

UM-8250

Marksman L/USBL, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP USBL User Manual

Issue B Rev 3

Date of Issue: 1st February 2016

© 2016 Sonardyne International Limited. All rights reserved.

This user manual is the copyright and intellectual property right of Sonardyne International Limited (“Sonardyne”) and is provided solely for the customer’s use of the Sonardyne equipment as described in this user manual and in accordance with Sonardyne’s then prevailing terms and conditions of sale.

This user manual has been compiled to the best of Sonardyne’s knowledge and belief, but no representation, warranty (whether express or implied) or guarantee is made to any persons or legal entities as to the accuracy, reliability or completeness of the information contained in this user manual.

This user manual contains the proprietary, confidential information of Sonardyne and other third parties and as such may not be used, disclosed or placed in the public domain (by whatever means) by the customer except expressly in accordance with and subject to the above referenced terms and conditions of sale.

The copyright and any and all intellectual property rights of any and all third parties which may be referenced in this user manual or which may have provided proprietary products and/or software and/or documentation (in whatever format) to Sonardyne in respect of the Sonardyne equipment as described in this user manual are hereby duly acknowledged. The provision of any and all such products and/or software and/or documentation by Sonardyne shall be subject to and in accordance with the relevant third parties’ terms and conditions or the Sonardyne then prevailing conditions of sale, as appropriate.

The Sonardyne equipment described in this user manual is protected by various UK and US Patents and other patents internationally and registered trademarks of Sonardyne International Limited.

Third party and open source software used with Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP is acknowledged in *Appendix M*.

Contacting the Sonardyne Support Team

24-hour Emergency Telephone Helpline: +44 (0) 1252 877600

The Sonardyne 24-hour helpline is answered at the UK Headquarters during normal office hours (08:00 to 17:00). Outside these hours, your call is automatically transferred to an agency, which logs the details of your emergency and alerts the appropriate Sonardyne personnel.

Our aim is to make sure emergency requests are dealt with immediately during office hours, and are responded to within 30 minutes at all other times.

Please note the helpline is for emergency use only.

If you require NON-EMERGENCY product support, please contact your nearest Sonardyne office. Alternatively, contact the Sonardyne Head Office:

Sonardyne International Ltd
Blackbushe Business Park
Yateley
Hampshire
GU46 6GD
United Kingdom

Telephone: +44 (0) 1252 872288

Fax: +44 (0) 1252 876100

Email: support@sonardyne.com

Note



Email and telephone support is available during normal UK office hours (08:00 to 17:00).

Contents

Contacting the Sonardyne Support Team	ii
Amendment History	xvi
Section 1 – Introduction	1
1.1 Scope of this Manual	1
1.2 Purpose of this Manual	1
1.3 Related Publications	1
1.4 Conventions	1
Section 2 – Safety	2
2.1 Introduction	2
2.2 Procedures	2
2.2.1 Warnings	2
2.2.2 Cautions	3
Section 3 – System Overview	6
3.1 Introduction	6
3.2 System Overview	6
3.2.1 Typical System	6
3.2.2 Surface Units	7
3.2.3 In-Water Units	8
3.3 Navigation Processor	8
3.3.1 Navigation Sensor Hub	8
3.3.2 Navigation Computer	10
3.4 In-water Systems	12
3.4.1 Transceivers	13
3.4.2 Transponder Beacons	13
3.5 Peripheral Systems	13
3.5.1 DP Navigation System	14
3.5.2 Vertical Reference Unit	14
3.5.3 Gyrocompass	14
3.5.4 Data Formats	14
3.5.5 Printer	15
3.5.6 External Mass Storage	15
3.6 Typical Navigation Cycle	15
Section 4 – Common Procedures	17
4.1 Introduction	17
4.1.1 New Setup	17
4.1.2 Instruction Format	17
4.2 Starting the Software	18
4.3 Initialisation	19
4.3.1 Creating a New Setup	19
4.3.2 Opening a Previous Setup	20
4.4 Adding Objects	21
4.4.1 Adding Objects from the System Setup Window	21

4.4.2 Adding Instruments using the Ports Table	23
4.4.3 Adding Beacons using the Quick Track Tool	24
4.4.4 Adding Beacons using the Beacons Table	25
4.5 Deleting Objects	26
4.6 Configuring the Vessel	26
4.7 Configuring a Transceiver	28
4.7.1 Offsets	29
4.7.2 5G and 6G Technologies	29
4.8 Configuring a Beacon	30
4.8.1 Mixed 5G & 6G Jobs	30
4.8.2 Adding a GyroCompatt	31
4.9 Array Beacons and Array Calibration	33
4.9.1 Adding and Calibrating Beacons from the Beacon Symbol on the Chart	33
4.9.2 Adding and Calibrating Beacons from the Beacons Table	34
4.10 Configuring a GNSS	36
4.11 Geodesy Tool	37
4.11.1 UTM Zone Reset	37
4.12 Configuring a Vertical Reference Unit (VRU)	38
4.13 Configuring a Depth Device	39
4.13.1 Depth Device Formats	39
4.14 Configuring a Gyrocompass	40
4.15 Configuring a Lodestar GyroUSBL Device	41
4.15.1 Overview of the Offsets Form	43
4.16 Configuring System Devices	44
4.16.1 Network Sensor Hub (NSH)	45
4.16.2 Electronic Riser Angle (ERA)	45
4.16.3 Programmable Acoustic Navigator (PAN)	46
4.16.4 Remote Control Interface	47
4.16.5 Signal Tower	51
4.16.6 Sound Speed Sensor	52
4.16.7 Time of Day (TOD)	52
4.17 Configuring a Waypoint	53
4.17.1 Waypoint Main Tab	53
4.17.2 Watch Circle	54
4.18 Adding a Vessel Reference Point	55
4.19 Configuring the Sound Speed	56
4.20 Configuring Output Telegrams	59
4.20.1 Configuring an Output Telegram	62
4.20.2 Operation	65
4.21 Viewing Setup Files Offline	65
4.22 Sending Log files to Sonardyne Support	67
Section 5 – Beacons	68
5.1 Beacons Table	68
5.1.1 Common to all Tabs	68

5.1.2 Main Tab	68
5.1.3 Interrogate and Reply	69
5.1.4 Interpreting Link Status Information	70
5.1.5 Tracking Tab	71
5.1.6 Advanced tab	72
5.1.7 Sensors Tab	73
5.1.8 Sensor DataTab	73
5.1.9 Hardware Status Tab	74
5.1.10 Additional Status Tab	75
5.1.11 Common Commands	75
5.1.12 Beacon Selection	76
5.1.13 Sorting Columns	77
5.1.14 Beacon Groups	77
5.1.15 Beacon Operations	78
5.1.16 Bulk Changes	80
5.1.17 Change Groups Dialog Box	81
5.1.18 User Defined Beacon Group Settings Dialog Box	82
5.1.19 Beacon Specific Properties Dialog Box	82
5.2 Add Beacon Wizard	83
5.2.1 Beacon Type	84
5.2.2 Beacon Address	85
5.3 Optimum Choice of Wideband Signals for USBL	88
5.3.1 Overview	88
5.3.2 Wideband Choices	88
5.3.3 Address Choices	88
5.3.4 Diagnostics	89
5.4 iWAND Tool	89
5.5 Beacon Discovery Tool	91
5.5.1 Beacon Discovery Operation	92
5.5.2 Beacon Identification.	93
5.5.3 Beacon Import	94
5.6 Multi-User Shared Arrays and Advanced Navigation Setup	95
5.6.1 Overview	95
5.6.2 Shared Array/Multi-User Setup	98
5.6.3 Advanced Navigation Mode Setup	98
Section 6 – Application Procedures	102
6.1 Introduction	102
6.1.1 Before you begin	102
6.2 USBL Mobile Beacon Tracking	102
6.2.1 Application Summary	102
6.2.2 Navigation Set-up	103
6.2.3 Navigate	103
6.2.4 GNSS Input	104
6.3 ROV Tracking	104

6.3.1 Application Summary	104
6.4 Towfish Tracking	105
6.4.1 Application Summary	105
6.5 Simple DP	105
6.5.1 Application Summary	105
6.6 Optimised USBL	105
6.6.1 Application Summary	105
6.7 LUSBL Tracking for DP	106
6.7.1 Application Summary	106
6.7.2 General Navigation Set-up	106
6.8 DP INS	107
6.8.1 Setup	107
6.8.2 Deployment and Calibration	107
6.9 Multiple Systems Tracking Independently	108
6.9.1 Application Summary	108
6.9.2 Set-up	108
6.10 Specialist Tracking Applications	109
6.10.1 iUSBL	109
6.10.2 Follow Sub	109
6.10.3 AUV Tracking (6G Only)	109
Section 7 – Optimised USBL and DP INS	111
7.1 Introduction	111
7.2 Installation and Set-up	111
7.2.1 Hardware Connections	111
7.2.2 Installations with Separate USBL Transceiver and Lodestar Units	112
7.2.3 Installations with Combined Lodestar GyroUSBL Unit	115
7.3 Software Setup	117
7.3.1 Create the Job and Add the NSH	117
7.3.2 Add the GNSS	118
7.3.3 Add a Combined Lodestar and USBL Transceiver Device	118
7.4 Suggested Procedure – Arriving on Location	120
7.4.1 Procedure	121
7.4.2 Reset the Lodestar	121
7.5 Simultaneous Operations	126
7.6 Suggested Procedure – Leaving a Location	126
Section 8 – Dual-Redundant LUSBL System	128
8.1 Description	128
8.2 Hardware Implications	128
8.3 Functional Implications	129
8.4 Installation and Configuration	130
8.5 CASIUS Calibration	133
8.6 Operation	133
Section 9 – Riser Angle Monitoring	135
9.1 Introduction	135

9.2 Marine Riser Angle Monitoring System (MRAMS)	135
9.2.1 MRAMS Software Configuration	135
9.2.2 MRAMS Calibration	136
9.2.3 MRAMS Output Telegram	138
9.2.4 MRAMS Operation	140
9.3 Electrical Riser Angle (ERA) Monitoring	141
9.3.1 ERA Software Configuration	141
9.3.2 ERA Operation	142
9.3.3 ERA Calibration	143
Section 10 – Riser Profile System	144
10.1 Introduction	144
10.2 RPS Configuration Prerequisites	144
10.3 Starting RPS	144
10.4 Software Configuration	145
10.4.1 Set the Collection Mode	147
10.5 Operation	149
10.5.1 Manual Data Collection Mode	149
10.5.2 Automatic Collection Mode	149
10.6 Riser Profiling System Displays	149
10.6.1 Profile Tab	149
10.6.2 Riser Beacon Data Tab	153
10.7 Automatic Logging of Processed Data	154
10.7.1 RPS Log File Management	155
10.7.2 RPS Log File Format	155
Section 11 – Beacon Sensor Monitoring Tool	157
11.1 Introduction	157
11.2 Overview	157
11.3 Assumptions	158
11.4 Configuration	158
11.5 Setting the Collection Mode	158
11.6 Setting the Beacons to be Monitored	159
11.7 Operation	160
11.7.1 Manual Data Collection Mode	160
11.7.2 Automatic Collection mode	160
11.8 Beacon Sensor Monitoring Tool Displays	161
11.8.1 Graphs tab	161
11.8.2 Beacon Data Tab	162
Appendix A – User Interface Description	164
A.1 Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP Main Window	164
A.2 Frame Selector	167
A.3 Button Controls	167
A.3.1 Windows XP	168
A.3.2 Windows 7	169
A.4 Target Selection Buttons	170

A.5 Plan View Pane	170
A.6 Tracking Pane	171
A.7 Message Pane	172
A.8 System Menu	173
A.8.1 Setup	173
A.8.2 New	173
A.8.3 Open	173
A.8.4 Save options	173
A.8.5 Override UI Lock	174
A.8.6 Print	174
A.9 View Menu	174
A.9.1 Beacons	174
A.9.2 Ports	174
A.9.3 Telegrams	179
A.9.4 Alarms	180
A.9.5 Events	181
A.9.6 Lodestar Statistics	182
A.9.7 Comms	183
A.9.8 Clear Position History	183
A.10 Tools Menu	184
A.10.1 Acoustic Travel Times	184
A.10.2 Array Planner	187
A.10.3 CASIUS	190
A.10.4 Environmental	191
A.10.5 Geodesy	192
A.10.6 Quick Track	192
A.10.7 Waypoints	193
A.10.8 MRAMS	194
A.10.9 ERA	194
A.10.10 Sensor Monitoring	195
A.10.11 Riser Profiling	195
A.10.12 Advanced	196
A.10.13 Maintenance	214
A.10.14 Options	221
A.11 Help Menu	226
Appendix B – System Integrity	229
B.1 UI Lock	229
B.1.1 Overview	229
B.1.2 Override UI Lock	229
B.2 Sonardyne Resource Monitor	230
B.2.1 Overview	230
B.2.2 General Operation	230
B.2.3 Resource Monitor Warning Actions	231

Appendix C – Installation	232
C.1 Introduction	232
C.2 System Installation	232
C.2.1 Navigation Processor	232
C.3 Hardware Installation	233
C.3.1 Before you Begin	233
C.3.2 What you will Need	233
C.3.3 Installation	233
C.3.4 NSH Interface Card Details	236
C.3.5 Interface Card Installation	238
C.3.6 Network Connection	238
C.4 USBL Transceiver Installation	238
C.4.1 General Requirements	239
C.4.2 Pole Mounting	239
C.4.3 Through-Hull Mounting	240
C.4.4 Installation	246
C.4.5 GyroUSBL	247
C.5 External Sensors	249
C.5.1 VRU	249
C.5.2 Gyrocompass	249
C.5.3 GNSS Receiver System	250
C.6 NSH Firmware Installation	250
C.6.1 Upgrade	250
C.6.2 View Stored Applications	251
C.6.3 Firmware Roll-Back	252
C.7 Software Installation	252
C.7.1 Security Keys	252
C.7.2 For Sonardyne Navigation Computer Installations	253
C.7.3 Non-Sonardyne Computer Installations	254
Appendix D – Interface Cables	257
D.1 Serial Interfaces	257
D.2 Cable Diagrams	257
D.3 Cable Diagrams for DP INS/Optimised Applications	264
Appendix E – Remote Control Interface	274
E.1 Hardware interface	274
E.2 Software Protocol	274
E.3 Client Software	274
E.4 Operation	275
Appendix F – Output Telegram Formats and Interfaces	277
F.1 Introduction	277
F.2 HPR 309	277
F.2.1 Description	277
F.2.2 Format	277
F.2.3 Definition of Field Names:	278

F.3 HPR 418 – Message 1 (USBL / SSBL)	282
F.3.1 Description	282
F.3.2 Definition of Field Names	283
F.4 HPR 418 – Message 2 (LBL / LUSBL)	286
F.4.1 Description	286
F.4.2 Notes	287
F.4.3 Definition of Field Names	287
F.5 HPR 418 BCD – Message 1	290
F.5.1 Description	290
F.5.2 Definition of Field Names	291
F.6 HPR 418 BCD – Message 2	293
F.6.1 Description	293
F.6.2 Definition of Field Names	294
F.7 NMEA 0183 SSB – (USBL / SSBL Position)	296
F.7.1 Description	296
F.7.2 Definition of Field Names	297
F.8 NMEA 0183 – LBP (LBL / LUBSL Position)	299
F.8.1 Description	299
F.8.2 Field Description	299
F.8.3 Definition of Field Names	300
F.8.4 X_coordinate, Y_coordinate, Coordinate_system	300
F.9 PSONALL – Sonardyne General Position Report	300
F.9.1 Description	300
F.9.2 Format	300
F.9.3 Field Descriptions	300
F.10 PSONUSBL – Sonardyne USBL Report	301
F.10.1 Description	301
F.10.2 Format	302
F.10.3 Field Description	302
F.10.4 Example	302
F.11 PSONDP - Sonardyne DP Report	302
F.11.1 Description	302
F.11.2 Format	303
F.11.3 Field Description	303
F.11.4 Modifications	304
F.11.5 Example	304
F.12 NMEA 0183 GGA	304
F.12.1 Description	304
F.12.2 Format	304
F.12.3 Field Description	305
F.13 ATS ASCII	306
F.13.1 Description	306
F.13.2 Format	306
F.13.3 Field Description	306

F.14 Trackpoint II	306
F.14.1 Description	306
F.14.2 Field Description	307
F.15 HPR 300P	307
F.15.1 Description	307
F.15.2 Field Description	307
F.16 PSONMEAS – Sonardyne Measurements Report	308
F.16.1 Description	308
F.16.2 Format	308
F.16.3 Field Description	308
F.16.4 Definition of Field Names	309
F.17 PSONLLD – Sonardyne Lat, Long, Depth Report	309
F.17.1 Description	309
F.17.2 Format	309
F.17.3 Field Description	310
F.18 PSONMRAMS – Sonardyne MRAMS Report	310
F.18.1 Description	310
F.18.2 Format	310
F.18.3 Field Description	310
Appendix G – Alarms and Events	313
G.1 Alarms	313
G.1.1 System Manager	313
G.1.2 Device Manager	316
G.1.3 Alarm Details - Scheduler	327
G.1.4 Alarm Details - Tracker	329
G.1.5 Alarm Details - Logger	333
G.1.6 Alarm Details - Main UI	336
G.1.7 Alarm Details - Application Main	337
G.1.8 Alarm Details – Main UI	337
G.2 Events	338
G.2.1 System Manager	338
G.2.2 Event Details - Device Manager	341
G.2.3 Event Details - Scheduler	361
G.2.4 Event Details - Tracker	363
G.2.5 Event Details - Logger	365
G.2.6 Event Details - Main UI	374
G.2.7 Event Details - Application Main	374
G.2.8 Event Details - Main UI	375
Appendix H – Acoustic Positioning Methods	376
H.1 Long Baseline (LBL)	376
H.1.1 Hardware	376
H.1.2 Principles	376
H.1.3 Beacon Numbers	376
H.1.4 Baseline Distance	377

H.1.5 Calibration	377
H.2 Short Baseline (SBL)	377
H.2.1 Hardware	377
H.2.2 Baseline Distances	378
H.2.3 Principles	378
H.3 Ultra-short Baseline (USBL)	379
H.3.1 Hardware	379
H.3.2 Principles	379
H.4 Long / Ultra-short Baseline (L/USBL)	380
H.4.1 Hardware	380
H.4.2 Principles	380
H.4.3 Dual Operation	381
H.5 Long-short USBL (LSUSBL)	381
H.5.1 Hardware	381
H.5.2 Principles	381
Appendix I – System Calibration	382
I.1 Introduction	382
I.2 Sound Velocity	382
I.2.1 Background	382
I.2.2 Measurement of Sound Velocity	383
I.3 Transceiver Alignment Calibration	383
I.4 Simple Array Calibration	383
I.4.1 Top-down Calibration	383
I.4.2 DP-Ref Waypoint	384
Appendix J – CASIUS Data Collection Methods	385
J.1 Manoeuvring Guidelines	385
J.2 Data Collection – DP Vessel	385
J.3 Data Collection – Constantly Moving Vessel	386
J.4 Data Collection – DP Vessel with Tilted Transceiver	387
J.5 USBL Transceiver Alignment Calibration Check	388
J.5.1 Before You Begin	388
J.5.2 Alignment Check	388
Appendix K – Frames of Reference	390
K.1 Introduction	390
K.2 Geographical (World) Co-ordinate Frame	390
K.2.1 Seabed Frame	390
K.3 Local Grid Co-ordinate Frame	390
K.4 Vessel, VRU and Gyrocompass Body Frames	391
K.4.1 Origins	392
K.4.2 Compensated frame	392
K.5 Transceiver Co-ordinate Frame	392
K.6 Corrections Between Co-ordinate Frames	392

Appendix L – Time System	393
Appendix M – Third Party and Open Source Software Licence Notices and Terms	395
M.1 Third Party Software	395
M.1.1 SE46 AB	395
M.2 Open Source Software	395
M.2.1 Gios PDF Library	395
M.2.2 PTPd V1.0	395
M.2.3 Tera Term V4.8	395
M.2.4 Filezilla V3.7.3 FTP Software	396
Definitions	397

Figures

Figure 3–1 Typical Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP System	7
Figure 3–2 Navigation Sensor Hub Front View	9
Figure 3–3 Navigation Sensor Hub Rear View	10
Figure 3–4 Navigation Computer Front View	11
Figure 3–5 Navigation Computer Rear View	12
Figure 4–1 Mixed 5G and 6G Jobs	31
Figure 4–2 Remote Control Interface – by Serial Port	48
Figure 4–3 Remote Control Interface – by UDP (Ethernet) Port	48
Figure 4–4 Effect of Hysteresis on the Watch-Circle Alarm	55
Figure 4–5 Example Report of System Setup	66
Figure 5–1 Sonardyne Frequency Chart	87
Figure 6–1 Example 5-Beam Array Deployment Pattern	106
Figure 7–1 DP INS / Optimised USBL System with Separate Lodestar / Tcvr	112
Figure 7–2 Detail of Lodestar and Bracket Mounted on a Carriage	113
Figure 7–3 Separate Lodestar / Tcvr Wiring Diagram	114
Figure 7–4 GyroUSBL Wiring Diagram	116
Figure 8–1 Block Diagram of a Typical Dual-Redundant LUSBL System	128
Figure 8–2 Dual-Redundant System Transceiver Wiring	131
Figure 9–1 MRAMS Configuration Dialog Box	136
Figure 9–2 Riser Angle Monitoring Display	140
Figure 10–1 Relationship between BOP and Beacon Parameters	147
Figure A–1 Menu System	166
Figure A–2 Logging User Interface	214
Figure C–1 Typical Interconnections - NSH and Navigation Computer	234
Figure C–2 Transceiver Mounting — Arrangement 1	241
Figure C–3 Transceiver mounting — Arrangement 2	242
Figure C–4 Alternative Isolation Flange	243
Figure C–5 Transceiver mounting — Arrangement 3	243
Figure C–6 Transceiver Bolt Hole Pattern	244
Figure C–7 HPT – GDT Transceiver Wiring	246
Figure C–8 5-Element Lodestar GyroUSBL	247
Figure C–9 7-Element Lodestar GyroUSBL	248
Figure D–1 NSH Dual Redundant Transceiver Cable – CPN 820-0118/DWG 8098-039-01	258
Figure D–2 RS232 Serial Data Cable to Flylead – CPN 820-6608/DWG 8020-060	259
Figure D–3 NSH Transceiver Cable – CPN 820-6459/DWG 8020-061	260

Figure D–4 Responder Cable – CPN 820-3349/DWG 7784-049-02	261
Figure D–5 USBL Transceiver Cable – CPN 820-6484/DWG 8020-069	262
Figure D–6 Transceiver Cable – CPN 820-3427/DWG 7769-038	263
Figure D–7 Serial I/O Cable – CPN 820-3650/DWG 7784-159	264
Figure D–8 Subsea Lodestar Console Cable Assembly – CPN 820-0065	265
Figure D–9 Subsea Lodestar Comms C1 Cable Assembly – CPN 820-0068	266
Figure D–10 Subsea Lodestar Comms Ethernet Tail Cable Assembly – CPN 820-0071	267
Figure D–11 Subsea Lodestar Comms Ethernet Cable Assembly – CPN 820-0072	268
Figure D–12 Subsea Lodestar Transceiver Tail Cable Assembly – CPN 820-0073	269
Figure D–13 NSH Lodestar Tail Cable – CPN 820-0147	270
Figure D–14 GyroUSBL Mobile System Cable – CPN 820-6873	271
Figure D–15 GyroUSBL Mobile System Cable – CPN 820-6882, 820-6917, 820-6913	272
Figure D–16 GyroUSBL Tail Cable – CPN 312-8091 to 8095	273
Figure E–1 Remote Control Interface	274
Figure E–2 Comms Viewer Window for the Remote Interface	276
Figure F–1 Interface Block Diagram	277
Figure H–1 Typical LBL System	376
Figure H–2 Typical SBL System	378
Figure H–3 Typical USBL System	379
Figure H–4 Typical L/USBL system	380
Figure J–1 Manoeuvring Pattern for a DP Vessel	386
Figure J–2 Manoeuvring Pattern – Constantly Moving Vessel	387
Figure J–3 Manoeuvring pattern – Tilted Transceiver	388
Figure L–1 Time System	394

Tables

Table 1–1 Related Publications	1
Table 1–2 Conventions used in this Manual	1
Table 4–1 Position Out Telegrams	60
Table 5–1 Beacon Controls Common to all Tabs	68
Table 5–2 Beacons Table - Main Tab Description	68
Table 5–3 Parameter Bounds for Link Status Information	71
Table 5–4 Beacons Table – Tracking Tab Description	71
Table 5–5 Beacons Table – Advanced Tab Description	72
Table 5–6 Beacons Table – Sensors Tab Description	73
Table 5–7 Beacons Table – Sensor Data Tab Description	74
Table 5–8 Beacons Table – Hardware Status Tab Description	74
Table 5–9 Beacons Table – Additional Status Tab Description	75
Table C–1 Interface Cards	236
Table D–1 Cable Diagrams	257
Table D–2 Cable Diagrams for DP INS/Optimised Applications	264
Table F–1 Field description of the HPR 309 Telegram	277
Table F–2 HPR Channel Flags	281
Table F–3 Field description of the HPR418 Telegram	282
Table F–4 Field Description of the HPR418 Telegram Message 2	286
Table F–5 Time_header format	288
Table F–6 Field Description of the HPR418BCD Telegram Message 1	290
Table F–7 Field Description of the HPR418BCD Telegram Message 2	294
Table F–8 Field Description of the SSBL Telegram	296

Table F–9 Supported options for NMEA SSB Telegram	298
Table F–10 Field Description of the LBP Telegram	299
Table F–11 NMEA 0183 LBP Coordinate Fields	300
Table F–12 Field Description for the PSONALL Telegram	300
Table F–13 Field Description for the PSONUSBL Telegram	302
Table F–14 Field Description for the PSONDP Reports	303
Table F–15 Field Description for the NMEA GGA Telegram	305
Table F–16 Field Description for the ATS ASCII Telegram	306
Table F–17 Field Description for the Trackpoint II Telegram	307
Table F–18 Field Description for the HPR 300P Telegram	307
Table F–19 Field Description for the PSONMEAS Format	308
Table F–20 Format Data field 1, Data Field 2, Data Field 3 for PSONMEAS Format	309
Table F–21 Field Description for the PSONLLD Format	310
Table F–22 Field Description for the NMEA PSONMRAMS Format	310
Table G–1 Alarm Details - System Manager	313
Table G–2 Alarm Details - Device Manager	316
Table G–3 Alarm Details - Scheduler	327
Table G–4 Alarm Details - Tracker	329
Table G–5 Alarm Details - Logger	333
Table G–6 Alarm Details - Main UI	336
Table G–7 Alarm Details - Application Main	337
Table G–8 Alarm Details – Main UI	337
Table G–9 Event Details - System Manager	338
Table G–10 Event Details - Device Manager	341
Table G–11 Event Details - Scheduler	361
Table G–12 Event Details - Tracker	363
Table G–13 Event Details - Logger	365
Table G–14 Event Details - Main UI	374
Table G–15 Event Details - Application Main	374
Table G–16 Event Details - Main UI	375

Amendment History

The amendment history records all amendments and additions made to this manual.

