	Ship Heading	f.d	Ship Heading (True)
6	Wind Speed true	f.d	In units specified in field 7
7	Wind Speed Units	Text	Knots
8	Wind Direction True	f.d	Degrees
9	Relative wind speed (apparent)	f.d	In units specified in field 10
10	Wind Speed Units	Text	Knots
11	Relative wind direction (apparent)	f.d	Degrees
12	Wind Direction Type	Text	"Rel" If the observed data was relative and the true data was calculated. "True" If the observed data was true and the relative data was calculated.
13	Status	Character	Status ('A' = valid, 'V' = not valid or "-" status not available)

TYPE 380 FORMAT

Field	Data	Format	Comment
1	Code	380	Tide Data
2	name	text	Device Name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	tide*	f.dd	Tide level (m)
5	status*	d	0 = Bad Data 1 = Good Data

*data output directly from the device

TYPE 390 FORMAT

Field	Data	Format	Comment
1	Code	390	Dynamic Tracking and Pipe Catenary Data
2	PIPE CATENARY	text	PIPE CATENARY
3	time	Floating point number	PC time in seconds (GPS time if available) the data was read
4	Vehicle Name	Text	Vehicle that data is measured from
5	Index	Integer	If 6 is Yes then this is an index to the "from vehicle" offset list that is the reference point on the "from vehicle"
6	Use manual offset point or one from the list of the "from vehicles"	Text	Yes= Use reference point from offset list. No = Use manual entered values for reference point
7	Offset Port/Starboard	Floating point number	Reference point offset on "From Vehicle"
8	Offset Fore/Aft	Floating point number	Reference point offset on "From Vehicle"
9	Offset Up/Down	Floating point number	Reference point offset on "From Vehicle"
10	Index	Integer	If 11 is Yes then this is an index to the "to vehicle" offset list that is the reference point on the "to vehicle"
11	Use manual offset point or one from the list of the "to vehicles"	Text	Yes= Use reference point from offset list. No = Use manual entered values for reference point
12	Offset Port/Starboard	Floating point number	Reference point offset on "To Vehicle"
13	Offset Fore/Aft	Floating point number	Reference point offset on "To Vehicle"
14	Offset Up/Down	Floating point number	Reference point offset on "To Vehicle"
15	Offset name, "from vehicle"	Text	Name of offset point used on this vehicle if field 11 is yes
16	Offset name, "to vehicle"	Text	Name of offset point used on this vehicle if field 11 is yes
17	Vehicle name	Text	Vehicle that data is measured to
18	Northing "from vehicle"	Floating point number	Northing of reference point on vehicle
19	Easting "from vehicle"	Floating point number	Easting of reference point on vehicle
20	Height "from vehicle"	Floating point number	Height of reference point on vehicle
21	Northing "to vehicle"	Floating point number	Northing of reference point on vehicle
22	Easting "to vehicle"	Floating point number	Easting of reference point on vehicle
23	Height "to vehicle"	Floating point number	Height of reference point on vehicle

24	Index	Integer	Index of this dynamic target pairs (1 to 5)
25	Calculate pipe catenary	Text	Yes or No
26	Touch down depth source	Integer	0 = the water depth assigned to the ROV will be used for the catenary calculation. 1 = that the operator entered a manual value (field 27) will be used for the catenary calculation. 2 = the depth assigned to the ROV will be used for the catenary calculation.
27	Manually entered depth	Floating point number	Depth the operator entered
28	Catenary depth	Floating point number	Depth used for catenary calculation
29	Layback	Floating point number	Distance between “from vehicle’s” reference point and “to vehicle’s” reference point to calculate catenary
30	Length	Floating point number	Calculated length of pipe to touch down
31	Angle	Floating point number	Calculated angle of pipe at the “from vehicle”
32	Water depth offset	Floating point number	Offset entered by operator which is added to the ROV’s water depth to get the vertical value for the catenary calculation. Used when item 26 = 1.
33	ROV altitude zero	Text	Yes or No Yes means that the altitude from the ROV device is zero indicating the water depth is bad. If the manual depth is used then this is always no. No means that the altitude from the ROV device is non-zero.
34	ROV depth offset	Floating point number	Offset entered by operator which is added to the ROV’s depth to get the vertical value for the catenary calculation. Used when item 26 = 2.

TYPE 402 FORMAT

Field	Data	Format	Comment
1	Code	402	Speed Log Data
2	name	text	Speed log name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	foreAft	f.dd	Filtered fore/aft velocity in m/s
5	portStbd	f.dd	Filtered port/stbd velocity in m/s
6	rUpDown	f.dd	Raw up/down velocity in m/s
7	rforeAft	f.dd	Raw fore/aft velocity in m/s
8	rPortStbd	f.dd	Raw port/stbd velocity in m/s
9	wForeAft	f.dd	Raw fore/aft speed thru water in m/s
10	wPortStbd	f.dd	Raw port/stbd speed thru water in m/s
11	wUpDown	f.dd	Raw up/down speed thru water in m/s
12	status		Data status: 0 – data relative to memory 1 – data relative to water 2 – data relative to bottom

TYPE 410 FORMAT

Field	Data	Format	Comment
1	Code	410	Gyro Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read (time of first heading record in data string)
4	heading	f.d	Raw heading output from device (in degrees)
5	status	d	
6	dTime	f.dd	Delta time from first time field (in seconds)

**heading, status, and dTime are repeated 15 times

TYPE 411 FORMAT

Field	Data	Format	Comment
1	Code	411	Echo Sounder Data
2	name	text(_text)	Device name (_Transducer Name)
3	time	f.dd	PC time in seconds (GPS time if available) the data was read (time of first depth record in data string)
4	depth	f.dd	Depth read from device in meters
5	status	d	
6	dTime	f.dd	Delta time from first time field (in seconds)

**depth, status, and dTime are repeated 15 times

TYPE 413 FORMAT

Field	Data	Format	Comment
1	Code	413 version 3	Attitude data
2	name	Text	Device name
3	time	Floating point number	PC time in seconds (GPS time if available) the data was read
4	pitch	Floating point number	Calculated pitch (degrees)
5	roll	Floating point number	Calculated roll (degrees)
6	status	Integer	0 = valid data 1 = invalid data
7	Roll Accuracy	Floating point number	m
8	Pitch Accuracy	Floating point number	m
9	Heave	Floating point number	m
10	Status Code	Integer	Device specific code

TYPE 420 FORMAT

Field	Data	Format	Comment
1	Code	420	LBL Hydrophone Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available)
4	sensorNorth	f.d	Hydrophone Northing (m)
5	sensorEast	f.d	Hydrophone Easting (m)
6	sensorHeight	f.d	Hydrophone height (m)
7	solRms	f.d	Solution RMS
8	lastSolutionStatus	dd	Last solution status
9	txCode	Text	Hydrophone tx code
10	ducerNum	ddd	Hydrophone number

***txCode repeated for each Hydrophone

TYPE 421 FORMAT

Field	Data	Format	Comment
0	Code	421-001-W	LBL Data
1	Name	text	Device name
2	Time	f.dd	PC time in seconds (GPS time if available)
3	sensorNorth	f.d	Transponder northing (m)
4	sensorEast	f.d	Transponder Easting (m)
5	sensorHeight	f.d	Transponder height (m)
6	solRms	f.d	Solution Root Mean Square Error (RMS)
7	lastSolutionStatus	ddd	Last solution status
8	txCode	text	Transponder transmit code
9	ducerNum	ddd	Transponder number
10	depth	f.dd	Transponder depth in meters
			For each transponder in the list
11	code	text	Transponder Code
12	travelTime	f.dd	Travel time from the transponder to the transducer in meters / second

TYPE 424 FORMAT

Field	Data	Format	Comment
0	Code	424-001-W	Acoustic Monitor Data
1	Name	text	Device name
2	Time	f.dd	PC time in seconds (GPS time if available)
3	Monitor ID	Integer	
4	Status	Text	"Good" = Solution was OK "Failed" = Solution was not OK
5	Num LBL Observations	Integer	Number of LBL observations used in record
6	RMS of LBL Residuals	Floating point number	Metres
7	Std. Dev. of LBL Observations	Floating point number	Metres

TYPE 432 FORMAT

Field	Data	Format	Comment
1	Code	432	RSIM Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	utc*	f.dd	UTC Time
5	refStn*	ddd	ID of RTCM source
6	status	d	Status
7	dLat*	[-]f.ddd	Latitude correction
8	dLon*	[-]f.ddd	Longitude correction
9	dHeight*	f. dd	Height correction
10	satsUsed*	dd	Number of satellites
11	hdop*	f.dd	Horizontal Dilution Of Precision
12	dgpsAge*	f.d	Age of DGPS correction
13	refLat	[-]dd.mmmmmmmmmmmmm	Reference latitude
14	refLon	[-]ddd.mmmmmmmmmmmmm	Reference longitude
15	refHeight	f.ddd	Reference height

* data read directly from data string output by the device

TYPE 450 FORMAT

Field	Data	Format	Comment
1	Code	450	PSN Data output to DP
2	name	text	Vehicle name
3	time	f.dd	The last Position time in seconds
4	CenterLat	[-]dd.mmmmmmmm	Latitude of fix at CRP
5	CenterLon	[-]ddd.mmmmmmmm	Longitude of fix at CRP
6	waypointX	[-]dd.mmmmmmmm	Latitude of tracked waypoint
7	waypointY	[-]ddd.mmmmmmmm	Longitude of tracked waypoint
8	desiredBrg	f.ddd	Desired bearing computed based on current CRP position and tracked waypoint (degrees)
9	desiredSpeed	f.ddd	Desired speed based on output configuration
10	desiredRange	f.ddd	Current range from CRP to the tracked waypoint (meters)
11	currentX	f.dddddddd	Computed northing of tracked waypoint (meters)
12	currentY	f.dddddddd	Computed Easting of tracked waypoint (meters)

Note: - Above positions are filtered and are referenced to the working ellipsoid.

TYPE 451 FORMAT

Field	Data	Format	Comment
1	code	451	Data telegram output by device
2	name	text	Device name
3	time	floating point number	AUV Position time in seconds
4	\$PUSBA	text	Header
5	time	hh:mm:ss.sss	Hours:minutes:seconds
6	AUV latitude	DDMM.MMMM	Degrees (D) and minutes (M)
7	N or S	text	Hemisphere
8	AUV longitude	DDDMM.MMMM	Degrees (D) and minutes (M)
9	E or W	text	Hemisphere

The next three values depend on operator selections.

If the filter flag (field 22) is F then:

10	Variance lat	floating point number	Meters ² (Either the kalman filter value or the manual value is selected)
11	Variance long	floating point number	Meters ² (Either the kalman filter value or the manual value is selected)
12	Covariance	floating point number	Either the kalman filter value or 0 if the manual value is selected

If the filter flag (field 22) is R then:

10	Variance lat	floating point number	Meters ² (Either calculated using covariance law from the manually entered error range and bearing or manual value)
11	Variance long	floating point number	Meters ² (Either calculated using covariance law from the manually entered error range and bearing or manual value)
12	Covariance	floating point number	Either calculated using covariance law from the manually entered error range and bearing or 0 if the manual values are selected
13	Standard deviation range	floating point number	Operator entered value
14	Standard deviation angle	floating point number	Operator entered value
15	Slant range	floating point number	Meters
16	Age of observation	integer	Seconds
17	Ship latitude	DDMM.MMMM	Degrees (D) and minutes (M)
18	N or S	text	Hemisphere
19	Ship longitude	DDDMM.MMMM	Degrees (D) and minutes (M)
20	E or W	text	Hemisphere
21	Height	floating point number	Meters
22	R or F	text	Filter flag

Note: - The maximum length is 512 characters.

TYPE 452 FORMAT

Field	Data	Format	Comment
1	Code	452	RTCM output record
2	Name	Text	Device name
3	Time	Floating point number	Time in seconds that an RTCM record was sent.
4	Reference station	Integer	RTCM reference station number

TYPE 455 FORMAT

Field	Data	Format	Comment
1	Code	455	Analog Speed Data output
2	name	text	Vehicle name
3	time	f.dd	PC time in seconds (GPS time if available) of the first speed record in the data string
4	speed	f.d	When tracking a line, downline or offline speed (filtered, knots). Otherwise the vessel's speed in knots - based on the vessels filtered northerly and easterly velocities.
5	deltaTime	f.dd	Delta time from first time field (in seconds)

** speed and deltaTime are repeated 15 times

TYPE 456 FORMAT

Field	Data	Format	Comment
1	Code	456	Cable data
2	name	ssss	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	OutTADStr	ssss	
5	OutSHPStr	ssss	
6	OutGLLStr	ssss	
7	OutLAYStr	ssss	
8	OutPORStr	ssss	
9	OutSTAStr	ssss	

TYPE 457 FORMAT

Field	Data	Format	Comment
1	Code	457	Cascade output data
2	name	ssss	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	outDataStr	sss	Data string output by the device

TYPE 490 FORMAT

Field	Data	Format	Comment
1	Code	490	Plow Data
2	Name	text	Device name
3	Time	f.dd	PC time in seconds (GPS time if available) the data was read
4	portPull	f.dd	Port tow tension (kN)
5	stbdPull	f.dd	Starboard tow tension (kN)
6	asLaidTension	f.dd	As laid tension (kN)
7	depHeight	f.dd	Depressor height (cm)
8	trenchDepth	f.dd	Trench depth (cm)
9	pitch	f.dd	Pitch of plow (degrees)
10	roll	f.dd	Roll of plow (degrees)
11	subDepth	f.dd	Submerged depth of plow (m)
12	umbTension	f.dd	Umbilical tension (kN)
13	portSkidHeight	f.dd	Port skid height (cm)
14	stbdSkidHeight	f.dd	Starboard skid height (cm)
15	heading	f.dd	Heading of plow (degrees)
16	altitude	f.dd	Altitude of plow off seabed (cm)
17	speed	f.dd	Speed of plow (cm/s)
18	travel	f.dd	Distance traveled by plow (m)
19	shipTowTen	f.dd	Tow wire tension at ship (kN)
20	shipTowOut	f.dd	Length of tow wire out (m)
21	telTension	f.dd	Telephone cable tension (kN)
22	burialDepth	f.dd	Telephone cable burial depth (cm)
23	towTension	f.dd	Tow tension (kN or T)
24	calcTrenchDepth	f.dd	Calculated trench depth (cm)
25	calcBurialDepth	f.dd	Calculated burial depth (cm)
26	portSpeed	f.dd	Port speed (m/s)
27	stbdSpeed	f.dd	Starboard speed (m/s)
28	cableAngle	f.dd	Cable angle (deg)
29	towCableAngle	f.dd	Tow cable angle (deg)
30	plowSteerAngle	f.dd	Plow rudder angle (deg)
31	stingerAngle	f.dd	Plow stinger angle (deg)
32	depressorAngle	f.dd	Plow depressor angle (deg)
33	layback	f.dd	Distance of plow behind vessel (m)

TYPE 491 FORMAT

Field	Data	Format	Comment
1	Code	491	Innovatum Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	relHdg	ddd	Relative heading (degrees)
5	mode	d	Mode
6	solution	ddd	Solution
7	sigStrng	f.dd	Signal strength
8	horVid	ddd	Horizontal video overlay
9	depVid	ddd	Depth video overlay
10	srcType	ddd	Source type
11	horDisp	f.dd	Horizontal displacement (m)
12	horDispErr	f.dd	Horizontal displacement error (m)
13	vertDisp	f.dd	Vertical displacement (m)
14	vertDispErr	f.dd	Vertical displacement error (m)
15	burialDepth	f.dd	Burial depth (cm)
16	magCur	f.dd	Magnetic/Current (m)
17	altitude	f.ddd	Altitude (m)
18	pitch	f.dd	Pitch (deg)
19	roll	f.dd	Roll (deg)
20	absHdg	f.dd	Absolute Heading (deg)
21	timeSplit	f.dd	Time split (sec)
22	corrBurialDepth	f.dd	UnFiltered Front Burial Depth (cm)
23	rearSolution	ddd	Rear solution
24	rearX	f.dd	Rear X (m)
25	rearZ	f.dd	Rear Z (m)
26	corrBurialDepthBck	f.dd	UnFiltered Back Burial Depth (cm)

TYPE 492 FORMAT

Field	Data	Format	Comment
1	Code	492	Cable Counter Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	count	f.dd	Cable count (m)
5	countToEvent	f.dd	Distance to event (m)
6	velocity	f.dd	Cable payout speed (m/min)
7	tension	f.dd	Cable tension, scale and offset applied (tonnes)
8	scale	f.dd	Scale
9	offset	f.dd	Cable count offset (m)
10	countCh2	f.dd	Channel 2 cable count (m)
11	countToEventCh2	f.dd	Channel 2 distance to event (m)
12	velocityCh2	f.dd	Channel 2 cable payout speed (m/min)
13	tensionCh2	f.dd	Channel 2 cable tension, scale and offset applied
14	scaleCh2	ddd	Channel 2 Scale
15	status	ddd	Status
16	statusCh2	f.dd	Channel 2 Status
17	offsetCh2	f.dd	Channel 2 cable count offset (m)
18	countCh3	f.dd	Channel 3 cable count (m)
19	countToEventCh3	f.dd	Channel 3 distance to event (m)
20	velocityCh3	f.dd	Channel 3 cable payout speed (m/min)
21	tensionCh3	f.dd	Channel 3 cable tension, scale and offset applied
22	scaleCh3	f.dd	Channel 3 scale
23	offsetCh3	f.dd	Channel 3 cable count offset (m)
24	statusCh3	ddd	Channel 3 status
25	countCh4	f.dd	Channel 4 cable count (m)
26	countToEventCh4	f.dd	Channel 4 distance to event (m)
27	velocityCh4	f.dd	Channel 4 cable payout speed (m/min)
28	tensionCh4	f.dd	Channel 4 cable tension, scale and offset applied
29	scaleCh4	f.dd	Channel 4 scale
30	offsetCh4	f.dd	Channel 4 cable count offset (m)
31	statuseCh4	ddd	Channel 4 status
32	cableAngle	f.dd	Cable angle (degrees)

TYPE 493 FORMAT

Field	Data	Format	Comment
1	Code	493	TSS device data
2	Name	text	Device name
3	Time	f.dd	PC time in seconds (GPS time if available) the data was read
4	zverDistance	text	Vertical distance to cable (cm)
5	zaltitude	text	Altitude (cm)
6	zverDepth	text	Vertical depth of cable(cm)
7	zlatOffset	text	Lateral offset (cm)
8	ssCoil1	ddd	Coil 1 signal strength (mV)
9	ssCoil2	ddd	Coil 2 signal strength (mV)
10	ssCoil3	ddd	Coil 3 signal strength (mV)
11	ssCoil4	ddd	Coil 4 signal strength (mV)
12	dataPacketType	c	Data pack type (T for coordinates and signal or I for coordinates only)
13	checkCode	ddd	Check code
14	qualityControlFlag	text	'?' = SET ' (space)' = RESET