Issue	Revision	Date	Comments	Section	Page
A	1	13-10-2010	Revised to support Marksman Ver 2	All	All
A	2	19-12-2010	Added support for DP INS application	Ch 4 App G	All P209 to end
A	3	19-08-2011	Updated throughout for v 3.01	Multiple	Multiple
A	4	16-12-2011	Update Lodestar configuration details Update Figure 12 Update Figures 58 to 60 Add dual-redundant system wiring diagram	2.13 4.2 App G 6.4	All P 98 App G P117
A	5	15-06-2012	Add details for Ranger 2 Pro	All	Multiple
A	6	13-10-2013	Updated throughout	All	Multiple
A	7	11-05-2014	Revised throughout	All	Multiple
B	1	01-02-2015	Updated for V4.02 Revised throughout	All	All
B	2	24-09-2015	Updated for V4.03 Revised throughout	All	All
B	3	01-02-2016	Updated for V4.04 Revised throughout	All	All

Section 1 – Introduction

1.1 Scope of this Manual

This manual refers to the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP systems, manufactured by Sonardyne International Limited. It provides important information about the systems, and offers advice on how to use the system safely and effectively.

Sonardyne International Limited operates a series of training courses that explain the theory and practice of the system.

1.2 Purpose of this Manual

This manual contains information for anyone involved with installing, using or maintaining the system. It includes technical and user information to deliver the best performance from the system.

Anyone using this system must ensure they read and understand the relevant parts of this manual.

To make sure the safety of the installer and operator is maintained it is important that all warnings, cautions and the Safety Section in this manual, as well as the warnings, cautions and Safety Section of any additional manuals are read and understood.

This manual may be printed in part or whole by the user but cannot be copied or changed. Copyright of this manual remains with Sonardyne International Limited at all times.

1.3 Related Publications

To make sure the system is operated safely, a Safety Manual is supplied with this user manual. It is important that the Safety Manual is read and understood before proceeding with any activity on the equipment.

Table 1–1 Related Publications

Publication	Title
<i>Sonardyne Safety Manual</i>	<i>Operational and Safety Precautions</i>
<i>UM-8026</i>	<i>User Manual for the Type 8026 i7 Navigation Computer</i> (supplied with the Navigation Computer)
<i>UM-8098</i>	<i>User Manual for Navigation Sensor Hub</i> (supplied with the NSH)
<i>UM-8142</i>	<i>User Manual for the HPT</i> (supplied with the HPT)

1.4 Conventions

Table 1–2 Conventions used in this Manual

Format	Conventions
Boldface Type	User Input, Menu Options, Keys, e.g. Click OK
<i>Italic Type</i>	References to Figures, Tables, Sections and other internal/external source
Arrow (>)	Selection of an additional menu item e.g. File > Save

Section 2 – Safety

2.1 Introduction

Before any activity is carried out on this system, it is recommended that the included Safety Manual and all warnings and cautions in this manual are read and understood.

It is recommended the operator complies with the Health and Safety Regulations applicable to the vessel and the region before operating this equipment.

Operators and service personnel must be familiar with the normal operating and safety procedures for subsea equipment.

Documentation must be consulted whenever a  or  warning symbol is found on the equipment, in order to determine the nature of the potential hazard and any actions which must be taken.

If any additional equipment is used, any warnings and cautions in the equipment user manual must be read and fully understood and the equipment must only be used as specified by the manufacturer.

The safety of any system incorporating this equipment is the responsibility of the assembler of the system.

2.2 Procedures

Warnings explain dangers that may result in personal injury or death. Caution explain hazards that may result in equipment damage. Before carrying out any procedure on the equipment, make sure all the following Warnings and Cautions are read and understood.

2.2.1 Warnings

 **Personal protection.** Appropriate protective equipment such as protective footwear, hard hat and gloves must be worn when handling or carrying out any procedures involving Sonardyne and other equipment.

 **Heavy Equipment.** Many Sonardyne products and equipment types, such as transponders, transceivers, cable drums etc. require Manual Handling Equipment (MHE) for lifting due to their heavy weight. If MHE is not available, it is the responsibility of the operator to perform a manual handling risk assessment prior to carrying out manual lifting/handling. Refer to the individual equipment documentation for weight specifications.

 **Risk of impact injury.** Do not stand in line with the end-cap when removing from beacon. Any internal pressure could rapidly force the end-cap from the beacon like a projectile.

 **Risk of crush injury.** Do not stand underneath suspended equipment.

 **Risk of crush injury.** Do not place hands near a Release Mechanism when in operation. The mechanism is opened with a high pressure spring which could trap fingers.

 **Risk of crush injury.** A GyroUSBL must only be lifted by the lifting eyes supplied with the equipment.

 **Risk of crush injury.** The Dunker 6 restraining cables must not be used if corroded or damaged as this could cause the Dunker 6 to drop suddenly.

 **Risk of burns.** If the battery pack has been exposed to flooding, corrosive liquids may be present. Personal protective equipment, such as gloves and goggles, must be worn to handle the battery pack.

 **Risk of burns.** Do not carry out maintenance on a transceiver if the housing is hot. Lower the

transceiver into cold water and wait for the housing to cool. Wear Personal Protective Equipment such as gloves.

 Risk of Asphyxiation. Only trained personnel must be allowed to work in confined spaces in general and in the sea-chest in particular. Make sure there is always an adequate supply of fresh air available inside the confined space.

 Molykote 44 is a mild irritant. When lubricating the connector faces, personal protective equipment such as gloves and goggles must be worn.

 Risk of fire. Make sure the power rating of any cables used is not exceeded.

 Risk of Electric shock. Do not push metal objects into the computer openings and keep metal objects away from connectors as this may result in short circuits, fire or electric shock.

2.2.2 Cautions

 Compass safe distance. The NSH and connecting cables should not be mounted within 5 metres of a navigational compass.

 Installation Recommendation. It is recommended that hardware installations are located at least 10 metres from any VHF radio antennae operating in the 156-165 MHz band.

 Installation Recommendation. This equipment is intended to be used (and draw its power) within the Bridge and deck zone of the ship. The BS IEC 60533 -1999 standard, Electrical & Electronic Installations in Ships, makes certain recommendation [see emission limits Table 3] to help aid protection in this specific zone. It requests that an inline RFI filter is to be installed in the power supply circuit between this zone and all other general power distribution zones. This filter is to be capable of achieving a decoupling of about 30 dB in the frequency range of 10 kHz to 30 MHz. This is the normal, anticipated practice and is stated here to secure EMC installation integrity.

 Installation Recommendation. It is advisable to use a power outlet with a surge protector fitted. Preferably the Navigation Computer and NSH should be supplied with power from an Uninterruptible Power Supply (UPS) to prevent vessel power interruptions affecting the operation.

 Loss of Data Risk. Damage can occur to the hard disk or data corruption by switching off system power when the hard disk is reading or writing data. Do not switch off system power until after you have shut down the system correctly.

 Network connection failure. Connection of the Navigation Computer and NSH to anything other than a closed private network or approved Sonardyne devices is at the risk of the operator. Sonardyne International Limited accepts no responsibility for network connections and configurations.

 Risk of equipment damage. All instruments must be maintained according to their individual operating manuals. Failure to follow recommended procedures could result in instrument failure, and loss of system integrity.

 Risk of equipment damage. When the navigation computer is operating in critical vessel operations, external devices must not be connected/disconnected and the front panel must be kept in the upright closed position. The USB ports and SATA drive can be sensitive to Electrostatic Discharge (ESD) under certain conditions which could result in the computer malfunctioning.

 Risk of equipment damage. Make sure that the Navigation Computer chassis and the NSH chassis are correctly installed in a rack or a console, and are provided with adequate fixings and support to avoid damage from vibration.

 Risk of equipment damage. Make sure the Navigation Computer chassis and the NSH chassis receive an adequate cool air supply to avoid damage caused by overheating.

-
-  Risk of equipment damage. There are no user-serviceable parts inside the Navigation Computer or the NSH, except for the external filters for the cooling fans. Do not attempt to open these items.
-  Risk of equipment damage. Make sure the Navigation Computer and NSH have an earth lead connected to the chassis earth at the rear of the computer when rack mounted.
-  Risk of equipment damage. Do not operate the Navigation Computer and NSH with any of the ventilation openings blocked or covered.
-  Risk of damaging connectors. Do not move the Navigation Computer or NSH with cables connected.
-  Risk of equipment malfunction. This product makes use of Microsoft Windows which is not intended for use in any system where failure or fault of any kind of the Product could reasonably be seen to lead to death or serious bodily injury of any person, or to severe physical or environmental damage (“High Risk Use”). High Risk Use is **STRICTLY PROHIBITED**.
-  Risk of equipment malfunction. For DP applications, the owner and operator must ensure that the DP control system accepts the position estimate and quality factors published by the system in the output telegram, and that it uses the quality factors to weight the estimate appropriately. Failure to do so can result in loss of system integrity. Refer to *Appendix F* for descriptions of the output telegram formats.
-  Risk of equipment malfunction. When a vessel is used for critical operations such as drilling, work over operations where attached to a live well, or diver operations, it is recommended that:
- for LUSBL mode, five or more transponders should be deployed.
 - for DP-INS mode, three or more transponders should be deployed.
- Loss of system integrity can occur if you use fewer than the recommended minimum number of beacons.
-  Risk of equipment malfunction. Do not operate multiple beacons on the same address in the water at the same time. The address must be unique to any one beacon operating in the same acoustic area.
-  Risk of equipment malfunction. Minimise any sources of high-level acoustic noise in the MF band. Examples of such noise sources include ROVs, vessel thrusters, and other vessels using acoustic positioning. High noise levels can disrupt the acoustic measurements and lead to loss of system integrity.
-  Risk of equipment malfunction. Do not ignore a system alarm because this can lead to incorrect operation. Investigate the cause of any system alarms, and make appropriate corrections for them.
-  Risk of equipment malfunction. Review the system event log periodically (particularly the Warnings and Alarms categories). Investigate any unexplained events, particularly repeated warnings, and make any appropriate corrections.
-  Risk of equipment malfunction. Mandatory software and firmware update notices must be applied as soon as practically possible.
-  Risk of equipment malfunction. It is recommended that hull gate valves are exercised at least once a month to prevent build-up of marine growth, etc. that could cause the mechanism to seize. A failed gate-valve prevents maintenance of the USBL transceiver being carried out.
-  Risk of equipment malfunction. Before carrying out hull gate valve maintenance, please deselect the PME from DP system and turn off vessel tracking. After the maintenance, restart tracking, reset the Lodestar (if fitted), allow tracking to stabilise and reselect the PME in the DP system.
-  Risk of equipment damage. Acoustic transceivers and Lodestar units contain delicate
-

transducers and motion sensing elements. Take care to protect this equipment during and after installation by following all the instructions in the user manual.

 Risk of equipment damage. To avoid galvanic corrosion of the USBL transceiver housing, make sure it is electrically isolated from surrounding metalwork by following all the instructions in the installation manual.

Section 3 – System Overview

3.1 Introduction

This is the user manual for the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP systems developed by Sonardyne International Limited. The following topics are covered:

- A description of the system .
- Information to help you operate and setup the system correctly.
- A description of the software.
- Instructions to help you calibrate the system.
- Instructions to complete all the procedures you are likely to need during an operation.
- Information to help you recognise a possible fault condition and to help you solve it.

The manual also includes additional background information that you can refer to if necessary. This additional information is included in a series of appendix chapters:

- Instructions on how to use the electronic version of this manual and how to find the information you need quickly.
- A brief explanation of how the acoustic navigation system works.
- General guidance to help engineers install the system's hardware and software .
- Detailed descriptions of the individual dialog boxes included in the software.
- Information about the various error messages and alarms that you might experience when you are using the system.
- Additional reference information, including a glossary of terms used.

The software images shown in this manual are captured using Marksman software. The images are identical to Ranger 2 Pro software apart from the small identification logo in the top left of the window.

Note



Some features shown here may not be available, depending on the exact product and options purchased.

3.2 System Overview

3.2.1 Typical System

Figure 3–1 shows an example of a typical system. It consists of sub-systems installed on the surface vessel and sub-systems deployed in the water.

3.2.3 In-Water Units

The in-water units are the acoustic transceivers and acoustic beacons.

The acoustic transceivers communicate with an array of reference transponders that are either tethered on the seabed or are mounted on mobile platforms operating in the area.

Accurate measurements of the time taken for each of the transponders to respond to a signal from the transceiver allows the system to compute its relative position with respect to the transponder array.

Control

The transceivers are connected to the Navigation Processor and are controlled by it according to the instructions defined by the system set up.

The transponders use battery packs to provide operating power for extended in-water deployments. Each of the transponders can be set up before being deployed in the water. Transponder set-up parameters include their listening and response channels within their operating band; their individual address details; their response turn-around time (TAT); their listening sensitivity and their transmit power. After deployment, these parameters can be changed remotely through a secure acoustic link from the Navigation Processor.

Note



Refer to the manual supplied with the transceiver, transponder or beacon for detailed information about the unit.

3.3 Navigation Processor

The Navigation Processor is the main control station for the complete system and includes:

- A Navigation Sensor Hub (NSH).
- A Navigation Computer.
- A monitor and keyboard unit.

3.3.1 Navigation Sensor Hub

The Type 8098 Navigation Sensor Hub (NSH) provides the interface between acoustic instruments, external sub-systems and sensors, and the Navigation Computer on which the software operates.

The main functions of the NSH are to:

- Provide power and an RS232, RS485 serial communications interface for ship-borne acoustic transceivers, gyros, GNSS receivers, VRUs, and so on.
- Provide responder beacon triggers.
- Provide external trigger capture, such as a 1PPS signal from GNSS
- Attach an accurate time-stamp to data arriving from external sources such as Vertical Reference Units (VRUs), gyrocompasses and GNSS receivers.

NSH Options

Sonardyne offers a range of hardware interface cards for use with the NSH, to allow the specific system to be used with a wide range of Sonardyne transceivers and external Instruments and sensors. These plug-in cards allow the NSH to support acoustic operations from the very simple to the more complex.

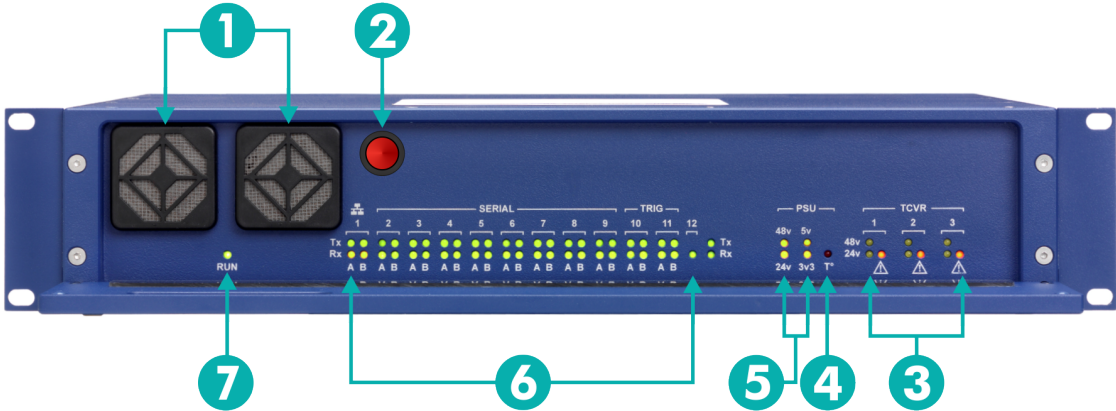
It is possible to add and configure a second NSH to the setup. This option requires an Ethernet address, a port number and a subnet mask to be set.

Front Features of the NSH

The front features of the NSH, shown in *Figure 3–2*, are as follows:

- Controller chassis fans.
- Power/Reset Button.
- Transceiver supply status.
- PSU over temperature.
- PSU status 48 V, 3.3 V, 5 V, PSU.
- Tx / Rx rear card LEDs to monitor all I/O activity through the rear mounted interface cards.
- Processor activity LED.

Figure 3–2 Navigation Sensor Hub Front View



Item	Description	Item	Description
1	Fan Filters	5	PSU Status
2	Power/Reset Button ¹	6	I/O Activity LEDs
3	Transceiver Supply Status	7	Processor Activity LED
4	PSU Temp		

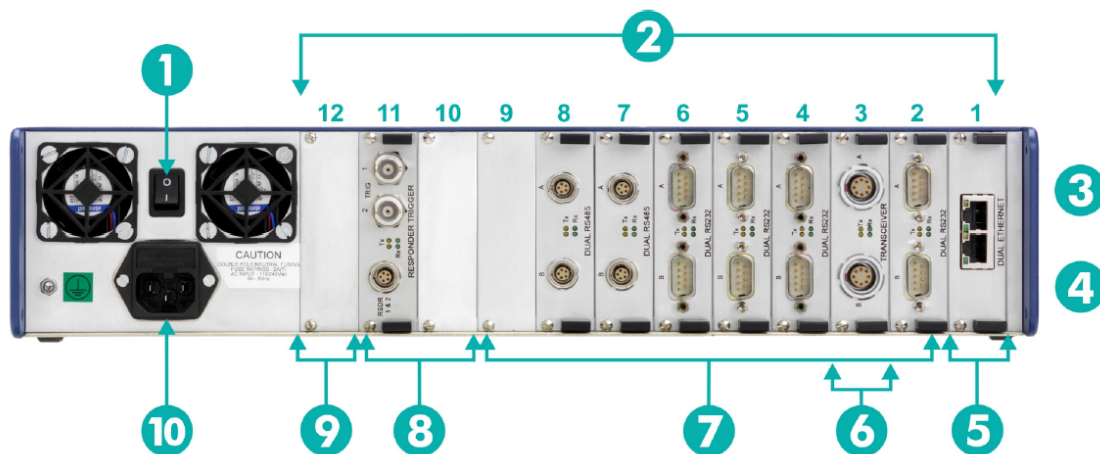
¹Type 8098-000-01: Reset function only

Rear Features of the NSH

The rear features of the NSH, shown in *Figure 3–3* are as follows:

- Power ON/OFF Switch.
- Card slot 1 – Dual RJ-45 connector for 10/100 BASE-T Ethernet.
- Card slot 2A is normally reserved for NSH management.
- Card slots 3 -9 – Dual Serial (Dual RS232, Dual RS485). Note: slots 3 - 5 Transceiver Power Out ports (or Dual Serial)
- Card slots 10 & 11 – Trigger Respond cards only.
- Card slot 12 – reserved.
- IEC Power Connector Socket 115-230 Vac, 6-3 A, 60/50 Hz.

Figure 3–3 Navigation Sensor Hub Rear View



Item	Description	Item	Description
1	Power ON/OFF	6	24 V / 48 V Transceiver
2	Card Slots (1 to 12)	7	Serial Ports
3	Port A	8	Trigger Responder
4	Port B	9	Reserved
5	RJ45 Ethernet	10	IEC 115/230 Vac Input

For more information on the NSH refer to *UM-8098 User Manual for the Navigation Sensor Hub*.

3.3.2 Navigation Computer

The Type 8026 i7 Navigation Computer is a powerful purpose-built industrial computer used in conjunction with the Navigation Sensor Hub. It has been optimised to run Sonardyne's software applications.

Front Features of the i7 Navigation Computer

The front features of the Navigation Computer, shown in *Figure 3–4*, are as follows:

- Fan filters.
- The power On/Off button also acts as a reset button if held for five seconds.

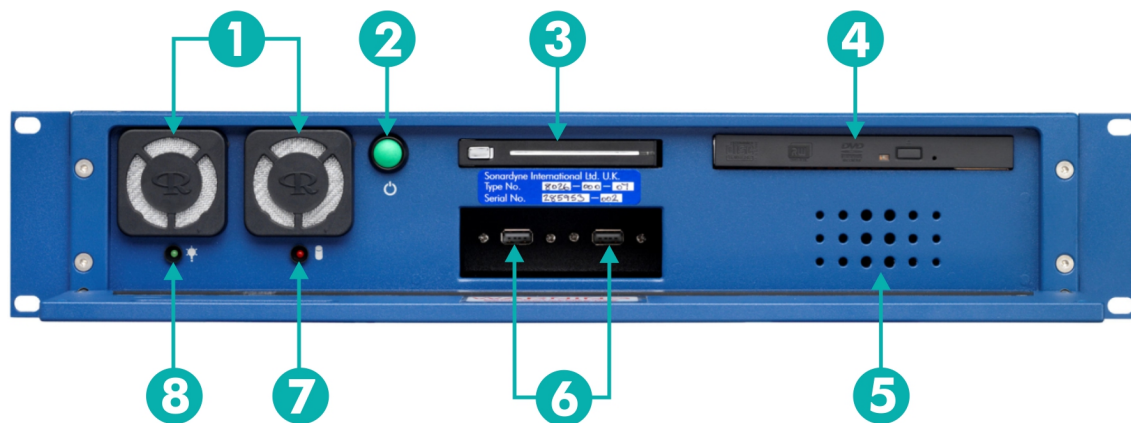
- A removable hard drive facility to enable external hard-drives to be installed for storing large quantities of data.
- A Slim-line DVD±R RW CD-RW enables reading and writing of storage data discs.
- Two USB 2.0 connections.
- A red LED shows when the hard disk drive is active reading or writing data.
- A green LED shows when the computer is on and blinks when the computer is in sleep mode.
- The Microsoft® Original Equipment Manufacturer (OEM) licence label affixed on the rear of the hinged panel.

Note



The OEM licence on the Navigation Computer is not transferable.

Figure 3–4 Navigation Computer Front View



Item	Description	Item	Description
1	Fan Filters	5	Speaker
2	On/Off/Reset (5 sec)	6	2 x USB 2.0 Connections
3	2.5" SATA Drive Bay	7	Red HD Indicator
4	Slimline DVD±R RW CD-RW	8	Green Power Indicator

Rear Features of the i7 Navigation Computer

The rear-panel of the Navigation Computer, shown in *Figure 3–5*, are as follows:

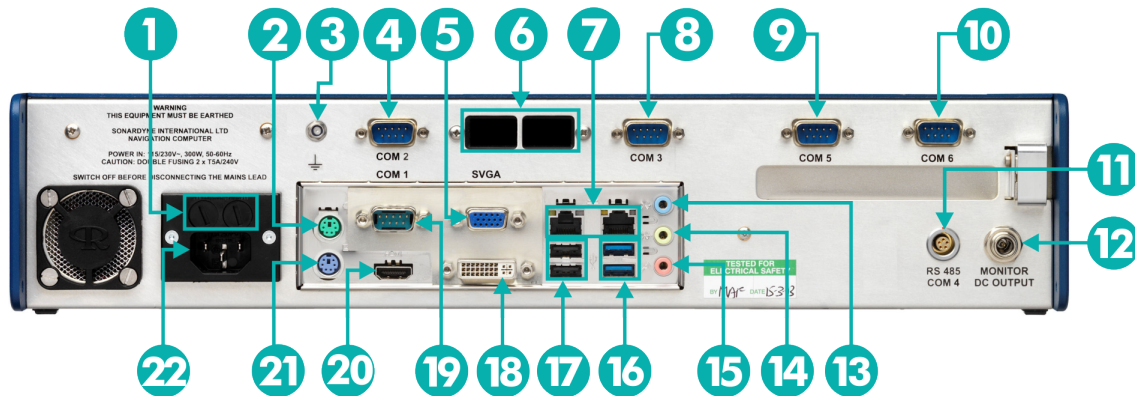
- Two PS/2 Type 6 pin mini DIN connectors. Green for the mouse, purple for the keyboard.
- Five RS232 serial ports, 9 pin connectors – "D" Conn compatible.
- One RS485 coms port.
- Two USB 2.0 and two USB 3.0 ports.
- Two RJ45 connector for Ethernet LAN. 1.0 Gbps.
- Digital Video Interface (DVI).
- HDMI connector.
- VGA port.
- Chassis earth.

- IEC connector socket, 115/230 Vac, 300 W, 50/60 Hz, with 2 x T5 A/250 V fuses.
- 12 Vdc output for monitor only.

Note

 Sonardyne navigation computers are normally fitted with an internal security key (“dongle”). If it must be external, Sonardyne recommends that you always connect a dongle to a USB port on the rear-panel of the Navigation Computer rather than to a USB port on the front-panel.

Figure 3–5 Navigation Computer Rear View



Item	Description	Item	Description
1	2 x T5 A/240 V Fuses	12	Monitor DC Output
2	PS2 Mouse	13	Line In Audio
3	Chasis Earth/Ground	14	Line Out Audio
4	COM 2	15	Microphone
5	VGA	16	USB 3.0
6	CPU Cooling Fan Ventilation Port	17	USB 2.0
7	RJ45 Ports (LAN) Ethernet	18	DVI
8	COM 3	19	COM 1
9	COM 5	20	HDMI
10	COM 6	21	PS2 Keyboard
11	RS485 Com 4	22	IEC 115/230 Vac Input

Note

 Two monitors can be connected to the Navigation Computer and can be configured as either a single desktop display and repeater, or as two separate displays with the desktop extended across both.

For more information on the Navigation Computer refer to *UM-8026 i7 User Manual for the Type 8026 Navigation Computer*.

3.4 In-water Systems

The in-water systems include one or more transceivers and multiple transponders. The arrangement of these sub-systems is dependent on the installation requirements.

3.4.1 Transceivers

Under software control, the transceivers emit acoustic interrogation or command signals into the water, and receive acoustic responses from the transponders. They then communicate these responses to the software for display and logging.

The system can use a range of alternative transceiver types supplied by Sonardyne International Limited. This User Manual includes generic information about the transceiver only. For specific technical information about a Sonardyne transceiver type for use with the system, refer to the transceiver's user manual.

Refer to *Appendix H – "Acoustic Positioning Methods"* for an explanation of the method that the system uses to calculate position information.

3.4.2 Transponder Beacons

The transponders are a type of beacon. They listen for acoustic signals from the transceivers, and respond with a reply when required.

Several beacons can be assigned the same interrogation signal, often called a 'common interrogation' signal. They each reply on their 'individual reply' signal.

Depending on the nature of the interrogating signal, a transponder can either respond to a signal addressed to it individually, or can respond to a common interrogation signal that produces a response from all transponders in the system. Refer to *Appendix H – "Acoustic Positioning Methods"* for an explanation of these operating modes.

Operating Range

The system's operating range depends on several factors, including:

- the frequency used for acoustic transmissions.
- local water temperature and salinity profiles.
- receiver sensitivity and transmission power settings for the transceiver and transponder.
- vessel noise

3.5 Peripheral Systems

Peripheral systems for use with the system can include:

- a dynamic positioning (DP) navigation system.
- a GNSS.
- a vertical reference unit.
- a gyrocompass.
- an Attitude and Heading Reference System (AHRS).

Note



The Lodestar™ system supplied by Sonardyne International Limited provides the features of a vertical reference unit and a gyrocompass combined within a single unit.

- a printer.
- external mass storage.

Note



Refer to the technical documentation provided by the equipment manufacturer for installation and operating instructions for the peripheral devices you use with your system.

3.5.1 DP Navigation System

A dynamic positioning (DP) navigation system directs a vessel's thrusters to hold the vessel on station, combating the influence of currents, wind and wave effects.

This system communicates with the DP control system, and supplies information about the vessel's position in real time with respect to reference points in the water. The DP system then uses this information as a reference, and issues thruster commands to maintain the correct position with respect to that reference.

This method of operation has advantages over using GNSS as the position reference, because the reference points in the water can be attached to moving targets. This makes it possible for the DP system to maintain station with respect to the moving target, which would not be possible when using a GNSS-based reference.

3.5.2 Vertical Reference Unit

A vertical reference unit (VRU) measures the roll and pitch angles of the vessel on which it is installed, and the vertical displacement (heave) of the vessel under the influence of waves and swell.

The system uses these measurements to compensate its position calculation for any changes in the vessel attitude. If this information were not available to the software, errors could be present in the position calculations, and these would become greater with increasing angles of roll and pitch.

The Sonardyne Lodestar™ Attitude and Heading Reference System (AHRS) is a vertical reference unit that provides accurate measurements of roll, pitch and heave. Lodestar™ is also an accurate gyrocompass and provides measurements of the vessel's true heading.

3.5.3 Gyrocompass

A gyrocompass provides accurate heading information for use by the software. The system uses these measurements in its position calculations.

The Sonardyne Lodestar™ AHRS fills the combined role of gyrocompass and VRU (see above).

Note



Contact Sonardyne International Limited for information about the Lodestar™ AHRS.

3.5.4 Data Formats

The software can accept the following range of data formats from external equipment:

- Heading inputs:
 - NMEA 0183 HDT
 - SG Brown ASCII or binary
 - Robertson SKR82
- Attitude:
 - SON2 (preferred Lodestar format)
 - TSS1
 - TSS2

- TSS3
- EM1000
- EM3000
- PRDID
- PHOCT
- STD1
- PASHR
- Position:
 - GPGGA
 - GPGLL
 - NMEA SSB
- Depth:
 - NMEA SDDPT
 - DBS
 - PSSIROV
 - SONDEP
- Time:
 - UTC
 - ZDA (with separate PPS signal)

3.5.5 Printer

The system can print logging and status information to an external printer or can save a screen image to file for hard-copy storage and inclusion in an operation report. The Windows® operating system allows the use of a wide range of compatible printers.

3.5.6 External Mass Storage

The Navigation Processor continually logs data to the internal hard disk drive. However, it is good practice to use an additional external storage resource to provide a secure backup location for important configuration and archive data.

3.6 Typical Navigation Cycle

In a typical navigation cycle:

1. The software commands the transceivers to transmit an interrogation signal. If a system has multiple transceivers, they are each used to interrogate the beacons in sequence. All transceivers receive the reply signals.
2. Each transponder receives the interrogation signal and transmits a response, if necessary.
3. The transceiver receives the transponder responses and measures the time interval between the interrogation signal and the individual transponder responses.
4. The transceiver communicates these interval measurements to the software, which also receives information from the vertical reference unit and gyrocompass.

5. The software computes the position of each transponder relative to the transceivers and, if required, reports this information to a separate DP navigation system or survey computer.
6. The sequence continues automatically under software control.

Section 4 – Common Procedures

4.1 Introduction

Section 6 "Application Procedures" describes the specific procedures for a range of applications. However, before you can start to use these applications it is necessary to have a suitable setup already configured in the software. You can use a setup that you have used before and saved, or you can create a completely new setup to be used for the current operation.

4.1.1 New Setup

This section describe show to create a new setup. The common sequence to follow is:

1. Start the software.
2. Initialise the software using the current setup.
3. Add mobile objects such as ships, rigs, ROVs, structures and divers.
4. Add instruments to the mobile targets.
5. Configure the mobile and reference targets.

This chapter describes these common procedures.

4.1.2 Instruction Format

To simplify the instructions included in this User Manual, where possible the procedures include example screen images with instructions. Perform the actions in the order indicated.

These procedures include only the instructions you need to complete the task — they do not include detailed descriptions of the dialog boxes or of the controls and features of the software. If you need detailed information about the software and its dialog boxes, see *Appendix A "User Interface Description"*.

In common with many Windows-based applications, there are many valid methods that you can use to complete a command. For example there are buttons to click, and there are right-click context menus. This chapter explains the simplest method, and sometimes provides alternatives.

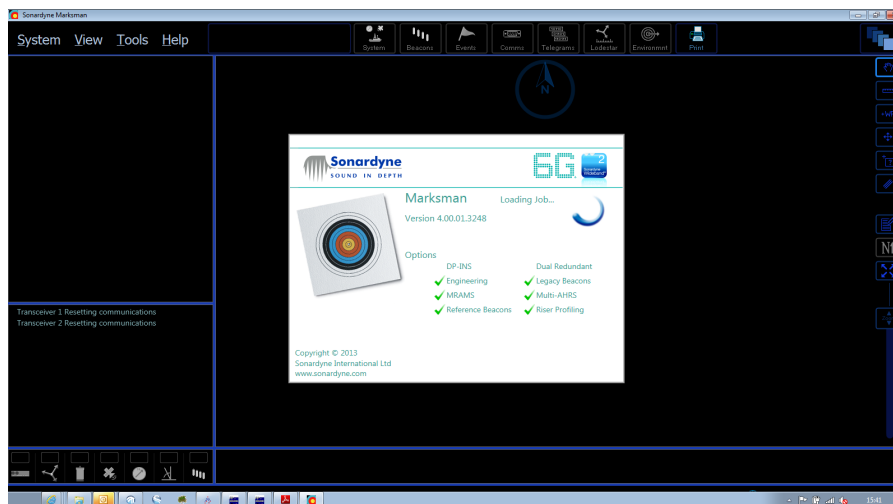
4.2 Starting the Software

Starting the software for the first time.

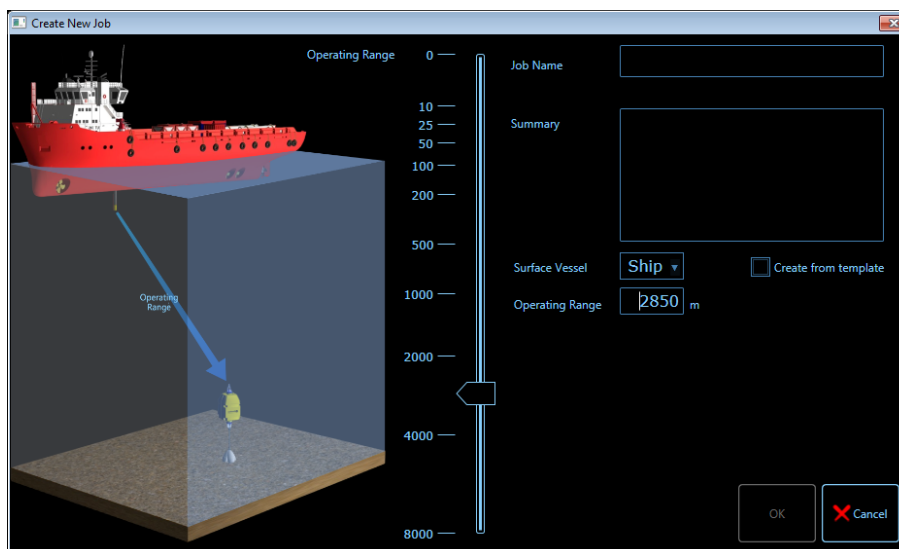
1. Double-click the icon on the desktop to start the software.



2. The software starts with the splash to show initialisation progress.



3. Wait for the **Create New Job** dialog box to be displayed.



Note



The New Setup dialog box is displayed during software start-up only if there is no existing setup. If setup files already exist on the computer, the software opens at the main screen for the setup that was most recently in use.

4. Type a name for the new setup.
5. Type a summary description for the setup, if required. This information helps you to identify the setup later.

6. Select either **Ship** or **Rig** to define the initial surface vessel.
7. Use the slider to select the expected maximum acoustic range.
8. Select the check box if you want to create the new setup from the template.
9. Click **OK** to display the **System Setup** window.
10. Follow the instructions in *Section 4.3 "Initialisation"* to use the **System Setup** window to edit the setup.

4.3 Initialisation

There are three options available to you when you start the software:

- You can open an existing setup and use it with or without changes.
- You can create a new job setup.
- You can open a previous setup, edit it for use in a different operation, and save it under a new name.

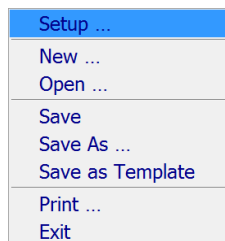
After you create a new setup, you can save it as a template. When you next create a new setup, you can then choose to base it on the template, so that you avoid having to re-enter all the details. Typically, the template includes information about the ship, the gyrocompass, the GNSS, the VRU and the transceiver.

The method that you use for initialisation depends on circumstances. This section explains how to use all the options that are accessible through the **System** menu on the main screen.

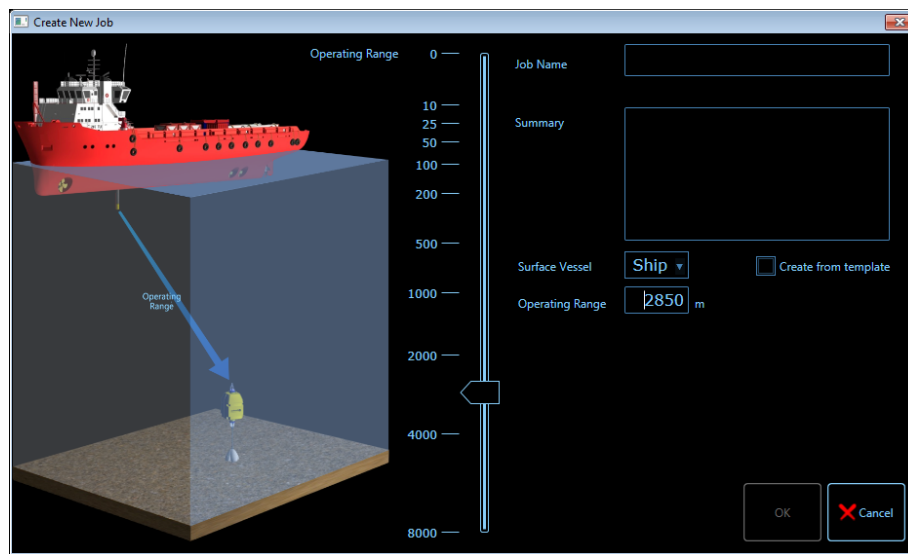
4.3.1 Creating a New Setup

Follow the instructions below to create a new setup from a fresh starting point.

1. Click **System > New** from the menu bar to display the **New Job** dialog box.



2. Type a name for the new setup.

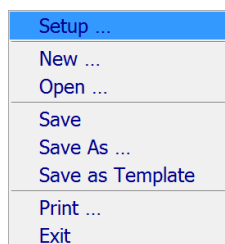


3. Type a summary description for the setup, if required.
4. This information helps you to identify the setup later.
5. Select either **Ship** or **Rig** to define the initial surface vessel.
6. Use the slider to select the expected maximum acoustic range.
7. Select the check box if you want to create the new setup from the template.
8. Click **OK** to display the **System Setup** window.
9. Refer to *Section 4.4 "Adding Objects "* to use the System Setup window to edit the setup.
10. By default, the software starts each session by using the same settings that it was using when the program closed previously.

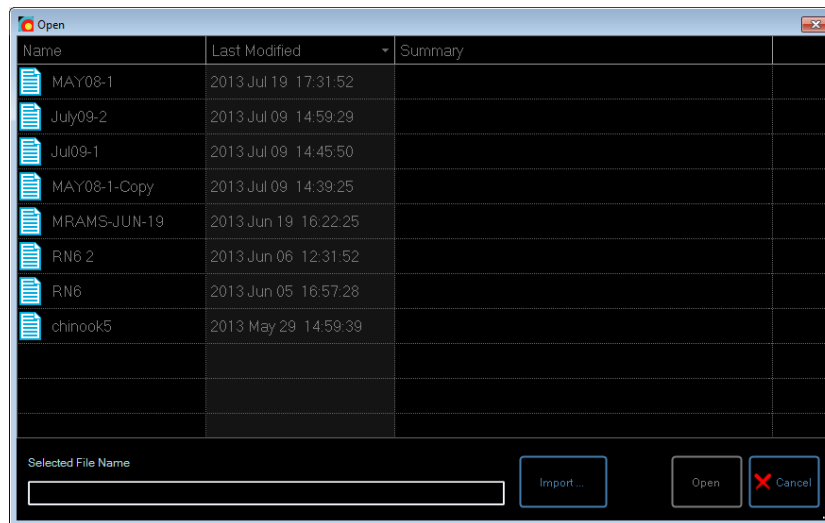
4.3.2 Opening a Previous Setup

Follow the instructions below to open a setup that already exists on the computer.

1. From the menu bar click **System > Open** to display the **Open** dialog box.
2. Click **Setup**.



3. The **Name** and **Summary** fields show the setup details.



4. Click **Open**.

The software loads the setup and displays the main screen. You can use the setup without making changes to it, or you can edit the setup.

Refer to *Section 4.4 "Adding Objects "*to edit the setup.

4.4 Adding Objects

A mobile object can be added in one of two ways:

1. Clicking the **System > Setup** or the **System** shortcut button to open the **System Setup** window or,
2. Clicking the **Ports** and **Beacons** shortcut buttons to open the **Communications Port Table** and **Beacons Table** windows.

Both methods achieve the same outcome and are described in *Section 4.4.1*, *Section 4.4.2* and *Section 4.4.4*.

4.4.1 Adding Objects from the System Setup Window

Adding Instruments

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.

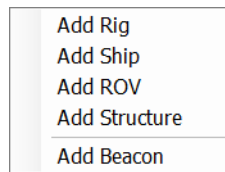


For a new setup, the **System Setup** window includes only the surface vessel that you defined when you created the setup. This is selected by default in the job tree, with the properties tabs showing the current properties for the object.

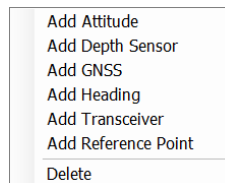
The job tree groups objects so that 'system' devices such as the NSH, PAN, TOD remain together, and 'ship' devices such as gyros, VRUs and other mobile devices remain together.

- a. To add a Mobile Object to the setup, right-click the **Mobile Objects** root in the job tree and select from the context menu.

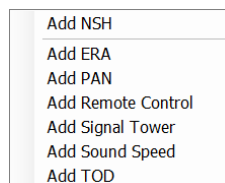
If you select **Add Beacon**, the Add Beacon wizard runs to guide you (see *Section 4.4.4* for a description of the beacon wizard).



- b. To add an instrument or an object to a vessel or ROV, right-click the vessel or ROV and select from the context menu.



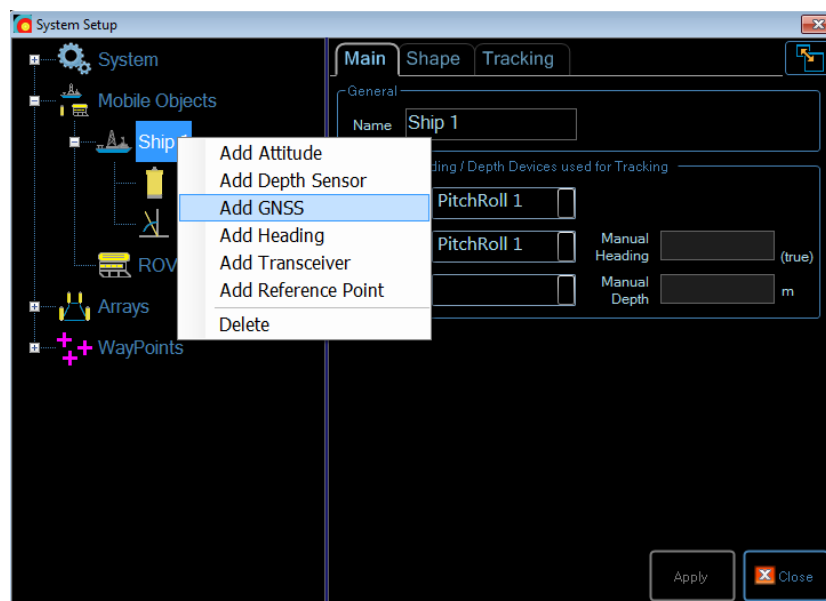
- c. To add a System Object to the setup, right-click the System root in the job tree and select from the context menu.



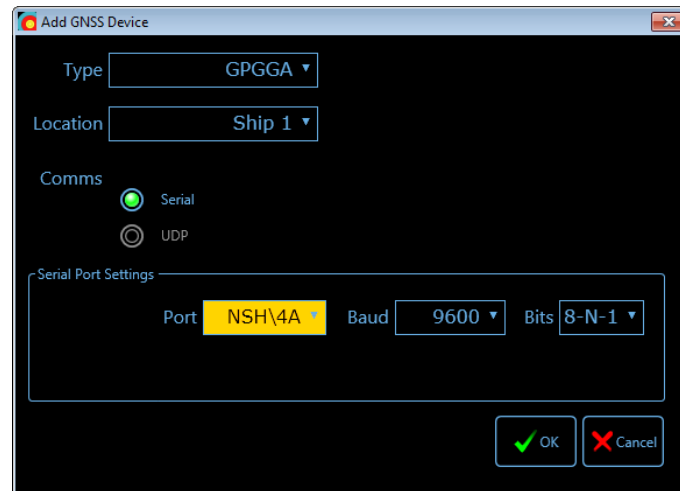
- d. Confirm the new object is included in the setup:
- A mobile object (for example an ROV) appears as a new branch in the job tree
 - An instrument (for example a satellite navigation system) appears as a sub-entry under its associated Mobile Object in the job tree
 - A system object appears under the system branch of the job tree
- e. Confirm the object's properties are displayed.