TYPE 494 FORMAT

Field	Data	Format	Comment
1	Code	494	Cable Model Data
2	name	Text	Device name Cable Model
3	time	Floating point number	PC time in seconds (GPS time if available) the data was read
4	Latitude	Floating point number	Latitude at touch down
5	Longitude	Floating point number	Longitude at touch down
6	slack	Floating point number	Desired slack to touch down (%)
7	slack	Floating point number	Incremental desired slack at touch down (%)
8	cable count	Floating point number	At touch down (m)
9	slack	Floating point number	Incremental slack at touch down (%)
10	KP	Floating point number	At touch down (m)
11	depth	Floating point number	At touch down (m)
12	cable speed	Floating point number	Observed m/min
13	max vessel speed	Floating point number	Maximum vessel (speed knots)
14	depth	Floating point number	Depth at ship (m)
15	cable count	Floating point number	At ship (m)
16	KP	Floating point number	At ship (m)
17	spare	Floating point number	0
18	hydrodynamic constant	Floating point number	Degree-knots
19	spare	Floating point number	0
20	slack	Floating point number	At touch down (%)
21	spare	Floating point number	0
22	tension	Floating point number	At ship (tonnes)
23	cable in water	Floating point number	between ship and touch down (m)
24	cable weight in water	Floating point number	Kg/m
25	cable type	Text	LW, DA etc
26	Reference point event name	Text	Name of event used as reference point for incremental calculations
27	Winch set speed	Floating point number	Desired payout speed to meet the slack requirement

TYPE 495 FORMAT

Field	Data	Format	Comment
1	Code	495	TSS 350 Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	zverDistance	ssss	Vertical distance (cm)
5	zaltitude	ssss	Altitude (cm)
6	zverDepth	ssss	Vertical depth (cm)
7	zlatOffset	ssss	Lateral offset (cm)
8	skewAngle	ssss	Skew angle (deg)
9	ssS1Chan	d	Signal Strength on SL Channel
10	ssSvChan	d	Signal Strength on SV Channel
11	ssPlChan	d	Signal Strength on PL Channel
12	ssPvChan	d	Signal Strength on PV Channel
13	ssSfChan	d	Signal Strength on SF Channel
14	ssPfChan	d	Signal Strength on PF Channel
14	dataPacketType	c	T for coordinates and signal or I for coordinates only
15	checkCode	d	Check Code
16	qualityControlFlag	ssss	space for reset and ? for set

TYPE 496 FORMAT

Field	Data	Format	Comment
1	Code	496	ROV data
2	name	Text	Device name
3	time	Floating point number	PC time in seconds (GPS time if available) the data was read
4	depth	Floating point number	ROV depth (m)
5	depthOffset	Floating point number	User entered ROV depth offset (m)
6	heading	Floating point number	ROV heading (deg)
7	pitch	Floating point number	ROV pitch (deg)
8	roll	Floating point number	ROV roll (deg)
9	altimeter1	Floating point number	ROV altitude (m)
10	altimeter2	Floating point number	ROV altitude (m)
11	altimeterOffset	Floating point number	User entered ROV altimeter offset (m)
12	burialDepth	Floating point number	Burial depth (cm)
13	cableDirection	Floating point number	Cable direction
14	lateralOffset	Floating point number	Lateral offset
15	verticalOffset	Floating point number	Vertical offset
16	diveNo	Floating point number	Dive number
17	soundVel	Floating point number	Observed sound velocity (m/s)
18	QcCode	Integer	only bits 0-5 used (1 = valid, 0 = invalid) 0 - Digiquartz 1 - Conductivity 2 - Altimeter 3 - Internal temp 4 - Velocity of sound 5 - Salinity calculation
19	Jet knife angle	Floating point number	angle of jetting tool, degrees
20	Jet knife depth	Floating point number	depth of jetting tool, metres
21	CP probe 1	Floating point number	CP probe 1 data, volts
22	CP probe 2	Floating point number	CP probe 2 data, volts
23	Telemetry state	d	1=on, 0=off
24	Comment	Text	Comment received from ROV computer, maximum length 49 characters
25	Salinity	Floating point number	Parts per thousand
26	Temperature	Floating point number	Celsius
27	Pressure	Floating point number	Millibars
28	Density	Floating point number	Kg/m ³
29	Raw pressure count	Floating point number	Raw count from Digiquartz
30	Raw temperature count	Floating point number	Raw count from Digiquartz
31	Jet knife offset	Floating point number	Operator entered, applied to observed offset (m)
32	Horizontal Jet knife #1 offset	Floating point number	Between ROV center and knife (cm)
33	Horizontal Jet knife #2 offset	Floating point number	Between ROV center and knife (cm)

TYPE 499 FORMAT

Field	Data	Format	Comment
1	Record Number	499-001	
2	Device Name	sssss	
3	Data Time	f.dd	Seconds
4	Telephone Cable Count	f.ddd	Metres
5	Telephone Cable Tension	f.ddddd	Tonnes
6	Telephone Cable Speed	f.ddd	m/min
7	Telephone Cable Data Time	f.d	Seconds
8	Tow Cable Count	f.ddd	Metres
9	Tow Cable Tension	f.ddddd	Tonnes
10	Tow Cable Speed	f.ddd	m/min
11	Tow Cable Data Time	f.d	Seconds
12	LCE Tension	f.ddddd	Tonnes
13	LCE Data Time	f.d	Seconds
14	CDE1 Tension	f.ddddd	Tonnes
15	CDE1 Data Time	f.d	Seconds
16	CDE2 Tension	f.ddddd	Tonnes
17	CDE2 Data Time	f.d	Seconds
18	Emergency Stop	d	0 – Normal 1 – Emergency
19	Stonker State	d	0 – Open 1 – Closed
20	Plough Mode	d	1 – Ready 2 – Stop in Progress 3 – LTM Mode 4 – LR Mode 5 – RM Mode 6 – Error
21	Repeater Detected	d	0 – None Detected 1 – Repeater Detected 2 – Splice Box Detected
22	Cable Engine Mode	d	0 – Stopped 1 – MSM 2 – ASM 3 – BTM 4 – BSM 5 – Error

TYPE 500 FORMAT

Field	Data	Format	Comment
1	Code	500	Rho Theta Data
2	name	text	Device Name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	code	ddd	Code (0 – 9)
5	range	f.dd	Range (m)
6	bearing	f.dd	Bearing (degrees)
7	verAngle	f.dd	Vertical Angle (degrees)
8	status	d	0 = Bad 1 = Good

TYPE 500 FORMAT (REPEATED)

Field	Data	Format	Comment
1	Code	500	Telemetry Data
2	name	text	Device Name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	centerLat	[-]dd.mmmmmmmm	Latitude at CRP
5	centerLon	[-]dd.mmmmmmmm	Longitude at CRP
6	centerHeight	f.dd	Height at CRP (m)
7	depth	f.dd	Water depth including offset and tide if enabled (m)
8	heading	ffff.d	Vessel's heading in degrees – filtering and offsets applied if enabled
9	advance	ffff.d	Vessel's course made good in degrees – based on the vessels filtered northerly and easterly velocities
10	speed	f.dd	Vessel's speed in knots - based on the vessels filtered northerly and easterly velocities
11	vNorth	f.dd	Vessel's filtered northerly velocity in m/s
12	vEast	f.dd	Vessel's filtered easterly velocity in m/s

TYPE 501 FORMAT

Field	Data	Format	Comment
1	Code	501	Telemetry Target Data
2	name	text	Device name
3	targetTime	f.dd	Computer processor time of the last time target data was received (milliseconds)
4	targetCode	d	Target code
5	Enabled	d	3 = enabled
6	lat	[-]dd.mmmmmmmm	Latitude of target
7	lon	[-]ddd.mmmmmmmm	Longitude of target

TYPE 501 FORMAT (REPEATED)

Field	Data	Format	Comment
1	Code	501	Range Range Data
2	name	text	Device Name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	code	text	Control station code
5	rawRange	f.d	Raw range to the control station
6	status	d	0 = raw range > 0. 1 = raw range != 0.

** code, rawRange and status are repeated up to 8 times

TYPE 507 FORMAT

Field	Data	Format	Comment
1	Code	507	Compass Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	numCompassRecs	ddd	Number of compass records (max 64)
5	id	ddd	Compass ID
6	heading	f.d	Raw heading from device
7	status	d	0 = OK / Good data 1 = Data not available or Bad

**ID, Heading, and Status are repeated for each compass record

TYPE 508 FORMAT

Field	Data	Format	Comment
1	Code	508	Depth Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	numDepthRecs	ddd	Number of depth records
5	id	ddd	Device ID
6	depth	f.d	Raw heading from device (m)
7	status	d	0 = Data OK / Good 1 = Data not available / Bad

**ID, Depth, and Status are repeated for each depth record

TYPE 509 FORMAT

Field	Data	Format	Comment
1	Code	509	Fin Data
2	name	text	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	numFinAngleRecs	ddd	Number of fin records
5	id	ddd	Device ID
6	angle	f.d	Raw fin angle from device
7	status	d	0 = Data OK / Good 1 = Data not available / Bad

**ID, Angle, and Status are repeated for each fin record

TYPE 510 FORMAT

Field	Data	Format	Comment
1	Code	510	Survey line Tracking Data
2	vehName	text	Vehicle name
3	name	text	Line name
4	Enabled	ddd	0 = line tracking off 1 = line tracking on (forward) 2 = line tracking on (reverse)
5	alongLine	f.dd	Alongline distance* (m)
6	offLine	f.dd	Offline distance* (m)
7	downLineSpeed	f.dd	Downline speed** (m/s)
8	offLineSpeed	f.dd	Offline speed** (m/s)
9	Azimuth	ffffff.dd	Azimuth of segment (deg)
10	GeoAzimuth	ffffff.dd	Geographic Azimuth of segment (deg)
11	Length	f.dd	Length of segment (m)
12	currentSegment	ddd	Segment number
13	layback	f.dd	layback true distance (m)
14	laybackHeading	ffffff.dd	Layback heading (deg)
15	kilopost	f.ddd	Kilometer post at tracked offset
16	displayCurrSegm	ddd	Display current segment (0 = false, 1 = true)
17	displaySegmAnnot	ddd	Display current segment annotation (0 = false, 1 = true)
18	useCorridor	ddd	Enable checking for ship position inside corridor (0 = false, 1 = true)
19	MaxDistOffLine	f.d	Width of corridor (m)

* - computed using filtered Northing and Easting position of the tracked offset

** - computed based on the vessels filtered northerly and easterly velocities

TYPE 511 FORMAT

Field	Data	Format	Comment
1	Code	511	Line Tracking Data
2	vehName	text	Vehicle name
3	name	s	Line name (maximum 35 characters)
4	firstNode	d	The node number of the first node contained in the record ¹
5	type	d	Not Used
6	StartShot	d	Number identifier of the first shotpoint downline
7	firstShotDDL	f.fff	Distance downline to the first shotpoint
8	startKP	f.fffff	KP at the start of the line
9	kpDir		KP increment/decrement control flag: • 1 = increments, line in original state • 2 = increments, line reversed • -1 = decrements line in original state -2 = decrements, line reversed
10	numNodes	d	Total number of nodes in the line
11	scalable	d	Scaleable KP flag, 0= normal, 1=scalable
12	kpScaleLimits	f.ff	Allowable deviation from calculated KP distances between nodes for scaleable KPs entered, (%)
The following 5 fields are repeated for each node of the line contained in the record, up to 5			
13	node[i].lat	f.fffffffff	Latitude of node (decimal of degrees)
14	node[i].lon	f.fffffffff	Longitude of node (decimal of degrees)
15	node[i].z	f.ff	Elevation of node relative to MSL (m)
16	node[i].radius	f.ff	Radius of curve at the node (m)
17	node[i].kp	f.ff	KP for the node (km)

Comments: positions giving on working ellipsoid

¹This record can be used in multiples to form a sequence of records that together contain all the node information for a given line. Each record can contain up to 5 nodes.

TYPE 512 FORMAT

Field	Data	Format	Comment
1	Code	512	Waypoint Tracking Data
2	vehName	text	Vehicle name
3	time	f.dd	PC time in seconds (GPS time if available)
4	Enabled	ddd	0 = Waypoint tracking Off 1 = Waypoint tracking On
5	alarmOn	ddd	0 = Waypoint alarm Off 1 = Waypoint enter alarm On 2 = Waypoint depart alarm On
6	alarmRange	f.dd	Alarm range

TYPE 513 FORMAT

Field	Data	Format	Comment
1	Code	513	Waypoint Data
2	vehName	text	Vehicle name
3	time	f.dd	PC time in seconds (GPS time if available)
4	name	text	Tracked waypoint name
5	lat	[-]dd.mmmmmmmm	Latitude of waypoint
6	lon	[-]ddd.mmmmmmmm	Longitude of waypoint
7	icon	dd	Waypoint icon
8	circle	f.dd	Circle radius (m)
9	color	ddd	Waypoint color
10	elev	f.dd	Waypoint elevation (m)

TYPE 513 FORMAT (REPEATED)

Field	Data	Format	Comment
1	Code	513	Password data
2	vehName	ssss	Vehicle Name
3	time	ssss	
4	userName	ddd	
5	userLevel	ssss	
6	password	ddd	
7	currentUser		

TYPE 514 FORMAT

Field	Data	Format	Comment
1	Code	514	Log Data
2	Name	text	Name of log event
3	Time	f.dd	PC time in seconds (GPS time if available) the log was taken

TYPE 515 FORMAT

Field	Data	Format	Comment
1	Code	515	Ship Data
2	vehName	text	Vehicle name
3	wpName	text	Waypoint name
4	time	f.dd	PC time in seconds (GPS time if available)
5	rangeToWp	f.dd	Range to waypoint (m)
6	bearingToWp	ffff.d	Bearing to waypoint (degrees)
7	Enabled	d	0 = Waypoint tracking Off 1 = Waypoint tracking On

TYPE 516 FORMAT

Field	Data	Format	Comment
1	Code	516	Offset Record
2	aVehName	text	Vehicle Name
3	name	text	Offset Name
4	x	f.dd	X component of offset (m)
5	y	f.dd	Y component of offset (m)
6	z	f.dd	Z component of offset (m)
7	plot	ddd	0 = Hide offset position 1 = Display offset position
8	plotLabel	ddd	0 = Hide offset label 1 = Display offset label

TYPE 517 FORMAT

Field	Data	Format	Comment
1	Code	517	Picture Record
2	pen	d	0 = Pen up 1 = Pen down 2 = Picture header 3 = Picture text
if pen < 2			
3	lat	[-]dd.mmmmmmmm	Picture point latitude
4	lon	[-]ddd.mmmmmmmm	Picture point longitude
if pen = 2			
3	name	text	header name
4	color	ddd	A 32-bit value used to specify an RGB color
5	green	ddd	
6	blue	ddd	
7	linetype	d	0 = solid 1 = dashed
if pen = 3			
3	textString	text	Text
4	color	ddd	Text color
5	lat	f.dddddddd	Text position – latitude
6	lon	f.dddddddd	Text position – longitude
7	textSize	f.dd	Text size
8	rotation	f.dd	Text rotation
9	justification	d	Text justification

TYPE 518 FORMAT

Field	Data	Format	Comment
1	Code	518	Waypoint file data
2	Name	text	Waypoint file name
3	Time	f.dd	Time waypoint file was changed (seconds)

TYPE 519 FORMAT

Field	Data	Format	Comment
1	Code	519	Log Data
2	Time	f.dd	Time waypoint file was changed (seconds)
3	Layback	f.dd	in meters
4	Bearing	f.dd	in degrees

TYPE 555 FORMAT

Field	Data	Format	Comment
1	Code	555	Streamer data
2	vehName	ssss	Vehicle name
3	streamerNumber	d	Streamer number
4	numberOfBearingRecords	d	Number of bearing records
5	status	d	Heading status
6	heading	f.d	Heading (deg)
7	status	d	Depth status
8	depth	f.d	Depth (m)

** - Heading status and Heading are repeated for every bearing record
- Depth status and Depth are repeated for every depth record

TYPE 556 FORMAT

Field	Data	Format	Comment
1	Code	556	Streamer configuration data
2	vehName	ssss	Vehicle name
3	streamerNumber	d	Streamer number
4	pos	d	
5	definedPos	c	
6	source1Id	c	
7	source1VesselId	c	
8	source2Id	c	
9	source2VesselId	c	
10	streamerId	c	
11	tailBuoyId	c	
12	tailBuoy2Id	c	
13	unitMeter	d	
14	layBack	f.dd	
15	strmr1StID	d	
16	strmrIDInc	d	
17	stationInterval	f.dd	
18	numOfStations	d	
19	defaultRcvrDepth	f.dd	
20	compassLayBack	f.dd	
21	compassInterval	f.dd	
22	numOfCompasses	d	
23	lastCompassToTb	f.dd	
24	magneticDeclination	f.dd	
25	bearAccuracy	f.dd	
26	distAccuracy	f.dd	
27	streamerHead	ssss	
28	streamerTail	ssss	
29	source1	ssss	
30	source2	ssss	
31	calculationMode	d	
32	drawStreamer	d	
33	drawStreamerProfile	d	
34	strmrColor	d	
35	compassUse[0]	d	
36	compassUse[1]	d	
37	compassIntervals	c	**

** compassIntervals repeated 64 time

TYPE 560 FORMAT

Field	Data	Format	Comment
1	Code	560	Line Tracking Data
2	vehName	text	Vehicle name
3	time	f.dd	PC time in seconds (GPS time if available)
4	name	text	Line name
5	type	ddd	Line type (0 = solid, 1 = dashed)
6	StartShot	ddd	Start Shot number
7	firstShotDDL	f.ddd	First shot downline distance (m)
8	startKP	f.ddddd	Start kilometer post
9	kpDir	ddd	Kilometer post direction
10	numNodes	ddd	Number of nodes
11	scalable	ddd	0 = Design KP 1 = Scalable KP
12	kpScaleLimits	f.dd	Line KP scale limit (%)
13	lat	[-]dd.mmmmmmmm	Latitude of node
14	lon	[-]ddd.mmmmmmmm	Longitude of node
15	z	f.dd	Elevation of node (m)
16	radius	f.dd	Radius of curve at the node (m)
17	kp	f.dd	KP of node

**lat, lon, z, radius, and kp are repeated for each node

TYPE 600 FORMAT

Field	Data	Format	Comment
1	Code	600	Layback data
2	vehName	text	Vehicle name
3	fromVeh	text	From vehicle name
4	fromVehNum	ddd	From vehicle number
5	toVeh	text	To vehicle name
6	toVehNum	ddd	To vehicle number
7	layback	f.dd	Layback (m)
8	offset	f.dd	Offset (m)
9	refFAOffset	f.dd	Reference Forward or Aft offset (m)
10	refPSOffset	f.dd	Reference Port or Starboard offset (m)