For example, to add a GNSS:

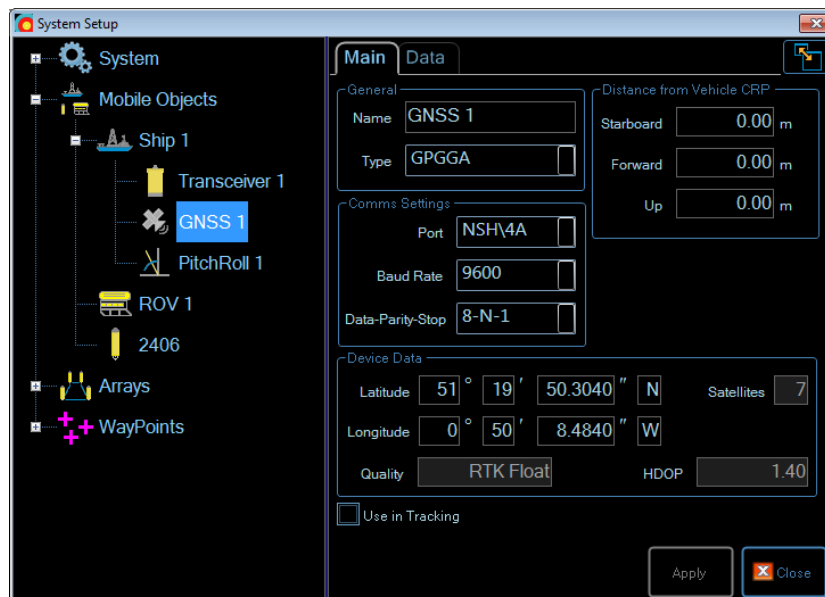
1. Right-click on the vessel (**Ship 1**) and select **Add GNSS**.



2. Select the **Type** and **Port** from the drop-down list.
3. Select the correct **Baud Rate** from the drop-down list e.g. **9600** and then click **OK**.



4. The **Longitude** and **Latitude** data will be automatically updated.



5. Add the **Starboard**, **Forward** and **Up** offsets for the GNSS antenna relative to the CRP and then click **Apply**.

Refer to *Section 4.7* to *Section 4.14* to configure the other instruments.

6. Repeat steps 1 to 3 to add other Mobile Objects and Instruments as required.

4.4.2 Adding Instruments using the Ports Table

1. Click the **Ports** shortcut button to open the **Communications Port Table** window.



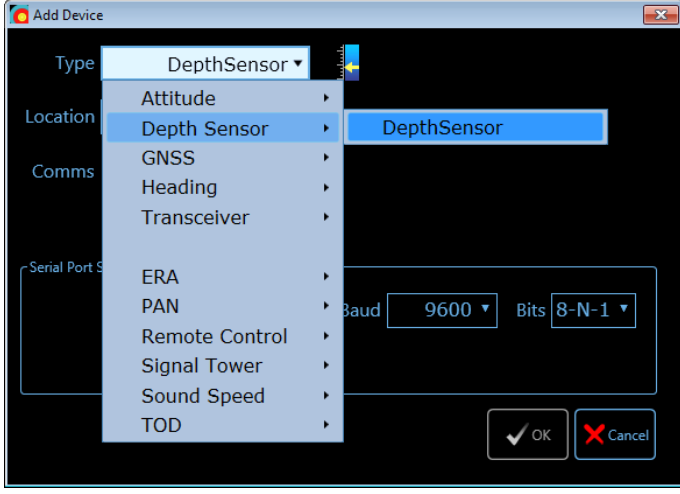
2. To add a new instrument, click **Add**.



Select	View	Comms	Edit	Port	Baud	Device Name	Protocol	Location	Data
☐				NSH\3A	38400	Transceiver 1	6G Protocol	Ship 1	<U001240, BR: EVT1, 500, U0
☐				NSH\4A	9600	GNSS 1	\$GPGGA	Ship 1	\$GPGGA,162511.216,5119.83840,N,00050.14140,W,5,07,1
☐				NSH\5B	115200	PitchRoll 1	:SON2	Ship 1	:162511240 000254 000482 046690 000g
☐				NSH\7A	9600	Heading 1	\$HEHDT	Ship 1	\$HEHDT,46.7,T*30

Buttons: + Add, - Delete, Data Legend (Receive: green, Transmit: pink), Apply Changes, Undo Changes, Print, Close

- Enter the **Type**, **Comms**, **Port** and **Location** settings. Further configuration is available after clicking **OK**.



Add Device

Type: DepthSensor

Location: Depth Sensor

Comms: GNSS

Serial Port S: ERA

Baud: 9600 Bits: 8-N-1

Buttons: OK, Cancel

4.4.3 Adding Beacons using the Quick Track Tool

For simple jobs requiring a small number of 6G or PGT beacons, it will be easier and faster to add beacons to the job using the Quick Track tool. Quick Track uses the unique IIS interrogate signal for a 6G beacon.

For jobs with many beacons or where complex acoustic scheduling is required, it is recommended to add beacons to the job using the Beacons Table described in *Section 4.4.4*

- Click **Tools > Quick Track** or the **Q-Track** shortcut button.
- Click the required address(es) on the **Quick Track** tool (clicking the same address again stops that beacon tracking and removes it from the job).
- A 6G beacon with that address is added to the job (see **Options** below for beacon type).
- An active Quick Track beacon is shown in green (beacon addresses already allocated are shown in pink).
- A beacon output telegram is enabled (if there is a telegram setup).

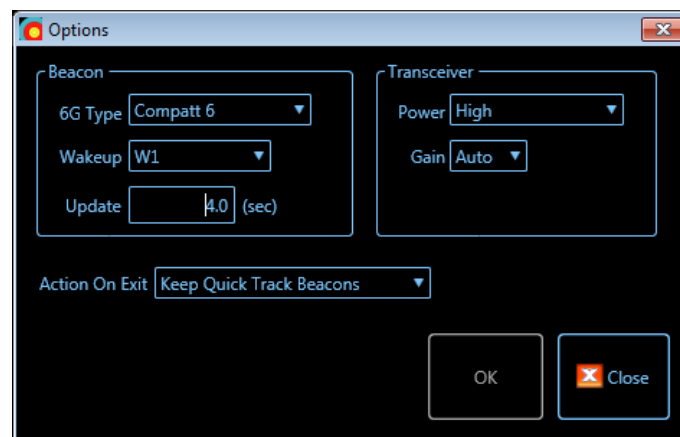
Quick Track Tool

Options

?

1701	1801	1901	2001	2101	2201	2301	2401	2501	2601	2701	2801	2901	3001	3101
1702	1802	1902	2002	2102	2202	2302	2402	2502	2602	2702	2802	2902	3002	3102
1703	1803	1903	2003	2103	2203	2303	2403	2503	2603	2703	2803	2903	3003	3103
1704	1804	1904	2004	2104	2204	2304	2404	2504	2604	2704	2804	2904	3004	3104
1705	1805	1905	2005	2105	2205	2305	2405	2505	2605	2705	2805	2905	3005	3105
1706	1806	1906	2006	2106	2206	2306	2406	2506	2606	2706	2806	2906	3006	3106
1707	1807	1907	2007	2107	2207	2307	2407	2507	2607	2707	2807	2907	3007	3107
1708	1808	1908	2008	2108	2208	2308	2408	2508	2608	2708	2808	2908	3008	3108
1709	1809	1909	2009	2109	2209	2309	2409	2509	2609	2709	2809	2909	3009	3109
1710	1810	1910	2010	2110	2210	2310	2410	2510	2610	2710	2810	2910	3010	3110
1711	1811	1911	2011	2111	2211	2311	2411	2511	2611	2711	2811	2911	3011	3111
1712	1812	1912	2012	2112	2212	2312	2412	2512	2612	2712	2812	2912	3012	3112
1713	1813	1913	2013	2113	2213	2313	2413	2513	2613	2713	2813	2913	3013	3113
1714	1814	1914	2014	2114	2214	2314	2414	2514	2614	2714	2814	2914	3014	3114

Use **Options** on the **Quick Track** tool to configure the default **Beacon** type, **Wakeup** tone and **Update** rate.



Options

Beacon

6G Type:

Wakeup:

Update: (sec)

Transceiver

Power:

Gain:

Action On Exit:

OK Close

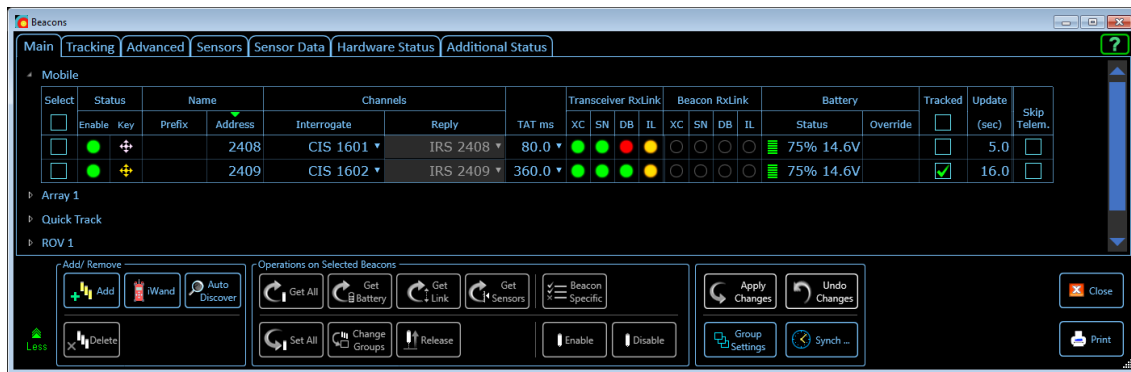
Refer to Section A.10.6 "Quick Track" for more details.

4.4.4 Adding Beacons using the Beacons Table

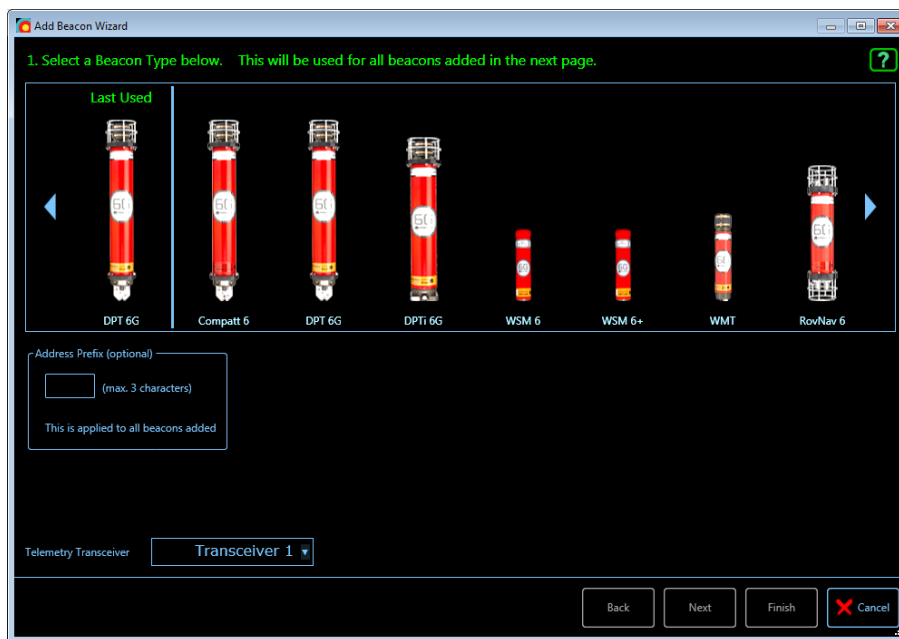
1. Click the **Beacons** shortcut button at the top of the main window to open the **Beacons Table** window.



2. Click **Add** to start the **Add Beacon Wizard**. A list of all configured beacons and their status can be viewed in this window.



3. The **Add Beacon Wizard** will start allowing one or more beacons to be configured.



4. The beacon(s) can be configured using the wizard and Beacons Table.

4.5 Deleting Objects

To delete an object from the setup, right-click the object in the setup tree and select **Delete** from the context menu.

To delete a port or beacon, select the port or beacon in the Port or Beacons Table and click the **Delete** button.

Note

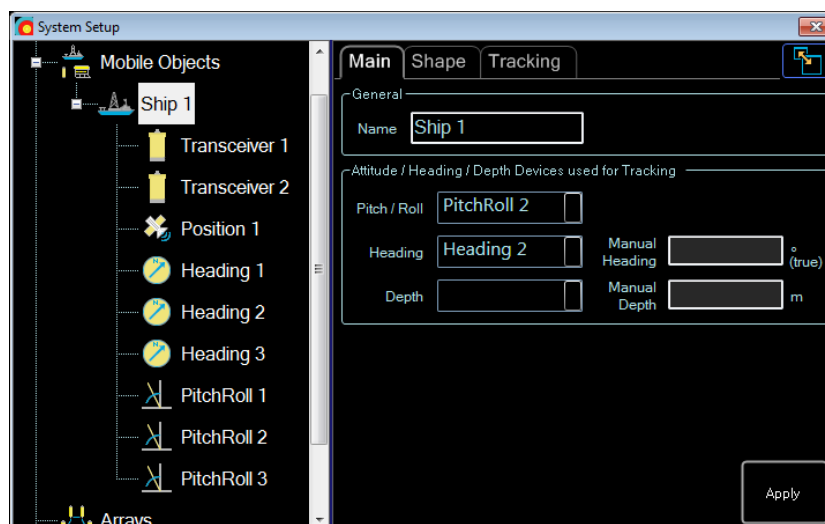
The software does not have an 'undo' feature — you cannot reverse a deletion. To re-insert a target that you have deleted accidentally you must insert and configure a new target.

4.6 Configuring the Vessel

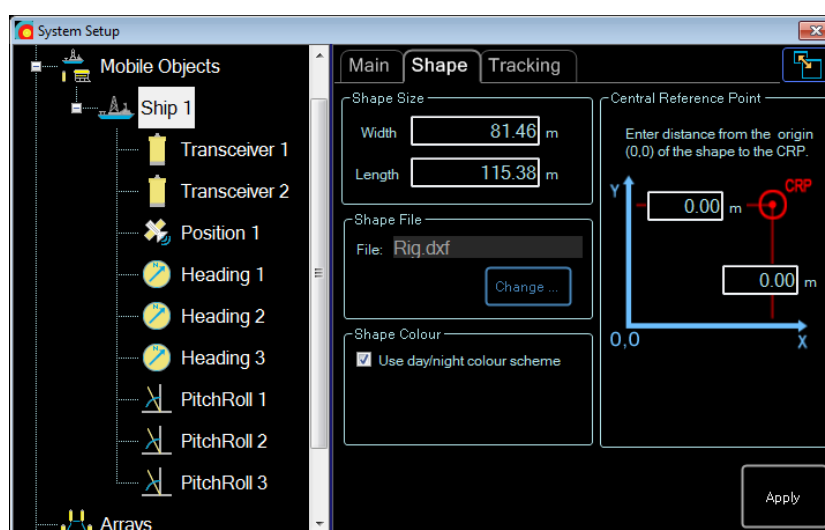
This procedure explains how to configure a basic setup for the vessel.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the vessel in the job tree.
3. Enter a **Name** for the vessel, if necessary, or use the default name.

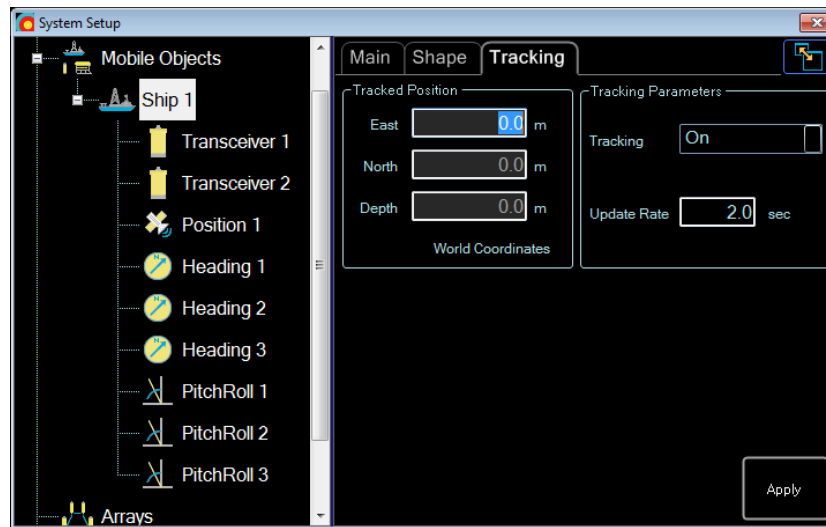
4. Select the preferred **Pitch/Roll** and **Heading** sensors to use on the vessel if there are multiple sensors.
5. Select **Manual Heading** and enter a fixed value if there is no heading sensor to use.
6. Select **Manual Depth** and enter a fixed value if it is necessary to constrain the computed vessel depth.



7. Select the **Shape** tab. To change the vessel shape select **Change** and pick from the list of available shapes. You can add a custom shape file in DXF format.



8. Enter the vessel **Width** and **Length** as required.
9. Select the **Use Day/Night Colours** check box so that the software uses uniform colours that fade with the brightness setting.
10. Click **Apply**.
11. Select the **Tracking** tab, where the vessel's acoustic position **Update** time can be set.



4.7 Configuring a Transceiver

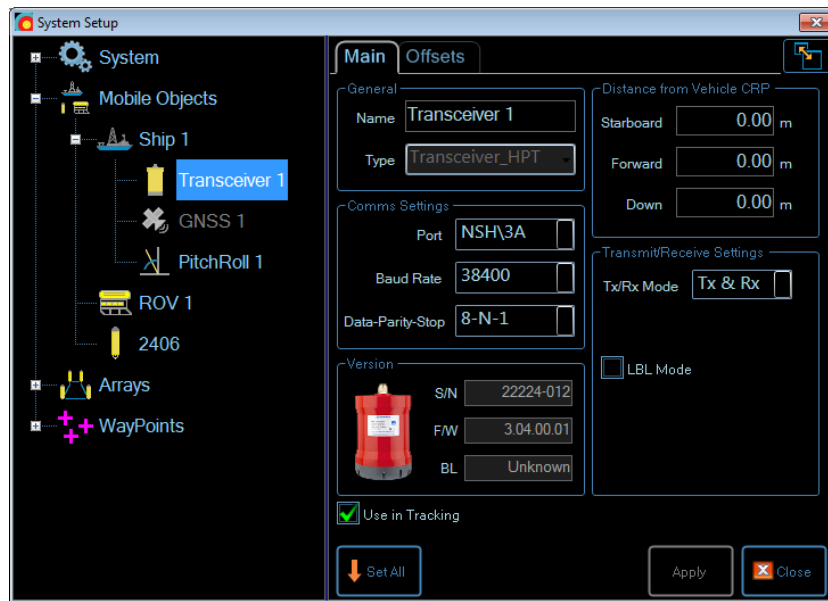
1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the transceiver in the job tree .
3. Type a **Name** for the transceiver, or use the default.
4. If you have several transceivers connected to one comms port in a multi-drop configuration, you must enter a serial number manually.
5. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the Transceiver if required.
6. Enter the **Starboard**, **Forward** and **Down** offsets with respect to the vehicle's CRP.
7. Select the Tx/Rx mode to **Tx & Rx** (the default) for normal operation, **Rx** for receive only, or **Disabled** to disable the use of the transceiver in the system.

Note

 The TxRx mode should only be used in special cases, e.g. a multi-transceiver setup with only one Lodestar INS fitted. In this case, it is necessary to ensure that the augmented primary (INS) transceiver is always measuring the direct range so that the Lodestar receives aiding data from every update. The secondary transceivers need to be configured to Rx only. If you try to track transponders with all transceivers set to Rx only, then the system will override this setting as it has to use something for the Tx function.

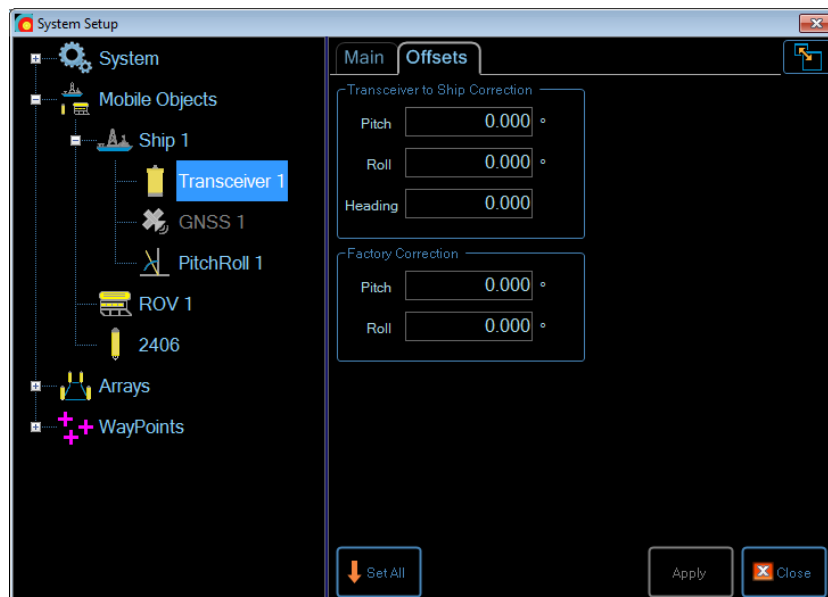
8. For normal USBL operation, leave **LBL Mode** deselected. This property should be selected only for special cases, such as for the second transceiver in a dual-transceiver LUSBL setup.
9. Click **Apply**.

A mobile object (for example an ROV) appears as a new branch in the job tree



4.7.1 Offsets

1. Select the **Offsets** tab and enter the **Pitch**, **Roll** and **Heading** correction angles necessary to align the transceiver with the vehicle's reference frame.
2. Enter the corrections measured by the factory for the transceiver's internal inclinometer.
3. Click **Apply**.



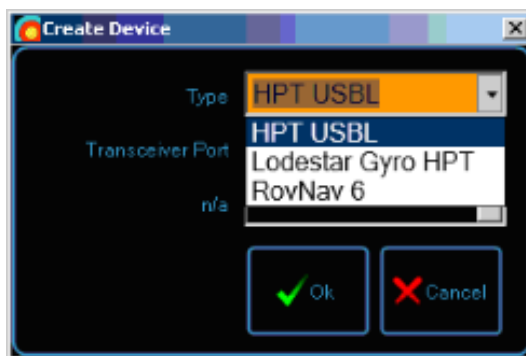
4.7.2 5G and 6G Technologies

Note



5G and 6G transceiver technologies cannot be mixed.

Once the transceiver has been defined in a setup, only a 'type' of the same generation can be added, for example an HPT or a GyroHPT or a ROVNav 6 can be added to a setup already containing a 6G HPT.