TYPE 700 FORMAT

Field	Data	Format	Comment
1	Code	700	Fairleads Data
2	vehName	text	Vehicle name
3	name	text	Fairlead name
4	y	f.dd	Port or starboard offset of the fairlead with respect to the vehicle's origin (m)
5	x	f.dd	Forward or aft offset of the fairlead with respect to the vehicle's origin (m).
6	n	f.dd	Design anchor position Northing (m)
7	e	f.dd	Design anchor position Easting (m)
8	ancN	f.dd	Current Northing of anchor (m)
9	ancE	f.dd	Current Easting of anchor (m)
10	plot	d	0 = False 1 = True
11	state	d	0 = on tug 1 = on barge
12	target	d	0 = no target 1 = target set
13	rngToMid0	f.d	Midbouy 0 distance from anchor (m)
14	rngToMid1	f.d	Midbouy 1 distance from anchor (m)
15	rngToMid2	f.d	Midbouy 2 distance from anchor (m)
16	drawRunLine	d	0 = False 1 = True
17	tugVehNum	ddd	Tug Vehicle number with anchor

TYPE 701 FORMAT

Field	Data	Format	Comment
1	Code	701	Anchor control data
2	vehName	text	Vehicle name
3	anchorNumber	ddd	Anchor number
4	refVehicle	ddd	Reference vehicle
5	aHTug	ddd	Tug number with anchor
6	state	d	0 = on tug 1 = on barge

TYPE 702 FORMAT

Field	Data	Format	Comment
1	Code	702	Anchor Data
2	tugVehNumber	ddd	Tug vehicle number
3	anchorNumber	ddd	Anchor number
4	txAnchorN	f.dd	Transmitted anchor position Northing (m)
5	txAnchorE	f.dd	Transmitted anchor position Easting (m)
6	drawRunLine	d	0 = False 1 = True

TYPE 777 FORMAT

Field	Data	Format	Comment
1	Code	777	MGD77 Data
2	name	text	vehicle name
3	time	f.dd	Time of data (seconds)
4	lat	[-]dd.mmmmmmmm	Latitude
5	lon	[-]ddd.mmmmmmmm	Longitude
6	bathy	f.dd	Bathymetry value (99999.99 if NA)
7	mag	f.dd	magnetometer value (99999.99 if NA)
8	linename	text	Current tracked line name
9	fix	d	Fix number

TYPE 800 FORMAT

Field	Data	Format	Comment
1	Code	800	Raw Magnetometer Data
2	name	ssss	Device name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	magneticField	f.dd	Magnetometer (nT)
5	signalStrength	f.dd	Signal Strength
6	depth	f.dd	Depth of fish (m)
7	quality	d	Quality
8	leak	d	Leak
9	tuning	f.dd	Magnetic tuning voltage
10	voltage	f.dd	Input voltage

TYPE 888 FORMAT

Field	Data	Format	Comment
1	Code	888	Raw heave data
2	name	text	device name
3	time	f.ddd	PC time in seconds (GPS time if available) the data was read
4	heave*	f.ddd	Heave
5	roll*	f.ddd	Roll
6	pitch*	f.ddd	Pitch
7	yaw*	f.ddd	Yaw

- data read directly from the device

TYPE 900 FORMAT

Field	Data	Format	Comment
1	Code	900	GPS Data
2	name	text	Vehicle name
3	time	f.dd	Time of data (s)
4	speed	f.dd	Vessel's filtered speed (knots)
5	cmgTrue	f.dd	Coarse Made Good (True)
6	velNorthTrue	f.dd	Velocity North (True)
7	velEastTrue	f.dd	Velocity East (True)
8	cmgMagnetic	f.dd	Coarse Made Good (Magnetic)
9	velNorthMagnetic	f.dd	Velocity North (Magnetic)
10	velEastMagnetic	f.dd	Velocity East (Magnetic)

TYPE 901 FORMAT

Field	Data	Format	Comment
0	Code	901-003-W	Acoustic Calibration Data – record for measured baselines
1	lat	Floating point number	Latitude of transducer degrees
2	lon	Floating point number	Longitude of transducer degrees
3	x*	Floating point number	Easting of transducer (m)
4	y*	Floating point number	Northing of transducer (m)
5	z*	Floating point number	Depth of transducer (m)
6	dsOffset	Floating point number	Vertical offset from transducer to depth sensor (m)
7	dsCalib	Floating point number	correction to be applied to compensate for atmospheric pressure or other calibration offsets. (Subtracted)
8	systemType	integer	systemType = 4
9	address	text	Transponder address
10	txCode	text	Transponder tx code
11	bcnCode	text	Transponder code
12	on	integer	0 = Transponder off 1 = Transponder on
13	name	text	Name of Transponder
14	calFlag	integer	calFlag = 1
15	rmsBaselines	Floating point number	Average RMS of all baselines (m)
16	rmsTotal	Floating point number	Total RMS of all baselines (m)
17	errorEllipse[0]	Floating point number	Error ellipse semi-major axis (m)
18	errorEllipse[1]	Floating point number	Error ellipse semi-minor axis (m)
19	errorEllipse[2]	Floating point number	Orientation of Error ellipse semi-major axis (deg)
20	iif	text	Individual response frequency
21	rmsDepths	Floating point number	The type of transponder as listed below:
22	xponderType	integer	0 = FIXED XPONDER, 1 = RELAY XPONDER, 2 = RESPONDER XPONDER,

			3 = SIMUL XPONDER, 4 = CYCLIC XPONDER, 5 = SEQUENTIAL XPONDER, 6 = STATIC TRANSCEIVER, 7 = STATIC SIMULTANEOUS, 8 = DYNAMIC ARRAY, 9 = SYNCHRONIZED PINGER, 10 =USBL FIXED TRANSPONDER, 11 = USBL TRACK TRANSPONDER, 12 = USBL FIXED PINGER, 13 = USBL TRACK PINGER, 14 = USBL FIXED RESPONDER, 15 = USBL TRACK RESPONDER, 16 = XPONDER UNKNOWN This value indicate the state of the Digi Quartz. Valid values are : 0 = no digiquartz active 1 = digiquartz active This value indicate if the Digi Quartz is deep rated capable. Valid values are : 0 = digiquartz is NOT deep rated 1 = digiquartz is deep rated This value indicate if the Digi Quartz is capable of quick measurement. Valid values are : 0 = digiquartz is NOT capable of quick measurement 1 = digiquartz is capable of quick measurement This value indicates the formula to use to convert pressure to depth: 1 = Average density
23	digiQuartz	integer	
24	deepRating	integer	
25	Quick Measurement	integer	
26	formulaNum	integer	
27	waterDensity	Floating point number	This is the water density value entered by the operator.
28	Atmospheric Pressure	Floating point number	This is the atmospheric pressure value entered by the operator.
29	coefficients[i]	Floating point number	These are the Digi Quartz coefficient values used with the formula number to calculate the water depth. There are a total of 14 parameters.
43	Height of instrument	Floating point number	Height transponder is above monument
44	Standard deviation	Floating point number	Computed standard deviation East, North and depth.
47	corrections	Floating point number	Correction to approximate coordinates East, North Depth.
48	Number observations	integer	
49	Double	integer	0=only one transponder at this

	transponders		location
			1=more than one transponder at this location
50	Number of other transponders	integer	Number of transponders at this location (5 max)
51	Other transponders	integer	Index to other transponders

* working ellipsoid

Note: A 901 record will appear for each transponder in the file

TYPE 902 FORMAT - BASELINE

Field	Data	Format	Comment
0	Code	902-001-W	LBL Calibration data
1	Baseline	text	"Baseline"
2	BaseLine Version	D	Baseline record version (0, 2 or 3)
3	fromCode	text	Code of the transponder the baseline was measure from
4	fromName	text	Name of the transponder the baseline was measure from
5	numLop	d	Number of ranges in the record
6	time	f.dd	time of observation (seconds)
	Version 0 members		Baseline data
7	scaledLop	f.ddd	Scaled range (m)
8	rawLop	f.ddd	Raw range (m)
9	toCode	Ssss	Code of the transponder the baseline was measure to
10	toAddress	Ssss	Address of the transponder the baseline was measure to
11	toName	Ssss	Name of the transponder the baseline was measure to
12	sigma	f.dd	Standard deviation (m)
			Note : Baseline data is based on the Baseline version number from Item #2 above.

TYPE 902 FORMAT - STATION

Field	Data	Format	Comment
0	Code	902-001-W	LBL Calibration data
1	<i>a fixed string</i>	Ssss	"Station"
2	time	f.dd	time of observation (seconds)
3	lat	[-]dd.mmmmmmmm	Station latitude
4	lon	[-]ddd.mmmmmmmm	Station longitude
5	heading	f.dd	Station heading (deg)
6	advance	f.dd	Station course made good (deg)
7	speed	f.ddd	Station speed
8	y	f.ddd	Station Northing (m)
9	x	f.ddd	Station Easting (m)
10	z	f.ddd	Station Height (m)
11	numLop	d	Number of ranges in the record
12	numSystem	d	numSystem = 2
13	scaledLop	f.ddd	Scaled range (m)
14	rawLop	f.dddddddd	Raw range (m)
15	sigma	f.dd	Standard deviation (m)
16	systemNum	d	System number
			The type of Line of Position (LOP) data
17	lopType	d	lopType = 0 : Transponder Range lopType = 1 : hyperbola lopType = 2 : northing lopType = 3 : easting lopType = 4 : ?? lopType = 5 : ?? lopType = 6 : bearing to a base station
18	code	ssss	Code of transponder
19	address	ssss	Address of transponder
20	time	f.dd	Time of observation (s)
21	velocity	f.dd	Velocity of the vessel
22	pitch	f.dd	Pitch of the vessel (deg)
23	roll	f.dd	Roll of the vessel (deg)
24	name	ssss	Name of device
25	name	ssss	Name of LOP system device
26	type	d	Type of LOP system Type = 0 : ??
27	xOff	f.dd	Calibration port / stbd offset (m)
28	yOff	f.dd	Calibration fore / aft offset (m)
29	zOff	f.dd	Calibration depth offset (m)
			* fields 13-24 repeated for each range to a transponder plus 2 for the GPS position
			** fields 25-29 repeated for each system (GPS and LBL)

TYPE 902 FORMAT – USBL STATION

Field	Data	Format	Comment
0	Code	902-001-W	LBL Calibration data
1	<i>a fixed string</i>	s	"USBLStation"
2	time	f.ff	time of observation (seconds)
3	lat	[-]ff.ffffff	Station latitude (degrees)
4	lon	[-]fff.ffffff	Station longitude (degrees)
5	heading	f.ff	Station heading (deg)
6	advance	f.ffff	Station course made good (deg)
7	speed	f.ffff	Station speed
8	y	f.fff	Station Northing (m)
9	x	f.fff	Station Easting (m)
10	numLop	d	Number of LOPs in the record
11	numSystem	d	Number of data items (systems) in the record

The fields 12 to 29 are repeated for each LOP.

NOTE: USBL data produces slant range, bearing and depth LOPs but only one instance of the data is written to the calibration file, the slant range LOP. The bearing and depth LOPs are recreated during the loading of the calibration file. In addition, a USBL system may provide a TWTT value. In this case, a separate LOP is written to the calibration file for this LOP, without any associated bearing or depth LOPs.

NOTE: GPS data produces 2 LOPs, Latitude/Northing and Longitude/Easting.

12	scaledLop	f.fffff	Scaled LOP ¹
13	rawLop	f.ffffff	Raw LOP ²
14	sigma	f.ff	Standard deviation (m)
15	systemNum	d	System number
			The type of Line of Position (LOP) data
			lopType = 0 : Transponder Range
			lopType = 1 : hyperbola
			lopType = 2 : northing
			lopType = 3 : easting
			lopType = 4 : not used
			lopType = 5 : not used
			lopType = 6 : bearing to a beacon
			lopType = 7 : depth
16	lopType	d	
17	code	s	Beacon code
18	address	s	Beacon address
19	time	f.ff	Time of measurement (s)
20	rawDX	f.ffffff	Raw X value (m), if LOP is not associated with a USBL system, this values is 0
21	rawDY	f.ffffff	Raw Y value (m), if LOP is not associated with a USBL system, this values is 0
22	rawDZ	f.ffffff	Raw Z value (m), if LOP is not associated with a USBL system, this values is 0
23	reducedDX	f.ffffff	Reduced X value (m), if LOP is not

			associated with a USBL system, this values is 0
24	reducedDY	f.ffffff	Reduced Y value (m), if LOP is not associated with a USBL system, this values is 0
25	reducedDZ	f.ffffff	Reduced Z value (m), if LOP is not associated with a USBL system, this values is 0
26	pitch	f.ff	Pitch of the vessel (deg)
27	roll	f.ff	Roll of the vessel (deg)
28	velocity	f.ff	LOP velocity, 0 for USBL systems.
29	twttMode	d	TWTT flag, if the data is based upon a TWTT value, this flag is set 1, otherwise it is 0
The fields 30 to 34 are repeated for system whose data is included in the record.			
30	name	ssss	Name of the system (GPS or USBL)
31	type	d	Calibration system type, currently set to 4 for GPS and USBL
32	xOff	f.ff	LOP system port/stbd offset (m)
33	yOff	f.ff	LOP system fore/aft offset (m)
34	zOff	f.ff	LOP system depth/elevation offset (m)

¹ Dependent upon the LopType:

- 0 Slant range (m) reduced to the map Projection (USBL)
- 1 Hyperbola
- 2 Map Projection Northing (m) (GPS)
- 3 Map Projection Easting (m) (GPS)
- 4 Not Used
- 5 Not Used
- 6 Bearing/angle to beacon (degrees) reduced to Map Projection (USBL)
- 7 Depth (m) (USBL)

² Dependent upon the LopType:

- 0 True slant range (m) (USBL)
- 1 Hyperbola
- 2 WGS 84 Latitude (degrees) (GPS)
- 3 WGS 84 Longitude (degrees) (GPS)
- 4 Not Used
- 5 Not Used
- 6 Bearing/angle to beacon (degrees) (USBL)
- 7 Depth (m) (USBL)

TYPE 903 FORMAT

Field	Data	Format	Comment
1	Code	903	Acoustic constraint data
2	<i>a fixed string</i>	text	"Constraints"
3	numLops	d	Number of LOP constraints
4	dataType	d	0 = azimuth 1 = baseline
5	scaledLop	f.dddddddd	Scaled observation
6	rawLop	f.dddddddd	Raw observation
7	fromStation	text	Name of the station the observation was measure from
8	fromCode	text	Code of the station the observation was measure from
9	fromAddress	text	Address of the station the observation was measure from
10	toStation	text	Name of the station the observation was measure to
11	toCode	text	Code of the station the observation was measure to
12	toAddress	text	Address of the station the observation was measure to
13	applied	d	1 = observation applied 0 = observation not applied

** field 4 through 13 repeated for 'numLops' times

TYPE 904 FORMAT

Field	Data	Format	Comment
1	Code	904	Depth Station Data
2	<i>a fixed string</i>	text	"Depths"
3	station name	d	
4	station code	d	
5	station address	f.dddddddd	
6	digi quartz	f	1 = is digi quartz 0 = not digi quartz
7	num of LOPS	f	Number of LOP constraints
8	time	f.ddd	time of depth measurement
9	temperature count	f.ddd	temperature count
10	scaled LOP	f.ddd	scaled measurement
11	raw LOP	f.ddd	raw measurement
12	sigma	f.ddd	
13	depth error	f	
14	count Error	f	

** field 8 through 14 repeated for every depth LOP

TYPE 905 FORMAT

Field	Data	Format	Comment
1	Code	905-002-W	Base line summary data
2	<i>a fixed string</i>	text	"Baseline Summary"
3	Transponder name	text	Measured from
4	Transponder code	text	Code measured from
5	Transponder address	text	Address measured from
6	Number of records	integer	
7	Transponder name	text	Measured to
8	Transponder code	text	Code measured to
9	Transponder address	text	Address measured to
10	Forward attempts	integer	Number attempted measurements forward
11	Forward successful attempts	integer	Number attempted measurements forward that succeeded
12	Forward failed	integer	Number attempted measurements forward that failed
13	Reverse attempts	integer	Number attempted measurements reverse
14	Reverse successful attempts	integer	Number attempted measurements reverse that succeeded
15	Reverse failed	integer	Number attempted measurements reverse that failed
16	Sum raw ranges	Floating point	Sum of all ranges used
17	Sum reduced ranges	Floating point	Sum of all reduced ranges used
18	Sum forward ranges	Floating point	Sum of forward ranges used
19	Sum reduced forward ranges	Floating point	Sum of forward reduced ranges used
20	Sum reverse ranges	Floating point	Sum of reverse ranges used
21	Sum reduced reverse ranges	Floating point	Sum of reverse reduced ranges used
22	Number forward ranges	integer	Number forward ranges weighted in
23	Number reverse ranges	integer	Number reverse ranges weighted in

TYPE 908 FORMAT

Field	Data	Format	Comment
1	Code	908	Attitude use settings
2	UseAttitudeForGPS	text	UseAttitudeForGPS
3	Yes/No	text	Answer to above
4	UseAttitudeForLBL	text	UseAttitudeForLBL
5	Yes/No	text	Answer to above
6	UseAttitudeForUSBL	text	UseAttitudeForUSBL
7	Yes/No	text	Answer to above
8	UpdateShipPositionInUSBLXponderCal	text	UpdateShipPositionInUSBLXponderCal
9	Yes/No	text	Answer to above
10	UseUSBLTWTTRanges	text	UseUSBLTWTTRanges
11	Yes/No	text	Answer to above

TYPE 909 FORMAT

Field	Data	Format	Comment
1	Code	909-001-W	Acoustic data
2	<i>a fixed string</i>	text	"Calibration Gating"
3	rngResMode	d	0 = range residual gating off 1 = range residual gating on
4	rngResGate	f.d	range residual gating size
5	brgResMode	d	0 = bearing residual gating off 1 = bearing residual gating on
6	brgResGate	f.d	bearing residual gating size
7	bslResMode	d	0 = baseline residual gating off 1 = baseline residual gating on
8	bslResGate	f.d	baseline residual gating size
9	psnResMode	d	0 = position residual gating off 1 = position gating on
10	psnResGate	f.d	position residual gating size

TYPE 910 FORMAT

Field	Data	Format	Comment
1	Code	910-001-W	USBL Calibration Data
2	<i>a fixed string</i>	text	"USBL Calibration"
3	calBcnCode	text	Beacon code
4	totalNumObs	integer	Number of observations
5	numObsUsed	integer	Number of observations used
6	iterCount	integer	Number of iterations to converge
7	aPosteriori	Floating point	aPosteriori variance factor
8	velocityStdDev	Floating point	Velocity standard deviation
9	rotationStdDev	Floating point	Rotation standard deviation
10	pitchStdDev	Floating point	Pitch standard deviation
11	rollStdDev	Floating point	Roll standard deviation
12	velocity	Floating point	Computed velocity
13	rotation	Floating point	rotation
14	pitch	Floating point	Vessel pitch
15	roll	Floating point	Vessel roll
16	xOffData	Floating point	x data offset (m)
17	yOffData	Floating point	y data offset (m)
18	zOffData	Floating point	z data offset (m)
19	CalTime	text	"CalTime"
20	time	Floating point	Time of calibration is seconds

TYPE 910 FORMAT (USED IN FILE VERSIONS 1-3)