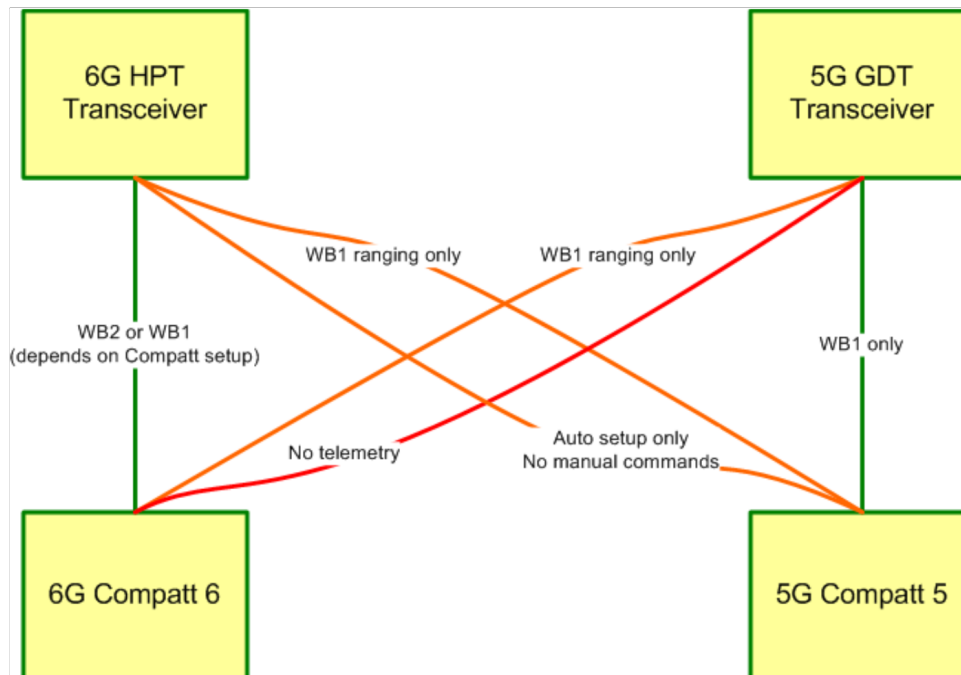
4.8 Configuring a Beacon

To add a beacon to the setup, right-click **Mobile Objects** and select **Beacon** or click the **Beacons** shortcut button and click **Add** on the **Beacons Table** and follow the instructions in the Wizard (see *Section 5.2 "Add Beacon Wizard "* for details)

4.8.1 Mixed 5G & 6G Jobs

- There are certain rules you must follow when you run a Job that uses a mixture of fifth and sixth generation transceivers and beacons:
- HPT (6G) with Compatt 6 gives full functionality (using Wideband1 and Wideband2).
- GDT (5G) with Compatt 5 gives full functionality (using Wideband1 only).
- HPT with Compatt 5 – Wideband1 ranging only (not Wideband2). Automatic set-up of the beacons only, with no tone or PP telemetry, and no manual commands.
- GDT with Compatt 6 – Wideband1 ranging is OK (not Wideband2), but NO TELEMETRY is possible.

Figure 4–1 Mixed 5G and 6G Jobs



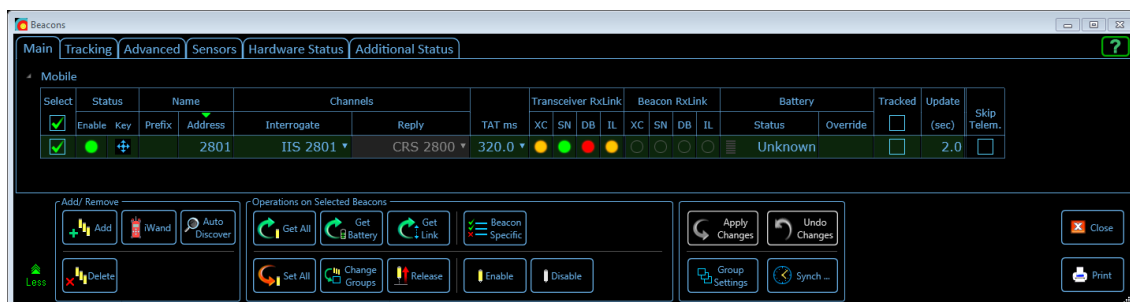
4.8.2 Adding a GyroCompatt

Follow the steps below to add a GyroCompatt to the system. Refer to *Section 5.1.10 "Additional Status Tab"* and *Section 5.1.19 "Beacon Specific Properties Dialog Box"*.

Note

This procedure applies to both GyroCompatt 5 and 6 variants.

1. Use the **Add Beacon Wizard** (refer to 5.2 "Add Beacon Wizard ") to add a GyroCompatt 5 or 6.
2. In the Beacons Table, set all standard acoustic and power settings as for a standard Compatt and click **Apply Changes**.

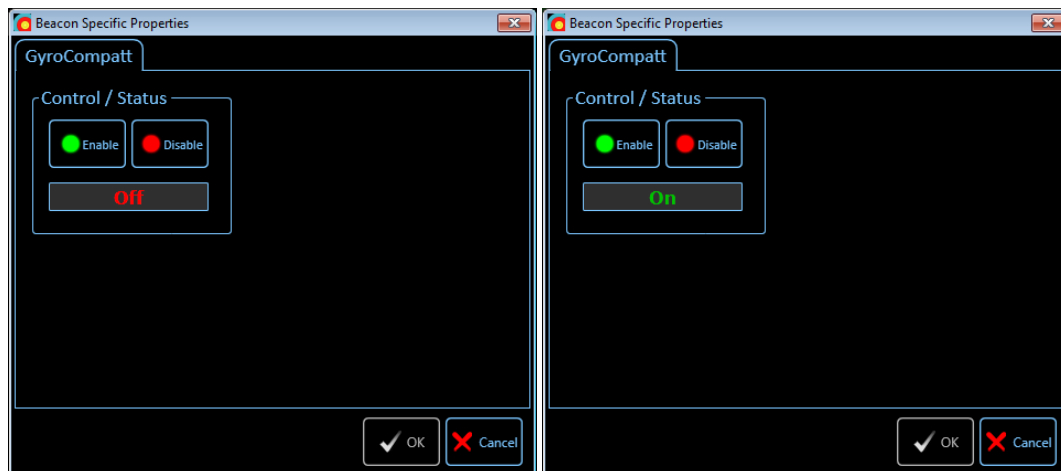


3. Select the GyroCompatt and click the **Beacon Specific** button.

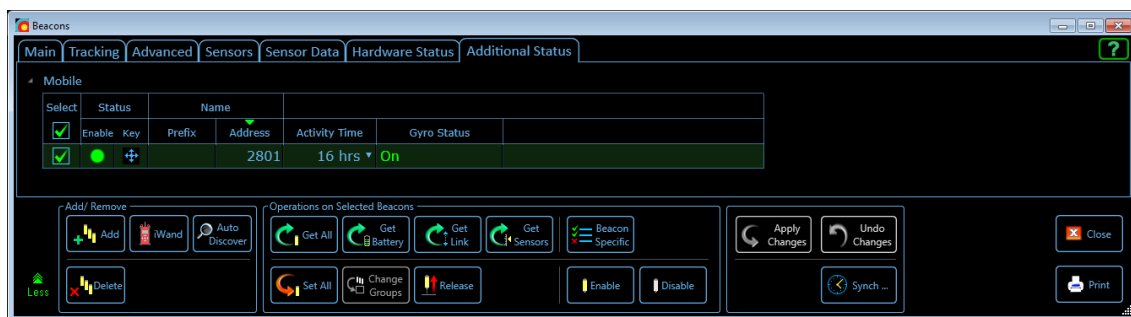


4. Click **Enable** to enable the GyroCompatt. This command sends the telemetry to switch on the gyro and to start collecting measurements. At first, the **Control/Status** shows **Off** (in red text),

but after the gyro boots up, the **Control/Status** shows **Unsettled** (in amber text). After the gyro has settled, the Control/Status shows **On** (in green text).

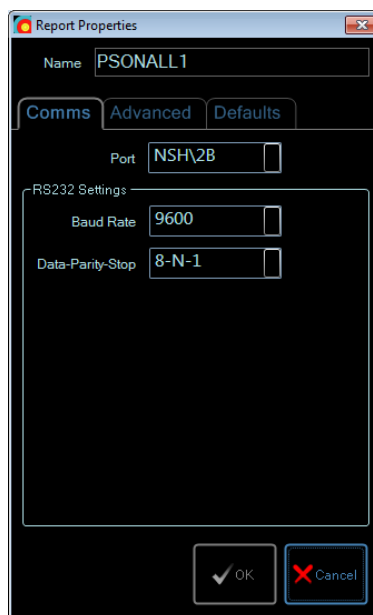


- The Beacons Table **Additional Status** tab also shows the GyroCompatt status. The GyroCompatt is ready to send data when it shows **On**.



Adding a PSONMEAS Report

- Add a PSONMEAS report (refer to *Section 4.20.1 "Configuring an Output Telegram"*).



- Set the telegram to **Enable** for the GyroCompatt in the telegram editor.

Note



The editor only provides the option to enable or disable this telegram.

Example output string format:

\$PSONMEAS,124752.49,INCINT,5410,,44.91,8.130,-7.840*5D

3. Use the Beacon Sensor Monitoring tool (refer to *Section 11 "Beacon Sensor Monitoring Tool"*) to enable sensor data collection from the GyroCompatt. Results are displayed in graphical and tabular form in the monitoring tool, as well as being output by PSONMEAS report to an external system.

4.9 Array Beacons and Array Calibration

By default, the software classes a beacon as a mobile beacon when you first add it to the setup. In this condition, the transceiver tracks the beacon's relative position by using acoustic navigation techniques. If the setup includes satellite navigation, gyrocompass and attitude instruments, the software can determine the beacon's position in real-world co-ordinates.

If the application requires one or more beacons to be set at fixed positions on the seabed or on a fixed sub-sea structure, it is possible to calibrate the beacon positions and then add them to the array. The software considers beacons in an array to have fixed positions, and displays the vessel or other mobile target positions as being relative to the reference beacon.

Note



It is important to check that you have set-up the beacons correctly, and that you have captured the beacon settings in the setup before you deploy the beacons. Track the beacons continuously after release, and manoeuvre the vessel in a way to allow a successful recovery.

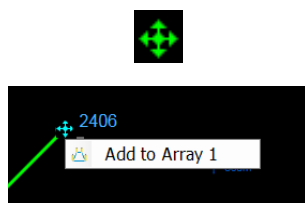
Deploy all the beacons to be included in the array and wait until they settle at the locations fixed for them.

Beacons can be added to an array and calibrated in one of two ways described in *Section 4.9.1* and *Section 4.9.2*. The first method involves right-clicking the individual beacon symbol, this can be useful for calibrating a single beacon.

The second method is preferred and involves clicking the **Beacons** shortcut button and calibrating beacons in the beacons table.

4.9.1 Adding and Calibrating Beacons from the Beacon Symbol on the Chart

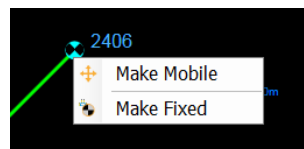
1. Right-click the beacon symbol that identifies the CRP on the beacon and select **Add to Array**.



2. The beacon is added to the array in the calibrating state, and the software begins to refine the beacon's position.
3. Repeat step a for each of the beacons in the array.
4. Select which frame to use for the display. The options depend on the mobile targets and arrays in the setup.



5. Wait for approximately one hour to achieve optimal accuracy in the beacon's position.
6. Right-click the beacon again and select **Make Fixed**.



7. Repeat the previous step for each of the beacons in the array.
8. The position of the beacon is fixed and the position of the surface vessel is shown relative to it.

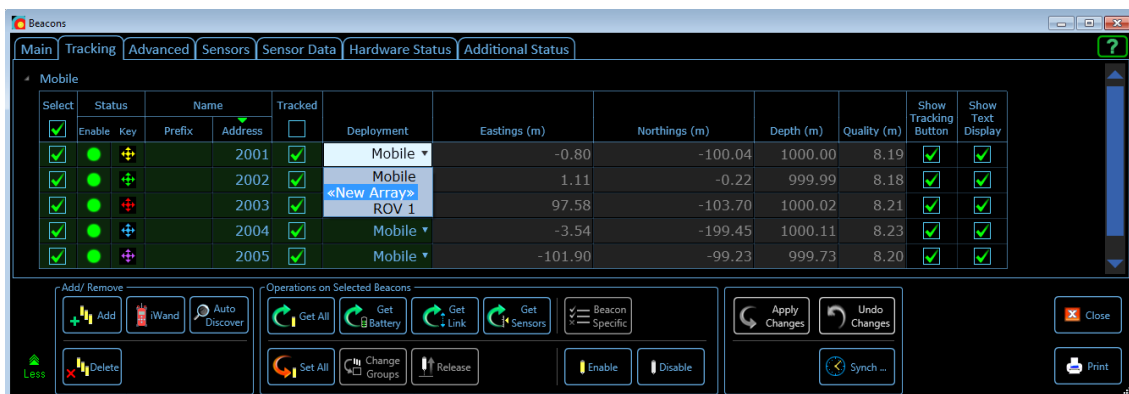
4.9.2 Adding and Calibrating Beacons from the Beacons Table

This is the preferred method of adding and calibrating beacons.

1. Click the **Beacons** shortcut button.



2. On the **Beacons** table **Tracking** tab, select the the beacons to be added to the array and then select **New Array** on the **Deployment** column.



3. The selected beacons will display **New Array** on the Deployment column.

Mobile						
Select	Status		Name		Tracked	Deployment
☒	Enable	Key	Prefix	Address	☒	
☒				2001	☒	«New Array» ▾
☒				2002	☒	«New Array» ▾
☒				2003	☒	«New Array» ▾
☒				2004	☒	«New Array» ▾
☒				2005	☒	«New Array» ▾

- Click **Apply Changes** to begin the array calibration.

Note



It is recommended to allow the calibration to run for one hour (or until the desired precision is reached and the Quality figure has stopped decreasing) until the beacons have completed calibrating. A graph showing the calibration status can be displayed from **Tools>Advanced>Graphs** and selecting Arrays, see *"Graphs"* in **Section A.10.12**.

Array 1						
Select	Status		Name		Tracked	Deployment
☐	Enable	Key	Prefix	Address	☐	
☐				2001	☒	Calibrating ▾
☐				2002	☒	Calibrating ▾
☐				2003	☒	Calibrating ▾
☐				2004	☒	Calibrating ▾
☐				2005	☒	Calibrating ▾

- After the beacons have calibrated, select **Fixed** on the **Deployment** column.

Array 1						
Select	Status		Name		Tracked	Deployment
☒	Enable	Key	Prefix	Address	☒	
☒				2001	☒	Calibrating ▾
☒				2002	☒	Calibrating ▾
☒				2003	☒	Fixed ▾
☒				2004	☒	Calibrating ▾
☒				2005	☒	Calibrating ▾

- Click **Apply Changes** to save the array settings.

Array 1						
Select	Status		Name		Tracked	Deployment
☐	Enable	Key	Prefix	Address	☒	
☐				2001	☒	Fixed ▾
☐				2002	☒	Fixed ▾
☐				2003	☒	Fixed ▾
☐				2004	☒	Fixed ▾
☐				2005	☒	Fixed ▾

Note

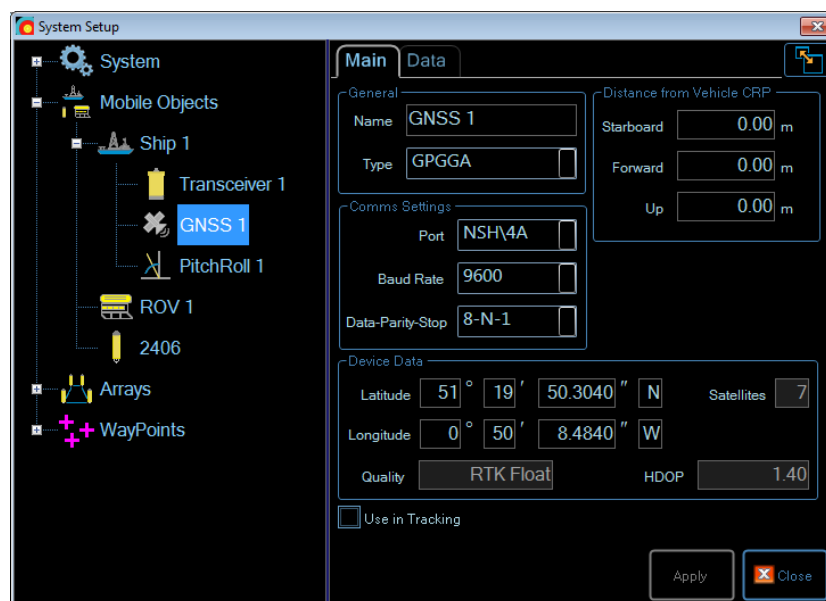


When the array is Fixed, GNSS is turned off automatically and navigation data is displayed in green text. If GNSS is turned on, positions are displayed with an underscore.

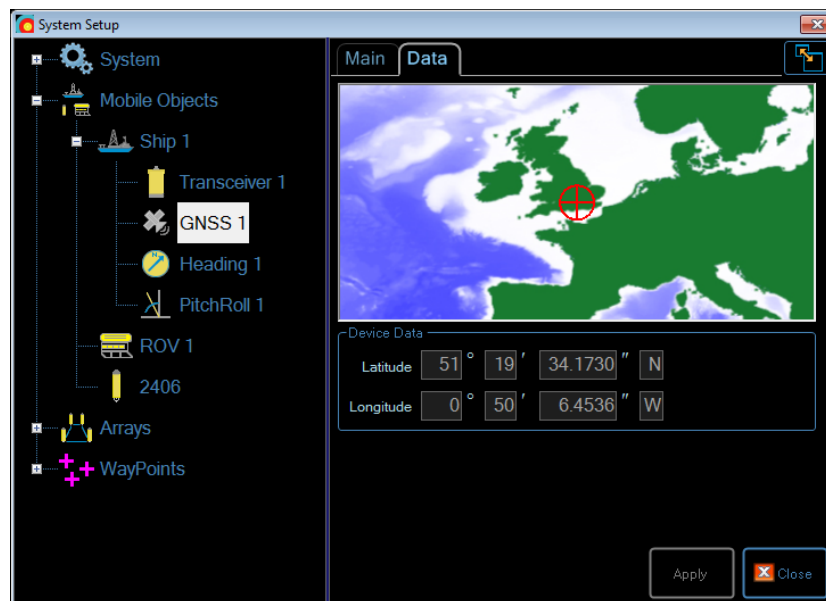
7. To remove a beacon from the array, select the beacon and then select **Mobile** on the **Deployment** column.

4.10 Configuring a GNSS

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the GNSS in the job tree .
3. Select the type of GNSS data string supplied by the receiver.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the GNSS if required.
5. Enter the location of the GNSS antenna relative to the vehicle's CRP.
6. Click **Apply**.



7. Select the **Use in Tracking** check box.
8. Select the **Data** tab.
9. Confirm the position is displayed as a flashing red circle and cross on the map, with **Longitude** and **Latitude** data.

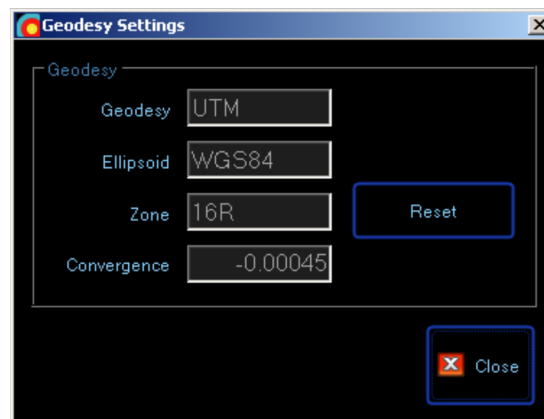


4.11 Geodesy Tool

The geodesy tool provides a visual indication of:

- The current geodetic projection.
- The ellipsoid.
- The zone.
- The convergence.

These fields are read-only.



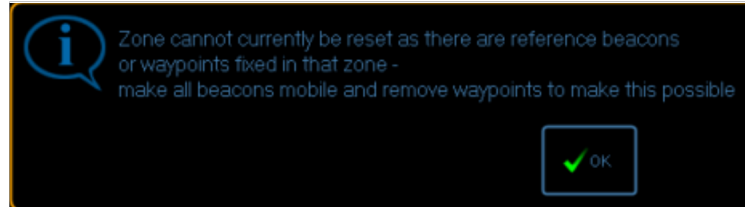
4.11.1 UTM Zone Reset

When the vessel moves across a UTM zone boundary to a new location, the software raises a zone alarm to warn of the increasing convergence error.

In order to avoid tracking discontinuity, the system does not automatically change zones. Click the zone **Reset** button to set the UTM zone for the new location.

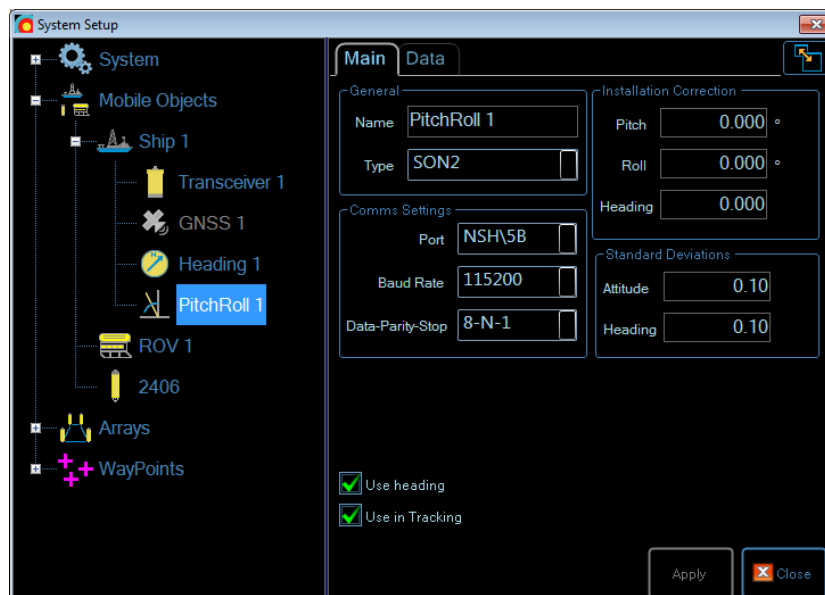
Note

 You must delete any waypoints or fixed references for the old UTM zone/location before the reset can be completed successfully.



4.12 Configuring a Vertical Reference Unit (VRU)

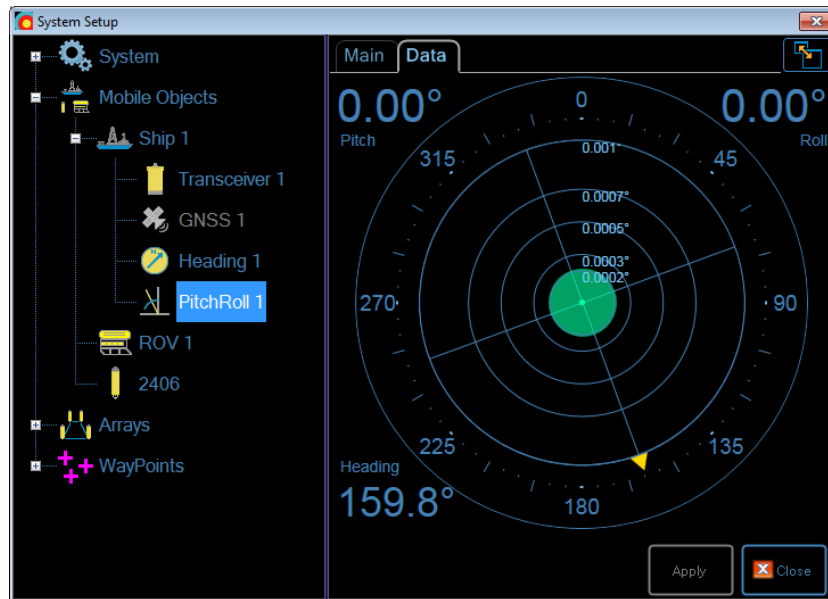
1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the VRU in the job tree .
3. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the VRU, if required.
4. Enter the **Pitch**, **Roll** and **Heading** correction angles necessary to align the VRU reference frame with the vessel's reference frame.
5. Select the **Use in Tracking** check box.
6. Normally, leave the Use heading check box selected, unless you know the heading is uncalibrated or unavailable.
7. Click **Apply**.