Field	Data	Format	Comment
1	Code	910-001-W	USBL Calibration Data
2	<i>a fixed string</i>	text	"USBL Calibration"
3	velocity	Floating point	Computed velocity
4	rotation	Floating point	rotation
5	pitch	Floating point	Vessel pitch
6	roll	Floating point	Vessel roll
7	xOffData	Floating point	x data offset (m)
8	yOffData	Floating point	y data offset (m)
9	zOffData	Floating point	z data offset (m)

TYPE 911 FORMAT

Field	Data	Format	Comment
1	Code	911	Sounder Data
2	name	text	Device name(_transducer)
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	depth	f.dd	Water depth output by the device (m)
5	status	d	0 = bad data 1 = good data

TYPE 916 FORMAT

Field	Data	Format	Comment
1	Code	916	Raw Profile Data
2	name	ssss	Vehicle Name
3	time	f.dd	PC time in seconds (GPS time if available) the data was read
4	X	f.dd	Profile point Easting (m)
5	Y	f.dd	Profile point Northing (m)
6	Z	f.dd	Profile point depth (m)
7	time-oldTime	f.dd	0.01 seconds

* positions are based on filtered positions referenced to the working ellipsoid

* depths referenced to the elevation of the CRP

TYPE 920 FORMAT

Field	Data	Format	Comment
1	Code	920-001-W	Acoustic Data
2	<i>a fixed string</i>	text	"Relative Error Ellipse"
3	FromTo	text	'from station' – 'to station'
4	A	Floating point	semi-major axis (m)
5	B	Floating point	semi-minor axis (m)
6	Azimuth	Floating point	semi-major axis azimuth (deg)
7	x	Floating point	Location to draw ellipse (easting)
8	y	Floating point	Location to draw ellipse (northing)
9	From easting	Floating point	Easting of from transponder
10	From northing	Floating point	northing of from transponder
11	To easting	Floating point	Easting of to transponder
12	To northing	Floating point	northing of to transponder

TYPE 921 FORMAT

Field	Data	Format	Comment
1	Code	920-001-W	Acoustic Data, general relative error ellipse information
2	Number of error ellipses	integer	
3	a posteriori	Floating point	Of all baselines
4	a posteriori	Floating point	Of all ranges
5	test	integer	Test of a posteriori 0=not tested 1=failed test 2=failed but too pessimistic a priori 3=passed
5	Statistics available	integer	0=no 1=yes

TYPE 922 FORMAT

Field	Data	Format	Comment
1	Code	922	Base station information
2	name	text	Vehicle Name
3	easting	text	If easting have not been deweighted then the text "easting" will appear
4	northing	text	If northing have not been deweighted then the text "northing" will appear
5	depth	text	If depth have not been deweighted then the text "depth" will appear. I.e. if depth is to be solved for

* repeated for each base station

TYPE 923 FORMAT

Field	Data	Format	Comment
0	Code	923	Acoustic calibration file
1	Array offset	integer	Internal WinFrog use

TYPE 923 FORMAT

Field	Data	Format	Comment
0	Code	923-001-W	Raw File Static Vehicle data
1	name	ssss	Name of the vehicle
2	staticTime	f.dd	Time of the static vehicle
3	crpLatitude	[-]dd.mmmmmmmm	Latitude of the static vehicle's CRP
4	crpLongitude	[-]ddd.mmmmmmmm	Longitude of the static vehicle's CRP
5	crpNorth	f.ddd	Northing of the static vehicle's CRP in meters
6	crpEast	f.ddd	Easting of the static vehicle's CRP in meters
7	crpHeight	f.ddd	Height of the static vehicle's CRP in meters
8	orientation	f.dddddddd	Orientation of the static vehicle with respect to the transponder array
9	pitch	f.dddddddd	Pitch of the static vehicle
10	roll	f.dddddddd	Roll of the static vehicle

TYPE 998 FORMAT

Field	Data	Format	Comment
1	Code	998	Record type
2	Name	text	Device name
3	Time	float	Seconds
4	Speed Over Ground	float	Knots or m/s
5	Course Made Good (True)	float	Degrees
6	Velocity North (True)	float	Knots or m/s
7	Velocity East (True)	float	Knots or m/s
8	Course Made Good (Magnetic)	float	Degrees
9	Velocity North (Magnetic)	float	Knots or m/s
10	Velocity East (Magnetic)	float	Knots or m/s

TYPE 999 FORMAT

Field	Data	Format	Comment
1	Code	999	GPS ZDA Data
2	Name	text	Device name
3	Utc	f	UTC time from GPZDA message (s)
4	Time	f	PC time in seconds (GPS time if available) the data was read
5	utc-time	f	

TYPE 1001 FORMAT

Field	Data	Format	Comment
1	Code	1001	Position Average-Waypoint Data
2	logComment	s	Operator entered comment, max 80 characters
3	numRcds	d	Number of position records in file
4	meanN	f.fff	Calculated mean Northing (m)
5	stdDevN	f.fff	Standard deviation of sample for Northings (m)
6	meanE	f.fff	Calculated mean Easting (m)
7	stdDevE	f.fff	Standard deviation of sample for Eastings (m)
8	meanLat	f.ffffff	Calculated mean latitude on the working ellipsoid (decimal of degrees)
9	meanLon	f.ffffff	Calculated mean longitude on the working ellipsoid (decimal of degrees)
10	meanHt	f.fff	Calculated mean height (above MSL, m)
11	stdDevHt	f.fff	Standard deviation of sample for height (m)
12	meanDp	f.fff	Calculated mean water depth (m)
13	stdDevDp	f.fff	Standard deviation of sample for water depth (m)
14	meanHeading	f.fff	Calculated mean heading (T, decimal of degrees)
15	stdDevHeading	f.fff	Standard deviation of sample for heading (decimal of degrees)
16	vehName	s	Name of vehicle
17	vehOffset	s	Name of active vehicle offset, "None" if none active
18	foreAftOffset	f.fff	Active offset fore/aft offset (m)
19	portStbdOffset	f.fff	Active offset port/starboard offset (m)
20	heightOffset	f.fff	Active offset vertical offset (m)

Comments: Positions giving on Working Map Projection and Working Ellipsoid

TYPE 1002 FORMAT

Field	Data	Format	Comment
1	Code	1002	Position Average-Results
2	wptName	s	Name of waypoint being tracked, "No Name if none being tracked
3	wptLat	f.ffffff	Waypoint latitude (decimal of degrees)
4	WptLon	f.ffffff	Waypoint longitude (decimal of degrees)

Comments: Positions giving on Working Map Projection and Working Ellipsoid

TYPE 1003 FORMAT

Field	Data	Format	Comment
1	Code	1003	Position Average-Line track & line
2	1510	d	Sub-record identifier, indicates the start of the line tracking parameters component of the record
3	vehName	s	Vehicle name (maximum 25 characters)
4	name	s	Line Name (maximum 35 characters)
5	Enabled	d	Enabled flag, 0=tracking off, 1= tracking on
6	segCont	d	Segment tracking mode: • 0 = automatic tracking • 1 = not used • 2 = force first segment • 3 = manual control
7	currentSeg	d	Number of currently tracked segment
8	windowingOn	d	Active segment determination control option, specifically windowing mode flag, 0=disabled, 1=enabled
9	windowSize	d	Number of segments either side of current segment WinFrog will look for the next segment to track when it determines the current one is not valid if Windowing mode is enabled
10	displayCurrSegm	d	Graphics display flag controls if current segment is highlighted, 0=disabled, 1=enabled
11	displaySegmAnnot	d	Graphics display flag controls if segments are annotated, includes curve points, 0=disabled, 1=enabled
12	useCorridor	d	Active segment determination control option, specifically if vehicle is outside the specified corridor, WinFrog will not attempt to determine the next segment to track, 0=disabled, 1=enabled

13	MaxDistOffLine	f.f	Width of corridor either side of the line (m)
14	506	d	Sub-Record identifier, indicates the start of the line data component of the record
15	vehName	s	Vehicle name (maximum 25 characters)
16	time	f.ff	Time record create in PC time (seconds)
17	name	s	Line Name (maximum 35 characters)
18	type	d	Not used
19	StartShot	d	Number identifier of the first shotpoint downline
20	firstShotDDL	f.fff	Distance downline to the first shotpoint
21	startKP	f.ffff	KP at the start of the line
22	kpDir		KP increment/decrement control flag: • 1 = increments, line in original state • 2 = increments, line reversed • -1 = decrements line in original state • -2 = decrements, line reversed
23	numNodes	d	Number of nodes in the line
24	scalable	d	Scaleable KP flag, 0= normal, 1=scalable
25	kpScaleLimits	f.ff	Allowable deviation from calculated KP distances between nodes for scaleable KPs entered, (%)
The following 5 fields are repeated for each node of the line			
26	node[i].lat	f.ffffffff	Latitude of node (decimal of degrees)
27	node[i].lon	f.ffffffff	Longitude of node (decimal of degrees)
28	node[i].z	f.ff	Elevation of node relative to MSL (m)
29	node[i].radius	f.ff	Radius of curve at the node (m)
30	node[i].kp	f.ff	KP for the node (km)

Comments: Positions giving on Working Ellipsoid

TYPE 1010 FORMAT

Field	Data	Format	Comment
1	Code	1010	Position Average-Position Data
2	use	c	Flag indicating whether or not to use data in calculations, Y=use, N=don't use
3	time	f.ff	PC time of data (seconds)
4	n	f.fff	Vehicle Northing (m)
5	e	f.fff	Vehicle Easting (m)
6	ht	f.fff	Vehicle Height (relative to sea level) (m)
7	dp	f.fff	Water depth(m)
8	acc	f.ff	Accuracy assigned to position data for calculations (m)
9	resN	f.fff	Northing residual, mean – observed (m)
10	resE	f.fff	Easting residual, mean – observed (m)
11	resHt	f.fff	Height residual, mean – observed (m)
12	resDp	f.fff	Water depth residual, mean – observed (m)
13	heading	f.fff	Vehicle heading (decimal of degrees, T)
14	resHeading	f.fff	Heading residual, mean – observed (decimal of degrees)