Note

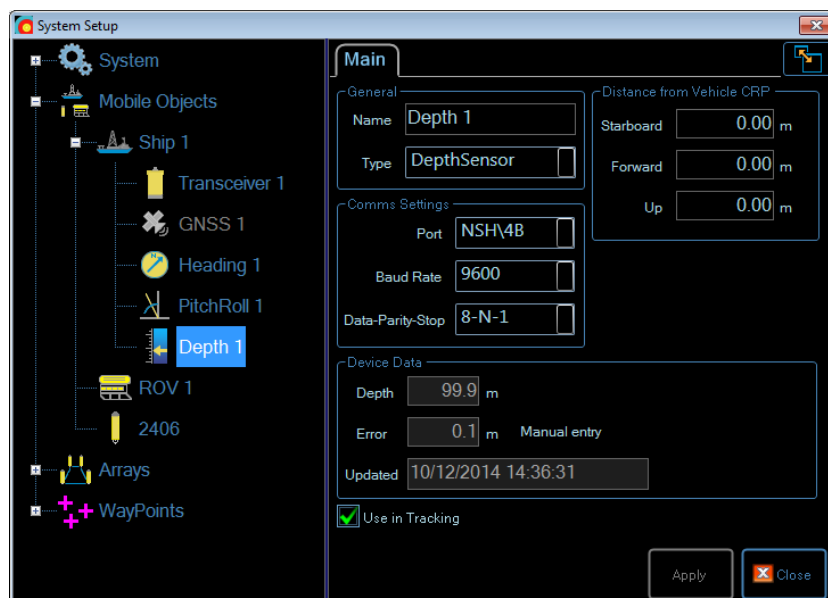
 The Standard Deviation value is an important quality assessment on this and on the Gyrocompass settings, see [Section 4.14 "Configuring a Gyrocompass"](#). The software uses this information to rank multiple instruments of the same type so that instruments providing a higher quality solution (that is, with a lower standard deviation) are more highly weighted.

8. Select the **Data** tab and confirm the VRU's measurements of **Pitch** and **Roll** are displayed.



4.13 Configuring a Depth Device

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the Depth device in the job tree.
3. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the Depth device if required.
4. Enter the **Starboard**, **Forward** and **Up** offsets with respect to the vehicle's CRP
5. Click **Apply**.



6. Confirm the depth value is being updated in the **Device Data** boxes.

4.13.1 Depth Device Formats

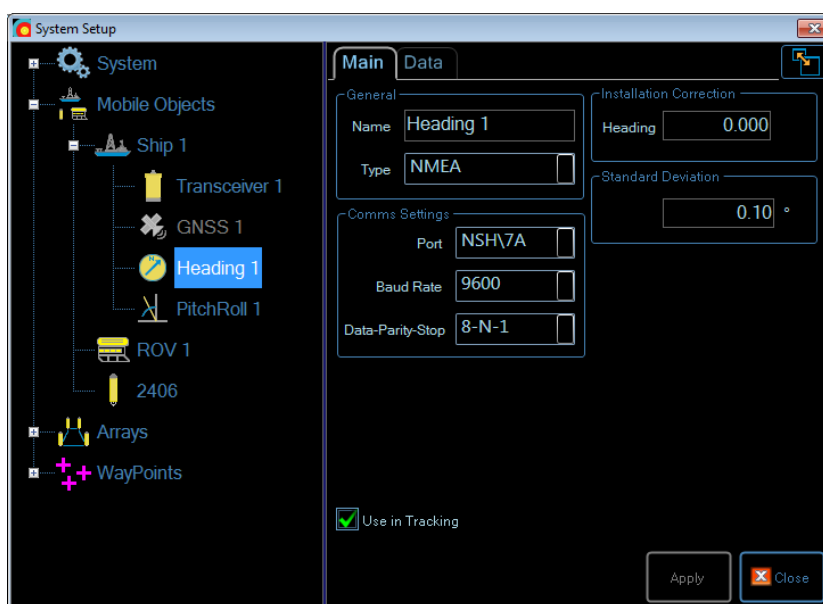
The Depth device supports four standard string types automatically with no user intervention:

- Perry Slingsby depth – \$PSSIROV
- Sonardyne proprietary depth – \$SONDEP
- NMEA depth – \$SDDPT
- Seaeye depth – \$DBS

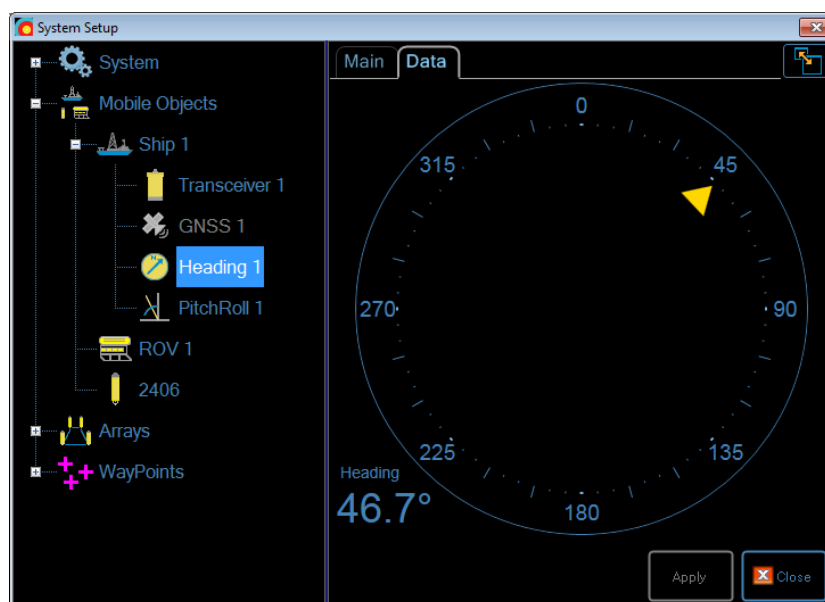
Units of depth in all string types are metres.

4.14 Configuring a Gyrocompass

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the Gyrocompass in the job tree.
3. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the Gyrocompass if required..
4. Enter the **Heading Correction** angle necessary to align the gyrocompass reference frame with the vessel's reference frame.
5. Select the **Use in Tracking** check box.
6. Click **Apply**.



7. Select the **Data** tab and confirm the heading is displayed.

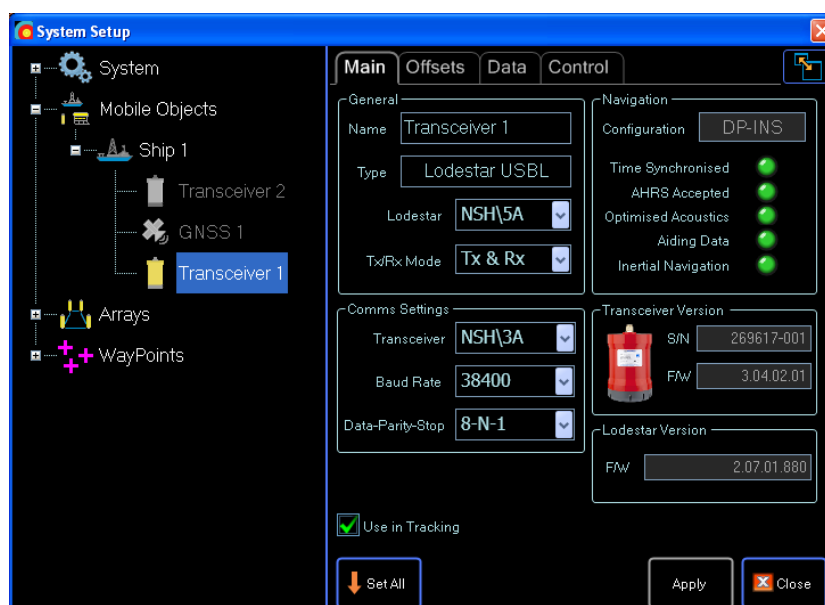


4.15 Configuring a Lodestar GyroUSBL Device

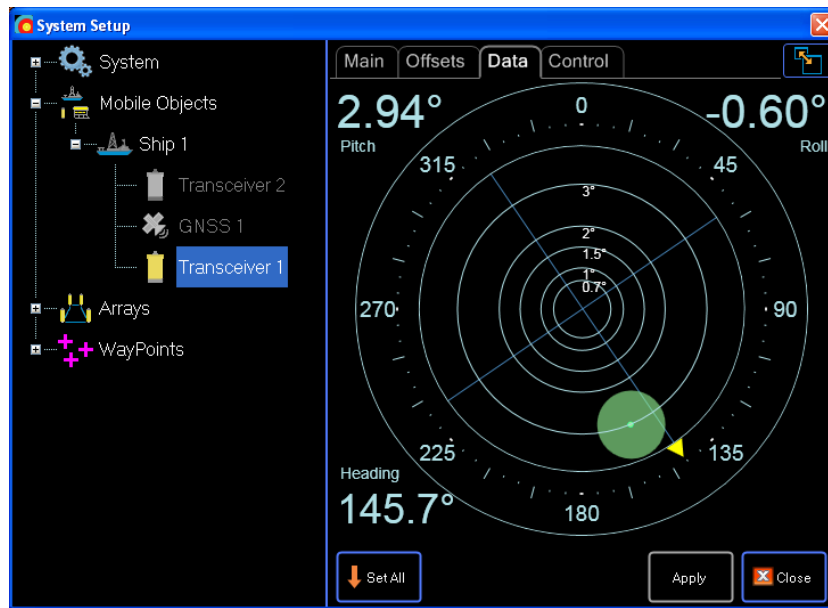
The Lodestar GyroUSBL device is available in 5-element and 7-element versions. Refer to the detail drawings in *Section C.4.5 "GyroUSBL"*.

The configuration procedure is the same for both types and is similar to adding a standard transceiver.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the GyroUSBL (Transceiver) in the job tree .
3. Select the Lodestar **Port** and **Tx/Rx Mode**.
4. Select the transceiver **Port**, **Baud Rate** and **Data-Parity-Stop** to match the transceiver communication parameters used by the GyroUSBL if required.
5. Select the **Use in Tracking** check box.
6. Click **Apply**.



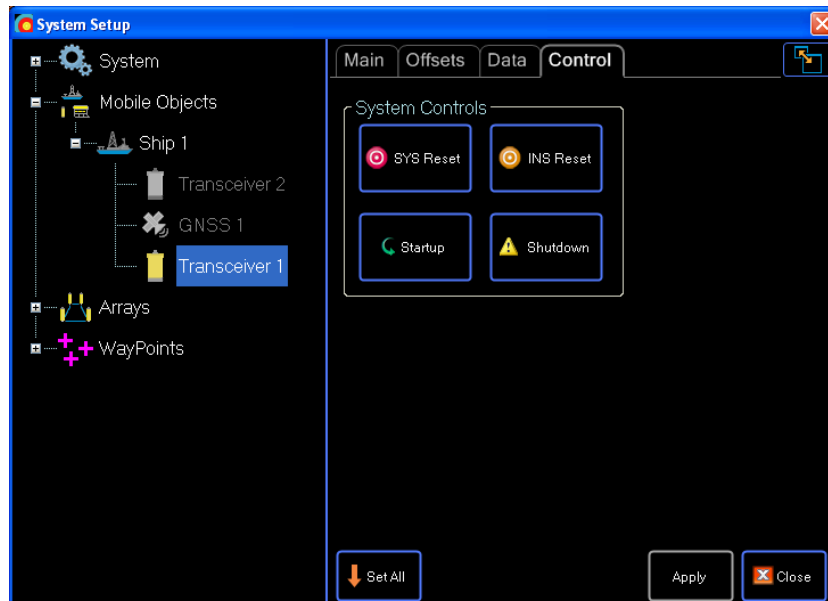
7. Select the **Data** tab and confirm the attitude measurements are displayed.



8. If necessary, select the **Control** tab to reset or shut down Lodestar.

CAUTION

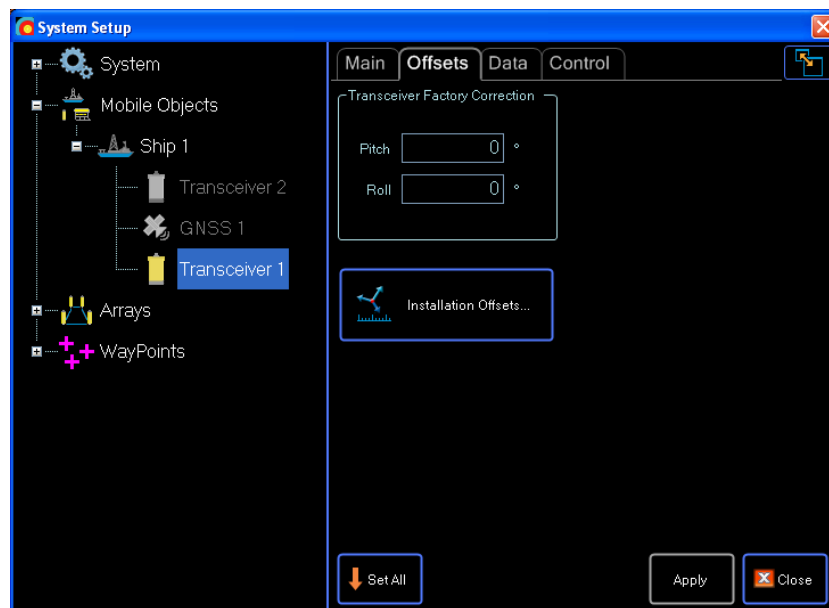
 Risk of equipment malfunction. Only qualified and experienced users should use the Control tab.



9. Select the **Offsets** tab and click **Installation Offsets** to enter the offset distances between the Lodestar INS and the vehicle. The misalignment angles are computed automatically using the Attitude/Heading Calibration tool and the CASIUS tool (see Section 7 "Optimised USBL and DP INS" for details).

CAUTION

 Risk of equipment malfunction. Only qualified and experienced users should use the Offsets tab.



4.15.1 Overview of the Offsets Form

This procedure is intended to deal with DP-INS/Optimised USBL using Gyro-USBL or where a Lodestar and USBL transceiver are rigidly coupled together but might not be perfectly aligned to the vessel reference frame.

The columns identified by small padlock symbols are not usually intended to be edited directly; they are either completed automatically by the system, or they would normally be constant values. However, you can click on the padlock symbol to edit the associated value if necessary.

The diagram on the right of the **Installation Offsets** window illustrates the relationship between the offsets that the dialog box displays in each column. Entering data in any two columns allows the system to complete the third so that all of the values are consistent.

The encircled cross symbol between the columns in the **Orientation Data** region of the dialog box indicates that these columns are combined together, but are not simply added to each other. They are rotations in three dimensions, and so do not simply add — the transformations **Lodestar to Transceiver**, and **Ship to Lodestar** are combined (similar to adding) together to make a single **Transceiver to Ship** correction.

XYZ Offsets

The **XYZ Offsets** region at the top of the dialog box displays the transceiver lever arms. Enter the offsets between the Lodestar and the transceiver (or the Ship CRP-to-Lodestar) in one column, and the transceiver-to-ship offsets as normal (established from accurate drawings or from CASIUS). The system then computes the Lodestar-to-ship (or Lodestar-to-transceiver) offset to fit. The important point is that the system keeps the Lodestar-to-transceiver offsets constant because they are rigidly connected, and the housing does not change its physical dimensions if the system is moved to another vessel).

Updating either the Lodestar-to-ship, or the transceiver-to-ship offsets causes an update in the other so as to keep all the offsets consistent, leaving the Lodestar-to-transceiver offsets unchanged.

Orientation Offsets

The **Orientation Offsets** region at the bottom of the dialog box operates in a similar way to the XYZ offsets. However, Sonardyne strongly recommends that you allow the system to change these values.

The first step is to use the AHRS alignment tool (**Tools>Advanced>Attitude/Heading Calibration**) with the ship's sensors set as reference sensors to estimate the alignment of the Lodestar to the ship. This sets the **Ship-to-Lodestar** column in the offsets dialog box automatically.

When first commissioning a GyroUSBL it is necessary to use CASIUS to calibrate the alignment of the transceiver to the vessel using the CASIUS tool (**Tools>CASIUS**). When you then apply the CASIUS corrections, it sets the values in the **Transceiver-to-ship** column, and the system automatically completes the **Lodestar-to-transceiver** column. Given that the transceiver and Lodestar are rigidly coupled together, then this result should be constant.

When you raise and lower the pole, or if you move the system between vessels, no further CASIUS is required — you can re-align the AHRS corrections to the ship, and the **Transceiver-to-Ship** corrections will be updated to be consistent, leaving the **Lodestar-to-Transceiver** values unchanged.

Template

Sonardyne recommends that you save the configuration as a template after you have set the offset values for a Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP system. This precaution makes sure all future jobs inherit the offsets.

4.16 Configuring System Devices

System devices consist of:

- The Network Sensor Hub (NSH).
- The Electronic Riser Angle (ERA).
- The PAN device.
- The Remote Control device.
- The Signal Tower device.
- The Sound Speed Sensor.
- The Time of Day (TOD).

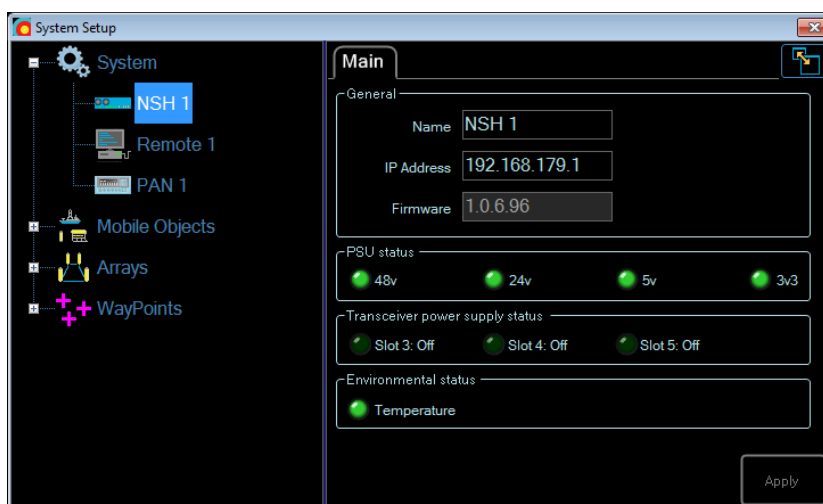
These devices are all grouped in the job tree under **System**.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click on **System** and select the device type.

Add NSH
Add ERA
Add PAN
Add Remote Control
Add Signal Tower
Add Sound Speed
Add TOD

4.16.1 Network Sensor Hub (NSH)

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the NSH in the job tree.
3. Enter a **Name** for the NSH, if necessary.
4. Enter the **IP Address** to connect the NSH to the Computer.
5. Click **Apply**.



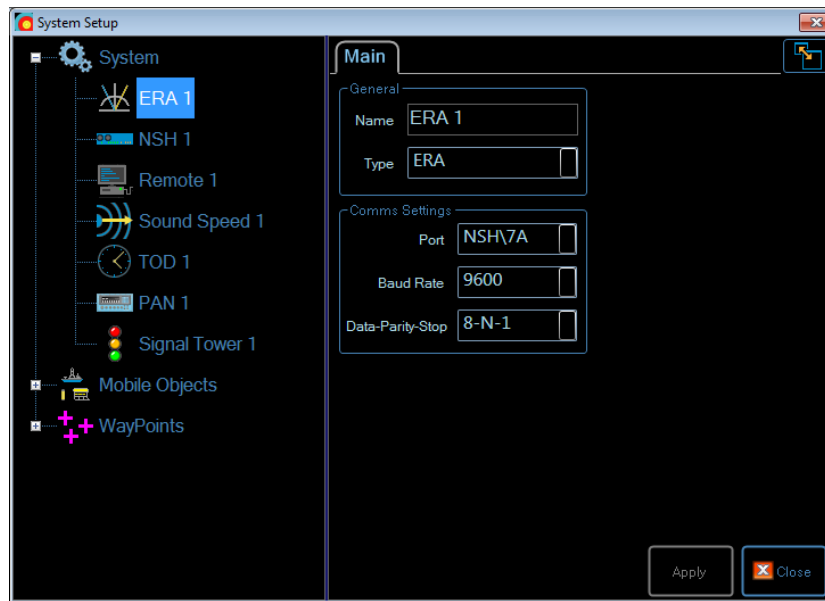
The software indicates a connection to the NSH by displaying a firmware version.

Status is indicated by green or red LEDs for:

- The various internal power supplies.
- The powered slots 3, 4, 5 dedicated to transceivers and Lodestars.
- The internal temperature.

4.16.2 Electronic Riser Angle (ERA)

1. Click **System** to expand the list and select or the **System** shortcut button to open the **System Setup** window.
2. Select the ERA in the job tree.
3. Enter a **Name** for the ERA, if necessary.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
5. Click **Apply**.



Note

 Standard strings are supported.

See Section 9.3 "Electrical Riser Angle (ERA) Monitoring" for more information.

4.16.3 Programmable Acoustic Navigator (PAN)

Note

 A PAN port allows an external system direct access to a Sonardyne transceiver. This feature is reserved for Sonardyne approved products only because unexpected behaviour can result.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the PAN in the job tree.
3. Enter a **Name** and select the Transceiver, if necessary.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
5. Select the Transceiver settings for telemetry scheme, transmit power, receive gain, and wait time.
6. Select the **SMS Mode** to have incoming SMS messages routed to the PAN port. This is particularly used for AUV Telemetry tracking combined with asynchronous SMS data transfer.
7. Select the **Raw Mode** check box if the external client application needs to take full control of the Transceiver.

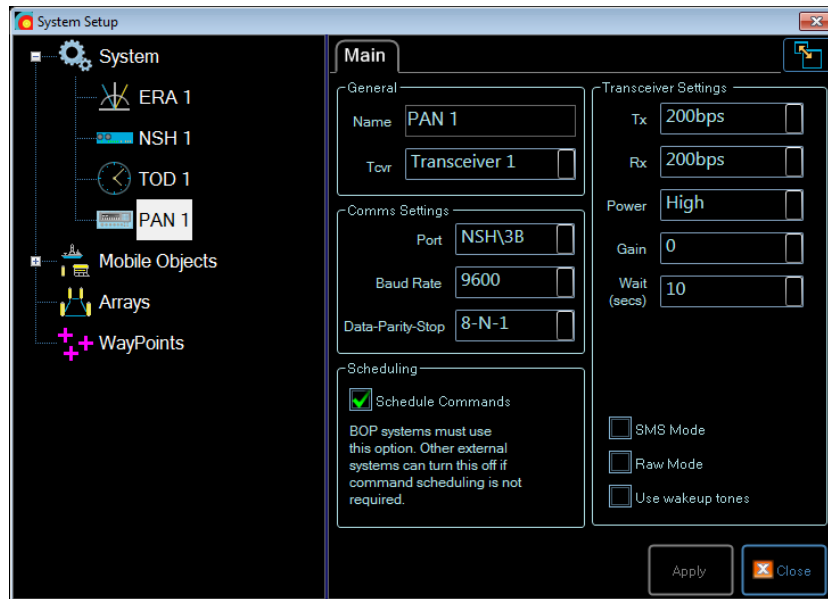
Note

 For use with Sonardyne integrated BOP control systems:

- For an HPT transceiver, the **Raw Mode** tick box must be checked.
- For a GDT transceiver, the **Raw Mode** tick box must not be checked.

7. Select the **Use wakeup tones** check box if using Sonardyne Compatt beacons that have long activity timeouts.

8. Click **Apply**.
9. Use the **Comms Viewer** to confirm the PAN communications are correctly sent and received.



4.16.4 Remote Control Interface

The Remote Control interface allows an External System to control and monitor the system. Typical uses for the Remote Control interface include:

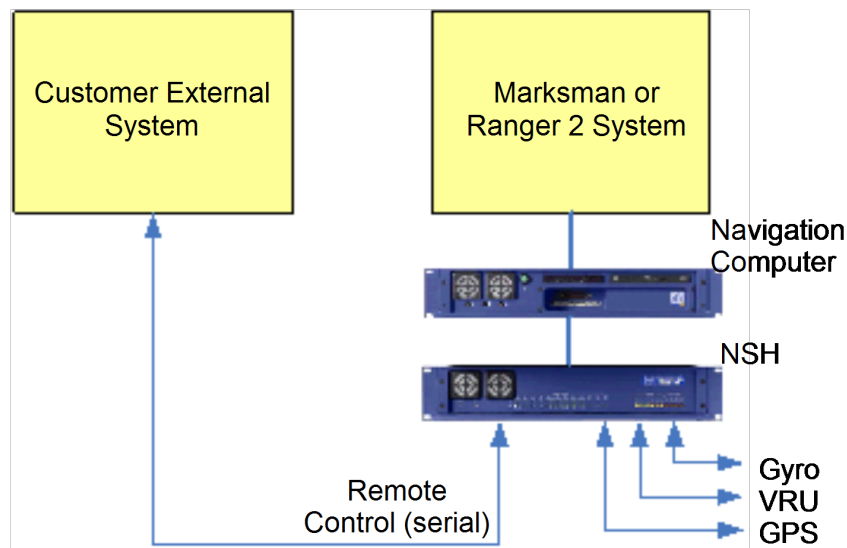
- Starting or stopping acoustic tracking.
- Interrogating the system status.
- Controlling depth aiding.

Hardware Interface

The remote control link consists of either:

- an RS232 or RS485 connection from an external system to either the Navigation Computer or to its attached NSH, or
- a UDP connection through Ethernet to the Navigation Computer's second port.

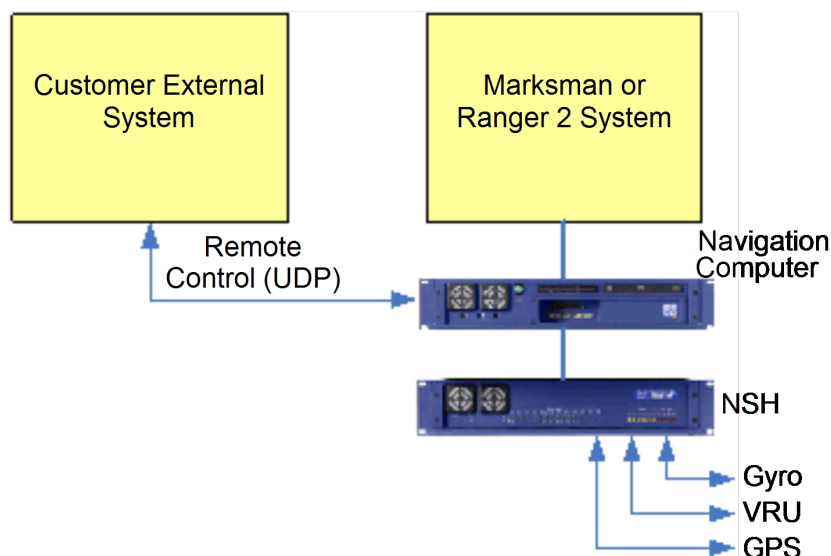
Figure 4–2 Remote Control Interface – by Serial Port



RS485 permits higher baud rates over longer distances than RS232; hence the choice between these two protocols may depend on system deployment.

The external system is connected to the NSH using an NSH RS485 or RS232 interface card.

Figure 4–3 Remote Control Interface – by UDP (Ethernet) Port



Software Protocol

All commands to and responses from the external system are encoded using standard XML. This enables a robust interface to which future commands and features can easily be added without affecting previous versions of the protocol.

Client Software

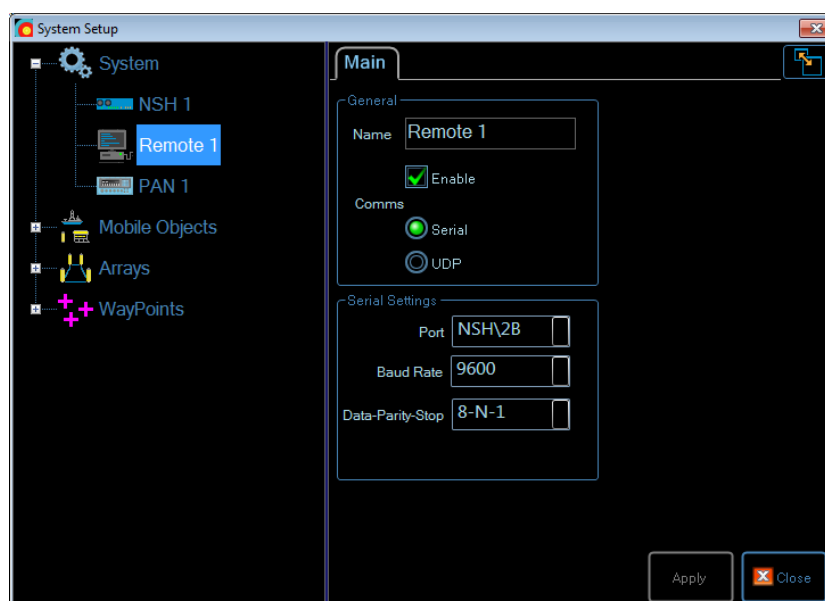
Client software can be written in any programming language and run on any operating system capable of sending and receiving XML via a serial port. A full Remote Control interface specification and sample C# .NET code is available on request from Sonardyne Support.

Operation

A Remote Control interface can be added to a system, just like any other device.

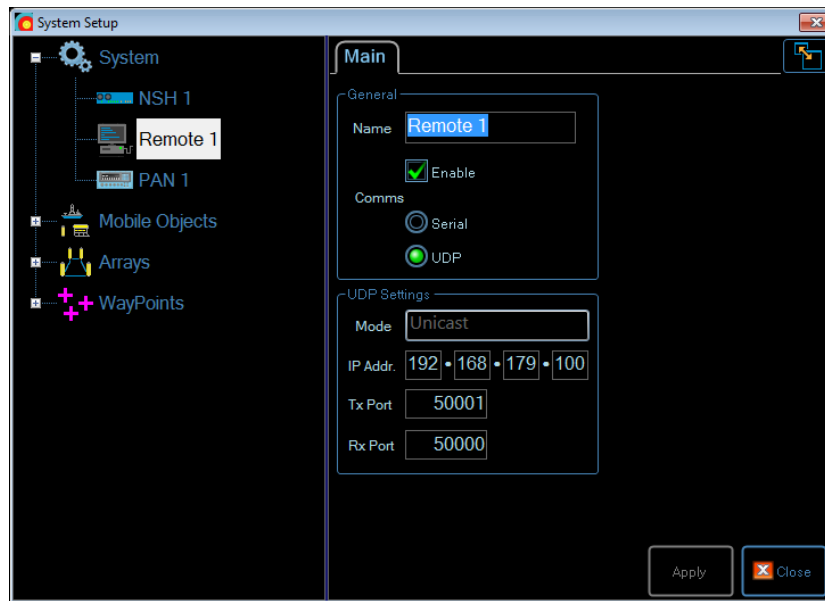
For serial connections:

1. Connect an available NSH RS232 or RS485 port (as appropriate) to the external system.
2. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
3. Right-click **System** and select **Add Remote Control**.
4. Enter a **Name** and select **Serial**.
5. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
6. Click **Apply**.



For Ethernet clients:

1. Connect the external system to the Navigation Computer's second port.
2. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
3. Right-click **System** and select **Add Remote Control**.
4. Enter a **Name** and select **UDP**.
5. Enter the **IP Address**, **Tx Port** and **Rx Port**.
6. Click **Apply**.



Notes

Do not attempt to share the private network that connects the Navigation Computer to the NSH with external systems. System malfunction is likely to occur if you do this.

Firewall settings may need to be adjusted to enable UDP comms.

For all connections:

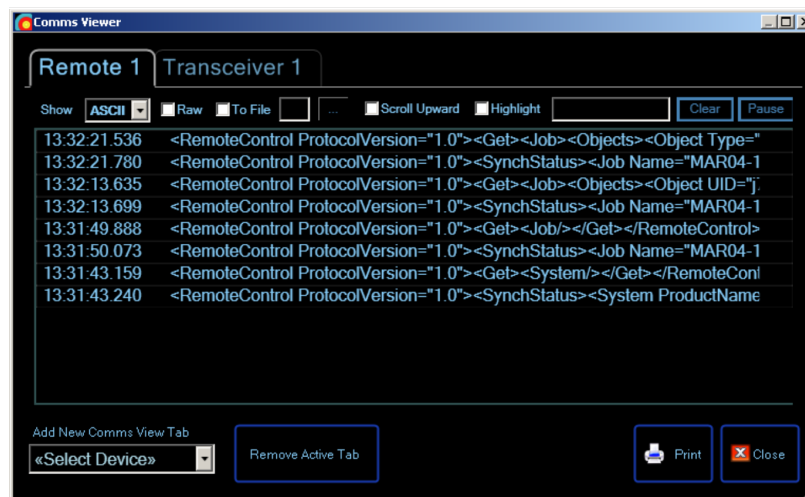
Run the external system's client software and establish communications.

Select the **Enable** checkbox and tick to enable or untick to disable the Remote Control. When Remote Control is enabled, an indicator appears at the bottom of the user interface.



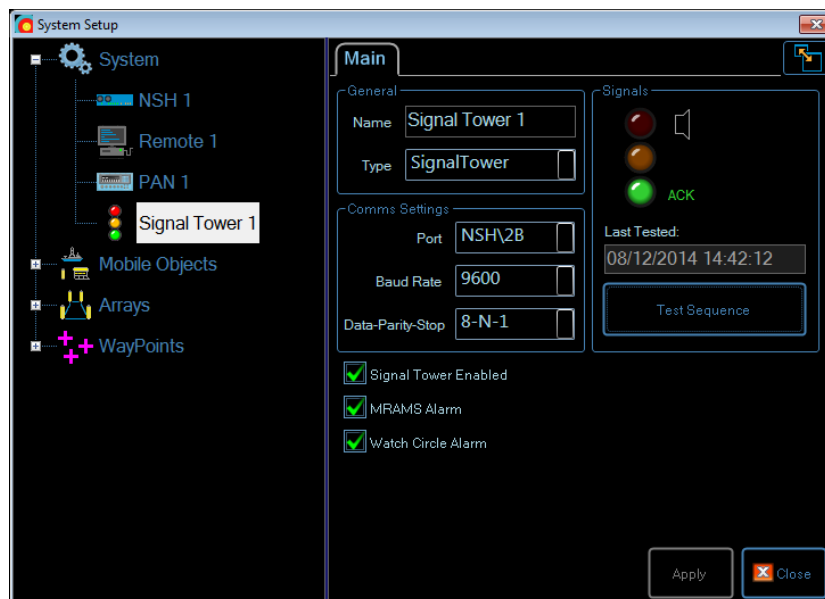
Note

Use the Comms Viewer to view and debug the Remote Control commands and responses: To get started, use the Sonardyne sample Remote Control application from a Windows PC to prove the basic setup.



4.16.5 Signal Tower

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **System** and select **Add Signal Tower**.
3. Enter a **Name**.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
5. Select the **MRAMS Alarm** to drive the signal tower from the MRAMS system status.
6. Select the **Watch-circle Alarm** to drive the signal tower from the watch-circle status.
7. Click **Apply**.



Signal Tower Operation

- If an MRAMS **Warning** alarm occurs, the signal tower indicates this by turning on its amber light.
- If an MRAMS **Critical** alarm occurs, the signal tower indicates this by turning on its red light and sounding its alarm.

The signal tower status is also indicated on the Signal Tower user interface.

The signal tower also works with **Watch Circle** alarms. Watch circles can be configured on the **Way Points** region of the **System Setup** dialog box after one has been set on the main navigation chart. If a Watch Circle alarm occurs, the signal tower indicates this by turning on its red light and sounding its alarm.

Test sequence

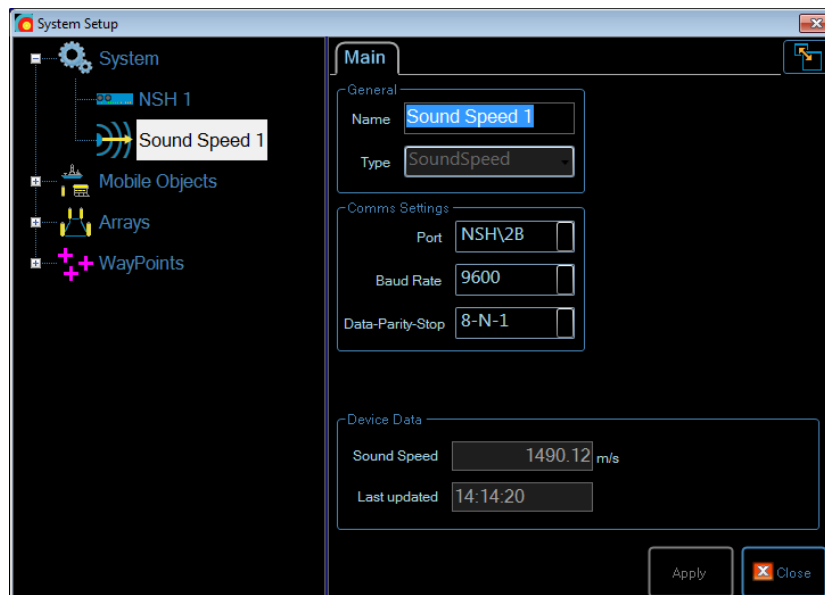
Click the **Test Sequence** button to run a sequence of lights on the signal tower. This test exercises all the different states that the signal tower can show. After you have started the test sequence, the system records the date and the time of the test, and displays that information on the configuration dialog box.

Note

 After you have initiated a test sequence, any new MRAMS alarms that occur will be ignored and not represented on the signal tower until the test sequence completes. See *Section 9 "Riser Angle Monitoring"* for information about MRAMS.

4.16.6 Sound Speed Sensor

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Right-click **System** and select **Add Sound Speed**.
3. Enter a **Name**.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
5. Click **Apply**.



Sound Speed Device Formats

The sound speed device supports two standard string types automatically, requiring no user intervention to select the correct type:

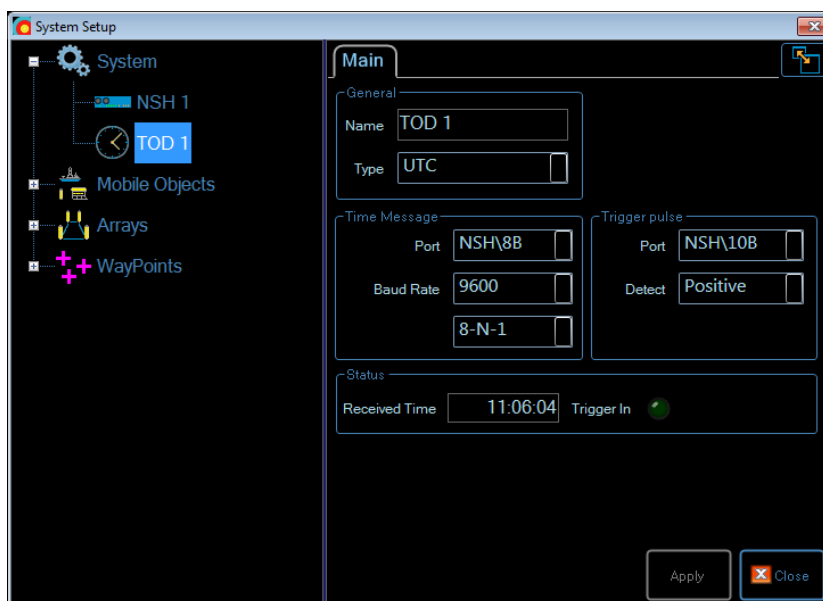
- **Valeport** – Valeport proprietary sound speed string.
- **\$PSONSS** – Sonardyne proprietary sound speed string.

4.16.7 Time of Day (TOD)

The TOD device allows the software to precisely synchronise the NSH clock with an external time source, typically provided by a GNSS set. UTC and ZDA time strings are supported. See *Appendix L "Time System"* for a description of the software time system.

1. Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.
2. Select the TOD in the job tree.
3. Enter a **Name** and **Type**, if necessary.
 - UTC for standard time input from GNSS set.
 - Receive_NSH_Time to receive time from another NSH.

- Send_NSH_Time to send time to another NSH.
4. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters if required.
 5. Enter the NSH trigger **Port** and **Detect**. Refer to the TOD documentation if necessary.
 6. Confirm the time details are shown correctly, and that the **Trigger In** indicator is flashing.
 7. Click **Apply**.

**Note**

There is no Received Time or Trigger In indicator when the TOD device is configured to Send_NSH_Time.

4.17 Configuring a Waypoint

With the system in tracking mode and a GNSS position established, click the **Add WayPoint** button on the main window. Move the cursor on the chart, and click at the location for the new waypoint.

**Note**

The software must be in tracking mode before you can add a waypoint.

4.17.1 Waypoint Main Tab

The **Main** tab shows the current position of the waypoint and allows you to edit the position by changing the Easting and Northing values.

A DP_Ref waypoint is created automatically when an array is calibrated. It is used by certain telegrams as the origin.

4.17.2 Watch Circle

A watch zone is an optional guard zone centred on a waypoint. The **Watch Circle** tab allows you to set the parameters for the guard zone.

1. Select the **Enable** check box to enable the watch circle alarm for the selected waypoint.
2. Select the **Warning Enable** checkbox if a warning circle is required.
3. In the **Watch Circle Radiuses** box Set the radius for the alarm and warning watch circles.
4. In the **Hysteresis**¹ box set the hysteresis for the watch circle.
5. In the **Raise Alarm when** and the **Circle** drop-down lists select which target will raise the alarm, and whether the alarm occurs when the target **Enters** or **Leaves** the watch circle.

¹ Hysteresis is used to prevent false watch-circle alarms when the target vessel or object is positioned near the edge of the circle. Some trial and error may be required in choosing the best value to suit the conditions.

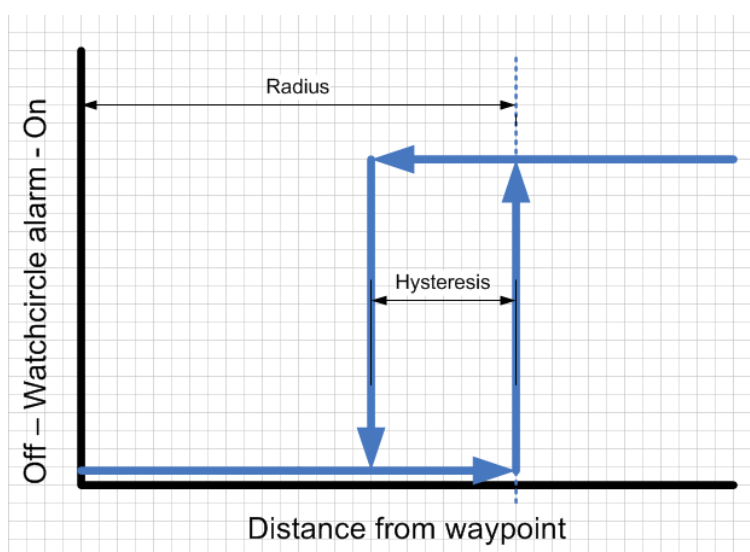
For **leaving the circle** type alarms:

- alarm is raised when the target position $>$ radius
- alarm is cleared when the target position $<$ radius - hysteresis

For **entering the circle** type alarms:

- alarm is raised when the target position $<$ radius
- alarm is cleared when the target position $>$ radius + hysteresis

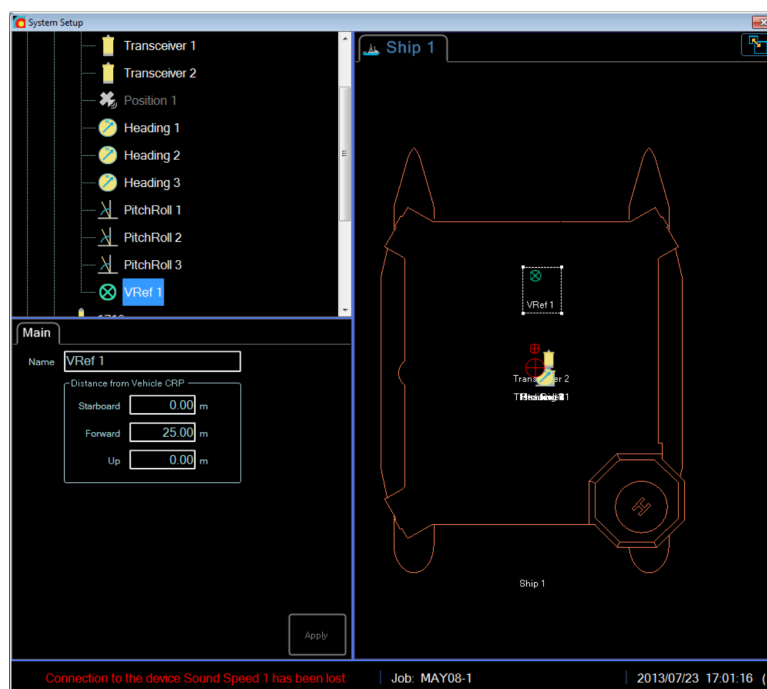
Figure 4-4 Effect of Hysteresis on the Watch-Circle Alarm



4.18 Adding a Vessel Reference Point

Click **System > Setup** or the **System** shortcut button to open the **System Setup** window.

1. Select the Vessel Reference Point in the setup.
2. Enter the location of the Reference Point relative to the vessel's CRP.
3. The Reference Point will display on the vessel's shape, both in the System Setup vessel shape view and on the main navigation chart.



4.19 Configuring the Sound Speed

1. Click **Tools > Environmental** to display the **Environmental Settings** dialog box.
2. Do one of the following:
 - Select the Sound Speed Profile option, click **Load** and follow the instructions below from step 3, or
 - Select the option to set and use the mean and surface sound speed values that you enter, or
 - Select the Sound Speed Sensor (if fitted).

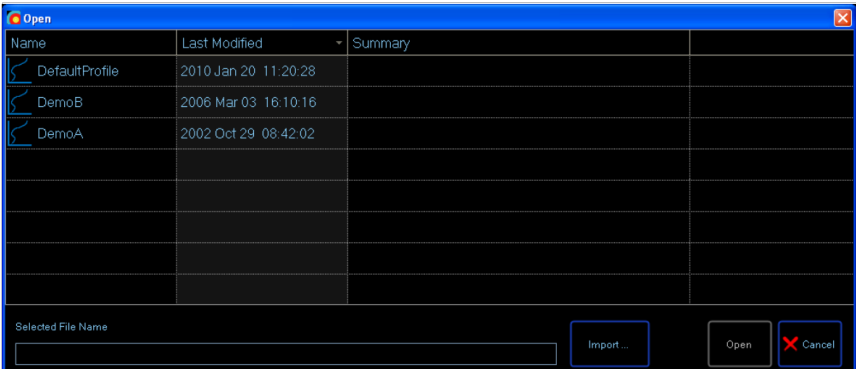
Notes

 If a sound speed profile has not been previously loaded, selecting the "Sound Speed Profile" option will open the profiles window without having to click "Load".

 The Maximum Range and Latitude settings on this dialog box is not connected with sound speed.



3. Click **Load** on the **Environmental Settings** dialog box and select the correct profile from those displayed.



If the profile you need is not included in the displayed list, click **Import**, navigate to the location of a different saved profile, and import it into the list.