Comments: Positions giving on Working Map Projection for the Vehicle's tracking point

TYPE 1510 FORMAT

Field	Data	Format	Comment
1	Code	1510	Position Average-Line track parameters
2	vehName	s	Vehicle name (maximum 25 characters)
3	name	s	Line Name (maximum 35 characters)
4	Enabled	d	Enabled flag, 0=tracking off, 1=tracking on
5	segCont	d	Segment tracking mode: • 0 = automatic tracking • 1 = not used • 2 = force first segment • 3 = manual control
6	currentSeg	d	Number of currently tracked segment
7	windowingOn	d	Active segment determination control option, specifically windowing mode flag, 0=disabled, 1=enabled

8	windowSize	d	Number of segments either side of current segment WinFrog will look for the next segment to track when it determines the current one is not valid if Windowing mode is enabled
9	displayCurrSegm	d	Graphics display flag controls if current segment is highlighted, 0=disabled, 1=enabled
10	displaySegmAnnot	d	Graphics display flag controls if segments are annotated, includes curve points, 0=disabled, 1=enabled
11	useCorridor	d	Active segment determination control option, specifically if vehicle is outside the specified corridor, WinFrog will not attempt to determine the next segment to track, 0=disabled, 1=enabled
12	MaxDistOffLine	f.f	Width of corridor either side of the line (m)

TYPE 1516 FORMAT

Field	Data	Format	Comment
1	Code	1516	Offset Data
2	VehName	text	Vehicle name
3	Enabled	d	0 = offset tracking not enabled 1 = offset tracking enabled
4	UseHeading	d	0 = CMG used in offset position calculation 1 = heading used in offset position calculation
5	Name	ssss	Offset name
6	X	f.dd	x offset (m)
7	Y	f.dd	y offset (m)
8	Z	f.dd	z offset (m)
9	Plot	d	0 = don't plot offset 1 = plot offset
10	PlotLabel	d	0 = don't plot label 1 = plot label

TYPE 1916 FORMAT

Field	Data	Format	Comment
1	Code	1916	Profiler Data
2	name	text	operator assigned name of the device
3	Time	f.dd	PC time of latest data input
4	profilerModel	d	designation of the profiler type, 0 = generic, 1 = Trittech DHSS
5	nmr_heads	d	number of heads in use
6	nmr_ranges	d	number of ranges per head logged in scan
7	last_scan_head	d	the head last updated
8	vp	f.dddd	the velocity of sound as decoded from the profiler
9	velocityUsed	f.dddd	the velocity of sound used in real-time processing
10	heading_true	f.ddd	the heading used to process the data in realtime
11	Pitch	f.dddddd	the pitch interpolated for the time of the scan
12	Roll	f.dddddd	the roll interpolated for the time of the scan
13	next_scan_nmr	d	the scan number
14	processed_ranges	d	is the data raw (=0) or processed (=1)

TYPE 1917 FORMAT

Field	Data	Format	Comment
1	Code	1917	Profiler Data
2	name	text	operator assigned name of the device
3	gps_time	f.ddd	the PC time the scan data was received by WinFrog
4	scan_time	f.ddd	the scan time output by the profiler
5	j	d	data index
6	scan_direction	d	the scan direction
7	duration	f.ddd	duration of the scan in
8	start_angle	f.dddddd	the scan start angle in degrees
9	step_angle	f.dddddd	the scan angle interval in degrees
10	orient	d	orientation of the head
11	head_setup	d	head setup as assigned by the operator (same as MultiRov)
12	yOff	f.ddd	the fore/aft offset for the head, this may be the offset decoded from the profiler if the operator has set WinFrog to use these offsets
13	xOff	f.ddd	the port/stbd offset for the head, this may be the offset decoded from the profiler if the operator has set WinFrog to use these offsets
14	ZOff	f.ddd	the vertical offset for the head, this may be the offset decoded from the profiler if the operator has set WinFrog to use these offsets
15	AzOff	f.dddddd	the azimuth correction/offset
16	POff	f.dddddd	the pitch correction/offset
17	ROff	f.dddddd	the roll correction/offset for the head, this may be the offset decoded from the profiler if the operator has set WinFrog to use these offsets
18	AnOff	f.dddddd	angle offset, for generic profilers only
19	headNorth	f.ddd	the Northing of the head computed in realtime
20	HeadEast	f.ddd	the Easting of the head computed in realtime
21	headDepth	f.ddd	the depth of the head computed in realtime
22...	rawRanges	f.ddd	the raw data: in microseconds if travel time, metres if distance

USER DECOMPRESSION OF VEHICLE DATA SENT FROM A MASTER WINFROG TO A SMART REMOTE

To obtain the vehicle data sent by the master to smart remote computers, listen on port 7050 with UDP/IP protocol. You must be on the same network as the master WinFrog with the same sub-net mask to receive this data.

There are three messages that can be received on this port. Two are commands relate to the receiving of configuration data. These messages are uncompressed ASCII characters and are preceded with either 10000 or 10001 followed by a comma. These messages can be ignored. The third message contains the navigation information for all vessels in a single packet. It is compressed and begins with a two-byte binary integer, little endian, indicating the message size. The size does not include the first two bytes. The third byte indicates whether the first block is compressed or not and is used by the decompression routine. This byte does not necessarily indicate if the whole message is compressed or uncompressed, just the first block. The size of the compressed data should not exceed 50K. The decompression routine below uses "string" to dynamically allocate space for the uncompressed vehicle data.

The decompressed message will begin with STARTNPS<LF> and end with ENDNPS<LF>. Each line between the header and trailer is prefixed by a code indicating the message type. The messages that are sent depends on WinFrog's configuration but will consist of and be in the following order: 300, 701, 494, 516, 1516, 600, 510, 512, 700, 556, and 555. These message types are described in the previous section of this appendix.

The following code segment describes the method to decompress.

- 1) Read the message.
 - 2) Test if the message begins with ASCII 10000 or 10001.
- If so ignore message
If not decompress by calling the function FastDecompress. The source code for this function and another that it uses, is given below.

```
#define FAST_BLK_SIZE    16384L
#define FLAG_COPIED      0x80
#define FLAG_COMPRESS    0x40
#define S16  short int

// *****
//
// Function Name:  FastDecompress
//
//
// Description:    This 16 bit function uses the FastDecompBlock() function to
//                decompress a buffer of bytes.
//
// Notes/Warnings:
//
// Parameters:     Source      - pointer to the compressed data buffer
//                Dest        - pointer to the raw data buffer
//                SourceSize  - size of the compressed data in bytes
//
// Returns:        raw data size
//
// *****
```



```

INT _export FastDecompress(BYTE *Source, string *decompressedStr, INT SourceSize)
{
    BYTE *Src = Source;
    INT bytes_left = SourceSize;
    INT total_size = 0;
    INT size, raw_size;

    BYTE *Dst = new BYTE[FAST_BLK_SIZE + 1024];

    bool first = true;

    while (bytes_left > 0)
    {
        // decompress a block
        size = *((S16 *)Src);
        raw_size = FastDecompBlock( &Src[2], Dst, (short int) size );
        if (first)
        {
            first = false;
            decompressedStr->assign( (char*)Dst, 0, raw_size );
        }
        else
            decompressedStr->append( (char*)Dst, 0, raw_size );

        Src += (size + sizeof(S16));
        bytes_left -= (size + sizeof(S16));
        total_size += raw_size;
    }
    delete [] Dst;

    return total_size;
} // End of Function: FastDecompress( )

```

```

// *****
//
// Function Name:  FastDecompBlock
//
//
// Description:   A fast decompression routine for small blocks
//                of bytes. Uses a fairly fast algorithm, but the
//                compression ratio is not as high as PKZIP or other
//                commercial utilities.
//
// Notes/Warnings: Since you provide both buffers ahead of time, you must
//                know the worst case size of the compressed data and
//                have a large enough buffer allocated.
//                (original size + 2 should be sufficient.)
//
//
// Parameters:      Source      - buffer for reading the compressed data from
//                Dest        - buffer for writing the raw data to
//                SourceSize - size in bytes of the compressed data
//
// Returns:         Size in bytes of the raw data

```

```

//
// *****
WORD FastDecompBlock(BYTE *Source,BYTE *Dest,WORD SourceSize)
{
    WORD X = 4;
    WORD Y = 0;
    WORD Pos,Size,K;
    WORD Command = (Source[2] << 8) + Source[3];
    BYTE Bit = 16;

    if (Source[0] == FLAG_COPIED)
    {
        memcpy(Dest,&Source[1],SourceSize-1);
        return (--SourceSize);
    }

    for (; X < SourceSize;)
    {
        if (Bit == 0)
        {
            Command = (Source[X++] << 8);
            Command += Source[X++];
            Bit = 16;
        }
        if (Command & 0x8000)
        {
            Pos = (Source[X++] << 4);
            Pos += (Source[X] >> 4);
            if (Pos)
            {
                Size = (Source[X++] & 0x0f)+3;
                for (K = 0; K < Size; K++)
                    Dest[Y+K] = Dest[Y-Pos+K];
                Y += Size;
            }
            else
            {
                Size = (Source[X++] << 8);
                Size += Source[X++] + 16;
                for (K = 0; K < Size; K++)
                    Dest[Y+K] = Source[X];
                X++;
                Y += Size;
            }
        }
        else
        {
            Dest[Y++] = Source[X++];
        }
        Command <= 1;
        Bit--;
    }

    return(Y);
} // End of Function: FastDecompBlock( )

```