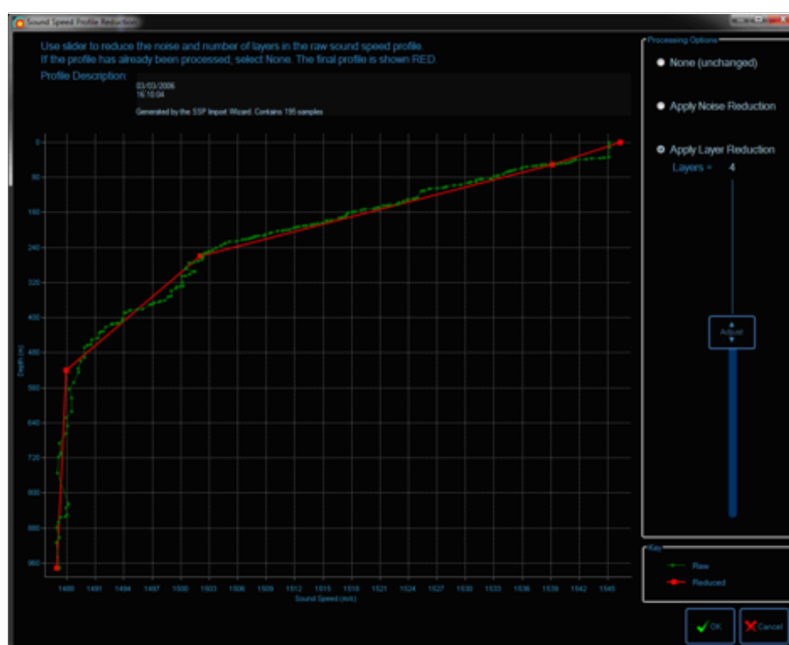
The profile (.PRO) file is a plain text file with the following format:

```
Title
Date
Time
ProbeType
Comments
DepthValue SpeedValue SalinityValue TemperatureValue1
DepthValue SpeedValue SalinityValue TemperatureValue2
DepthValue SpeedValue SalinityValue TemperatureValue3
...
```

4. After the profile is selected, the software displays the Sound Speed Layer Reduction tool.

This tool gives you the option to eliminate any noise in the data, and also to reduce the number of profile points for the software to process.

For example, selecting the **DemoB.pro** file results in the following:



The green points show the original raw data in the **DemoB.pro** file.

There are three options shown in the right hand panel:

1. **No changes**

This option allows you to import the raw (green) SSP data unchanged.

Use this option if the data has already been simplified (for example, by an external program).

2. **Apply Noise Reduction**

This option performs a fixed noise reduction algorithm on the raw SSP data. It should not change the number of points in the profile. The filtered points are shown in red.

Use this option if you want to retain all the points in the original data, but want to eliminate noisy outliers.

3. Apply Layer Reduction

This option allows you to interactively simplify the SSP data so that there are fewer points in the resulting profile. It also effectively reduces noise.

When you select this option, a vertical slider appears in the right hand panel. Move the slider up and down to change the number of layers (points) that the simplified profile will have (shown in red). The final position chosen will depend on the original data, but should have approximately 10 layers to give a reasonable fit.

Click **OK** to accept the option you have chosen, and return to the **Environmental Settings** dialog box.



The **Sound Speed Profile** button will have been highlighted in orange and the thumbnail graph updated.

Note



The changes will not be applied until you click the **OK** button on the **Environmental Settings** dialog box.

4.20 Configuring Output Telegrams

There are three main groups of users of output telegrams:

- DP systems
- Survey systems
- Miscellaneous other tools

The software supports several telegram types, but in practice the choice of telegram is usually governed by the third-party equipment that is to receive the telegram – the choices are often limited. Please consult the third-party equipment's user manual and/or the manufacturer's support group if in any doubt.

Table 4–1 lists the available telegram types, and gives basic choices of trackable targets, reference frames, etc.

Note



Measurement telegrams PSONMEAS and PSONMRAMS are also available (see *Appendix F "Output Telegram Formats and Interfaces"* for details).

Table 4–1 Position Out Telegrams

Telegram	Object	Valid Indexes	DR Support	Sim Flag Supp	Telegram Output with respect to the CRP of:		Supports User Assignments Mobile / Fixed Transponder Flag	Comments
					Valid Frames of Ref	Valid Frames of Orient		
HPR 309	Trans	1-16	Yes	Yes	SHIP/RIG/ROV	NorthUp BowUp	Yes	All positions are sent in ship reference frame. Telegram supports north, or bows up. Can include MRAMS data in telegram
	Vehicle	1-16					No	Vessel position is sent by reporting position of DP_REF waypoint with respect to the ship.
HPR 400 (481D, F)	Trans	B0 1-99 (see comment)	No	Yes	SHIP/RIG/ROV	NorthUp BowUp	Yes	Kongsberg apply an offset to the index number to indicate the frequency band. For MF, 100 is automatically added, and so B01-B87 are reported as indices 101 to 187 in the telegram. Can include MRAMS data in the telegram.
	Vehicle	0 = Vessel 1-16 = ROV1 to ROV16 17 = Position of Relay 1 18 = Position of Relay 1 19 = Position of Relay 1 20 = Position of Relay 1						
HPR BCD (418)	Trans	B0 1-99 (see comment)	Yes	Yes	SHIP/RIG/ROV	BowUp	Yes	Kongsberg apply an offset to the index number to indicate the frequency band. For MF, 100 is automatically added, and so B01-B87 are reported as indices 101 to 187 in the telegram. Can include MRAMS data in the telegram.
	Vehicle	0 = Vessel 1-16 = ROV1 to ROV16 17 = Position of Relay 1 18 = Position of Relay 1 19 = Position of Relay 1 20 = Position of Relay 1 (see comment)						
NMEA	Trans (SSB)	B01 to B99	No	Yes	WORLD	N/A	No	Can Carry MRAMS data.
					SHIPPING	NorthUp BowUp		

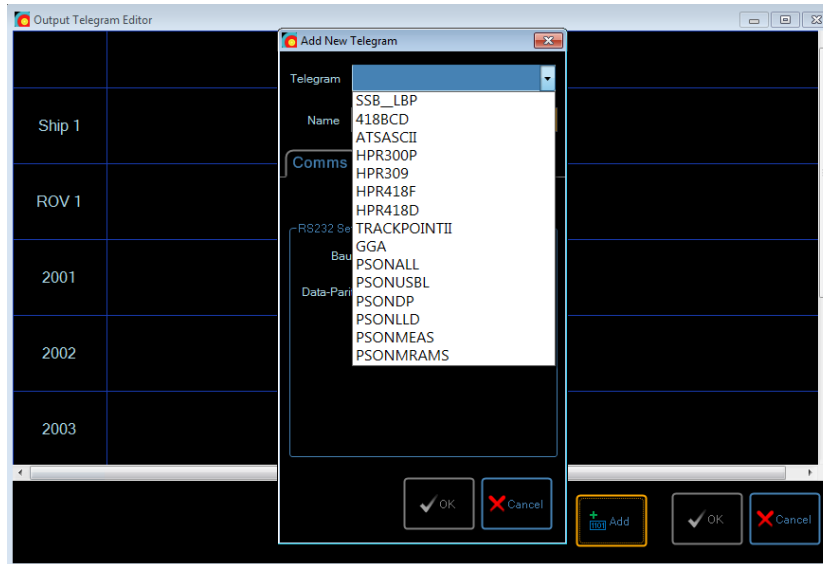
Table 4–1 Position Out Telegrams (continued)

Telegram	Object	Valid Indexes	DR Support	Sim Flag Supp	Telegram Output with respect to the CRP of:		Supports User Assignments Mobile / Fixed Transponder Flag	Comments
					Valid Frames of Ref	Valid Frames of Orient		
	Vehicle (LBP)	Ve or R1 to R4			WORLD	N/A	No	-
					BEACON WAYPOINT	NorthUp		
ATS ASCII	Trans	1 to 10	No	No	SHIP/RIG/ROV	BowUp	No	-
	Vehicle	0 = The Vehicle			WORLD	N/A	No	-
					BEACON WAYPOINT	NorthUp		
GGA	Trans	0-255	No	No	WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates
	Vehicle	0-255			WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates
HPR 300P	Trans	1 to 99	No	Implied	SHIP/RIG/ROV	NorthUp BowUp	No	Very rarely used
	Vehicle	-	-	-	-	-	-	Not supported
Track-point II	Trans	1 to 9.0 is simulating	No	Yes	SHIP/RIG/ROV	NorthUp BowUp	No	Very rarely used
	Vehicle	-	-	-	-	-	-	Not supported
PSON ALL	Trans	Uses name of vehicle / offset (or some other meaningful string)	No	No	WORLD	N/A	No	-
					WAYPOINT	NorthUp		
					SHIP/RIG/ROV	NorthUp BowUp		
	Vehicle	Uses name of vehicle / offset (or some other meaningful string)			WORLD	N/A	No	-
					BEACON WAYPOINT	NorthUp		
					SHIP/RIG/ROV	NorthUp		
PSON USBL	Trans	1 to 999	No	No	SHIP/RIG/ROV	NorthUp BowUp	No	-
	Vehicle	-	-	-	-	-	-	Not supported
PSON DP	Trans	-	-	-	-	-	-	Not supported
	Vehicle	1 to 9	Yes	Yes	WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates
PSON LLD	Trans or Vehicle	Object Name	No	No	WORLD	N/A	No	WGS 84 latitude and longitude co-ordinates

4.20.1 Configuring an Output Telegram

Open the Output Telegrams Editor and follow the steps below to configure a telegram.

1. Click **Add**.
2. Select the telegram type from the list.
3. Click **OK**.



4. Select the **Communications** tab.
5. For a serial connection select the **Port**, **Baud Rate** and **Data-Parity-Stop** and click **OK**.

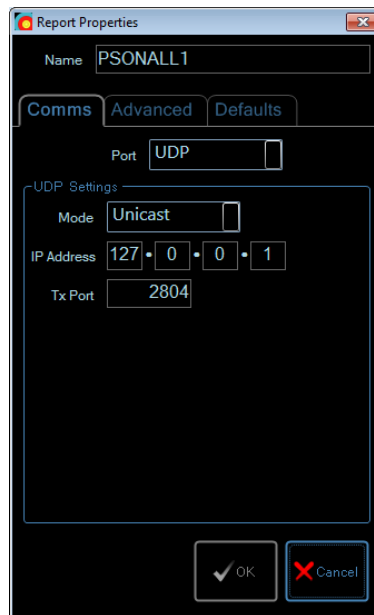


6. For a UDP connection, select **UDP** from the **Port** drop-down and then select:
 - The **Mode**: Unicast, Multicast, or Broadcast.
 - The **IP Address**.
 - The **Tx Port** and **Rx Port**.
7. Click **OK**.

Note

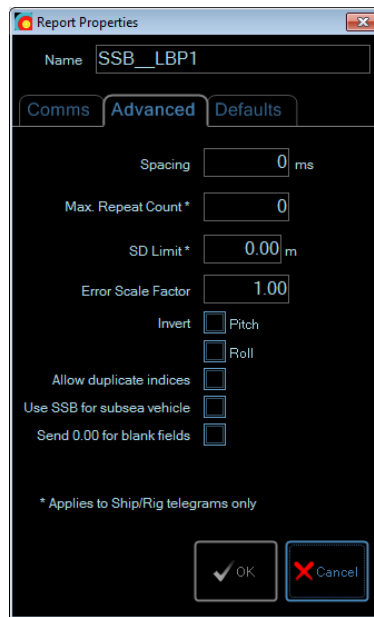


Firewall settings may need to be adjusted to allow UDP comms.



8. Select the **Advanced** tab and set the following as required:

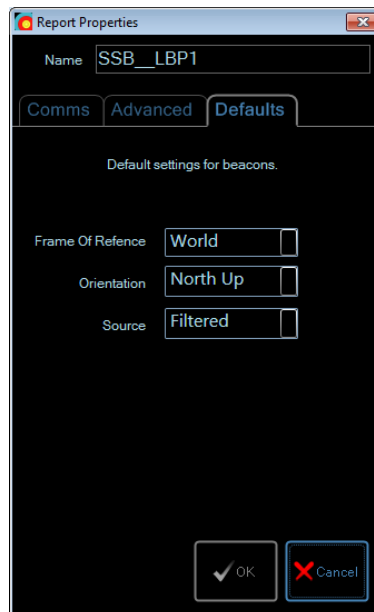
- For DP Use:
 - **Spacing**: The time between telegrams. Normally this parameter should be left at the zero, except in the case of the HPR418D and HPR418F telegrams, which are binary telegrams without unique terminators. The specified gap between these telegrams is 40 ms. Some older systems might require a gap between other telegrams to allow processing one telegram before the next arrives. Set this parameter in accordance with the requirements of the system receiving the data.
 - **Max Repeat Count**: The number of times a telegram can be re-sent. By default this field is set to zero to disable any repeating of telegrams. However, it might be necessary to enable data repetition in some cases. This field limits the number of times a given telegram will be repeated.
 - **SD Limit**: The system will not send a telegram for a position estimate where the predicted error ellipse is larger than this value. The default is zero, which disables this check. Set a non-zero value to enable the limit. This feature is useful for inertial telegrams to prevent free inertial data being delivered beyond a chosen confidence limit.
 - **Error Scale Factor**: This value scales-up or scales-down the error ellipse radius as required. Leave the scale factor at its default value of 1.0 except where it must be adjusted to suit a specific DP system. The valid range is 0.1 to 10.0.
- **Invert Pitch**: inverts the sign of the reported Pitch.
- **Invert Roll** : inverts the sign of the reported Roll.
- **Allow Duplicate Indices** : allows the user to select the same telegram index
- **Use SSB for subsea vehicle** : enables an NMEA SSB telegram rather than an LBP to be sent for a subsea vehicle.
- **Send 0.00 for blank fields** : sends 0.00 for fields that would normally be sent as empty fields in a telegram string. (Some applications do not accept nulls)



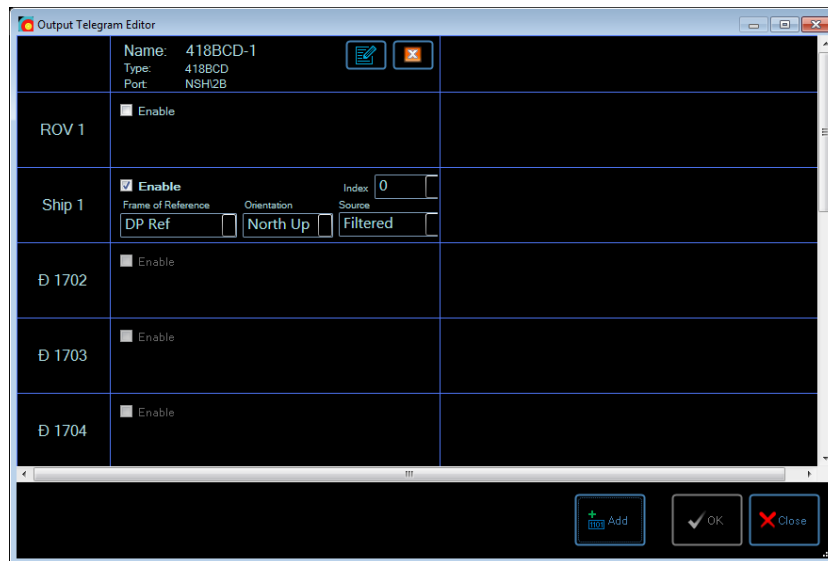
6. Select the **Defaults** tab to set the telegram parameters when beacons are added using the Add Beacon wizard, Quick Track or Remote Control.

Set the following as required :

- **Reference frame:** DP Ref, Ship, ROV or Structure
- **Orientation:** North or Bow up
- **Source:** Filtered, raw, INS or SPRINT



10. Set the following as required (with reference to *Table 4–1*).



Ship or specific beacons (as position feeds are required).

- Reference frame: DP Ref, Ship, World, Waypoint etc.
- DP index
- Source: Filtered, raw, INS or SPRINT (reserved for Sonardyne SPRINT systems).
- Orientation: North or Bow up

If necessary, you can set up more than one output telegram. Use the Comms viewer to check the output telegram.

To delete a telegram, click the red X button in the top right window.

4.20.2 Operation

No user intervention is necessary. Output telegrams are generated as soon as the position data is available.

4.21 Viewing Setup Files Offline

The software saves each setup in an XML-format setup (job) file with the filename extension .DJF. Each file is stored in its own folder.

The path to the jobs folder is:

Windows XP

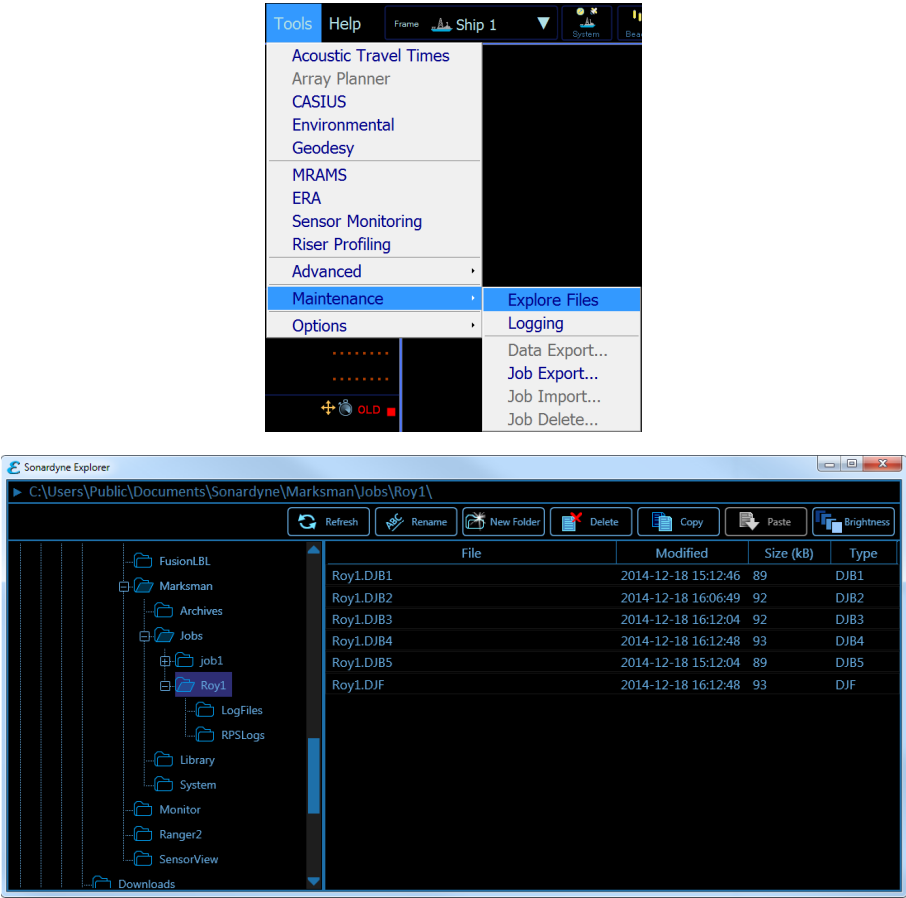
C:\Documents and Settings\All Users\Documents\Sonardyne\Marksman\Jobs\

Windows 7

C:\Users\Public\Documents\Sonardyne\Marksman\Jobs\

An XSL stylesheet called **Denovo.xsl** is installed automatically in the Jobs folder.

To view a setup (job) file in user-friendly style, use Windows Explorer or the built-in Marksman Explorer to navigate to the setup file:



Double-click on the setup .DJF file of interest to launch a simplified view in the default browser. For example:

Figure 4–5 Example Report of System Setup

Report for MarksmanJob "MAY08-1"

Description: ""

Created from template : true

All dimensions are in metres, angles are in degrees

Vessels and vehicles

Vessel	State	ManualHdg	ManualHdg (deg)	ManualDepth	ManualDepth
Ship 1	Tracked	false		false	

Beacons

Name	Type	TAT (ms)	Tx Power	Rx Gain	Rx Attn	Range Power	Interrogate	Reply	Tracking	Calibration	Update (secs)	Easting	Northing	Depth	UTMZone
101 - BOP	DPTi	125	High	High		High	CIS 0000	IRS 0101	NotTracked	Mobile	15				
102 - LFI	DPTi	250	High	High		High	CIS 0002	IRS 0102	Tracked	Mobile	6				
1702 - Compant6		80	High	High		High	CIS 1600	IRS 1702	Tracked	Fixed	3	655513.458	392516.017	1899.999	32N
1703 - Compant6		80	High	High		High	CIS 1600	IRS 1703	Tracked	Fixed	3	655513.272	392516.178	2010.050	32N
1704 - Compant6		160	High	High		High	CIS 1600	IRS 1704	Tracked	Fixed	3	655513.278	392616.028	1999.985	32N
1705 - Compant6		200	High	High		High	CIS 1600	IRS 1705	Tracked	Fixed	3	655413.421	392515.913	2099.977	32N
1706 - Compant6		240	High	High		High	CIS 1600	IRS 1706	Tracked	Fixed	3	655513.502	392416.018	1999.985	32N

Battery checks

Name	LastCheckTime
101 - BOP	2013-06-15 15:42:00 (00:00:00)

This simplified view of the system setup allows the user to perform important tasks, for example:

- View all the installation offsets for ship’s instruments, transceivers, and so on.
- Check beacon settings.

- View battery check data.
- View beacon array positions.
- View waypoint locations.
- Check software and firmware versions.

4.22 Sending Log files to Sonardyne Support

In the event of an error or system malfunction, system configuration data and log files can be appended into a compressed zip file and sent to Sonardyne Support for evaluation.

Click **Help>Sonardyne Support** to use the Sonardyne Support tool; see *Section A.11 "Help Menu"*.

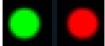
Section 5 – Beacons

5.1 Beacons Table

The Beacons Table brings the management of all the beacons in the system together in one integrated tool. It contains six tabs: Main, Tracking, Advanced, Sensors, Hardware Status and Additional Status.

5.1.1 Common to all Tabs

Table 5–1 Beacon Controls Common to all Tabs

Item	Function	Control Type
Select	Selects a beacon row	
Status/Enable	Current Beacon 'enabled' state.	 (green = enabled)
Status/Key	Graphic symbol / colour used on chart to represent the beacon.	 = mobile  = reference  = calibrating (The colour is unique for each beacon. The symbol rotates constantly.)
Name/Prefix	Beacon Name Prefix	Text Edit Box (Maximum 5 characters.)
Name/Address	Beacon Address	Text Label

5.1.2 Main Tab

The **Main** tab, shown below, displays the most important details about each of the beacons included in the setup, including its Name, Address, Interrogate and Reply, TAT, Acoustic Link Status, Battery status and Update period.

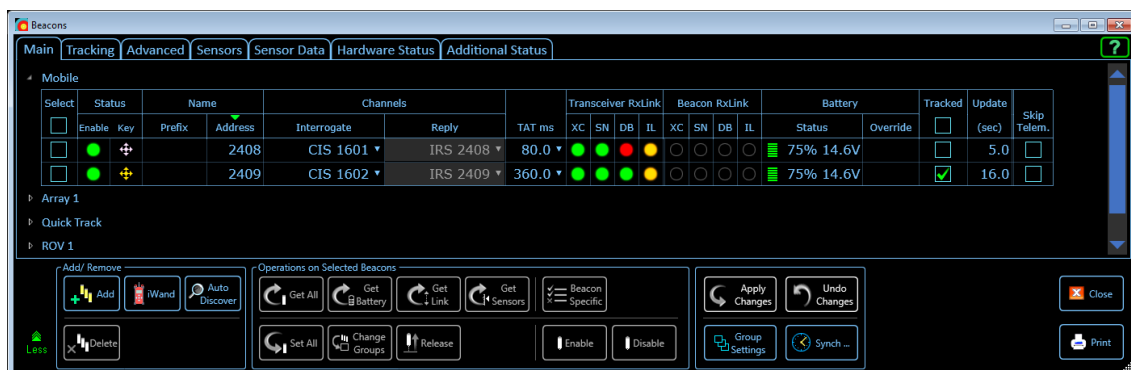
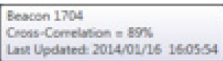
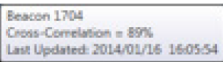


Table 5–2 Beacons Table - Main Tab Description

Item	Function	Control type
Channels/Interrogate	Interrogate channel	 Drop-down List

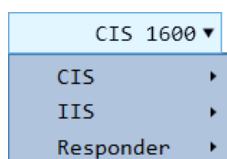
Table 5–2 Beacons Table - Main Tab Description (continued)

Item	Function	Control type
Channels/Reply	Reply channel	 Drop-down List
TAT ms	Turn Around Time (ms)	 Drop-down List
Transceiver RxLink	Transceiver Rx Link diagnostics	 Note that this will be disabled if no tracking has been done on the beacon. Tool tips over each LED to show description, values and the most recent update time, for example: 
Beacon RxLink	Beacon Rx Link diagnostics	 Note that this will be disabled if the beacon does not support ALS, or no Get Link has been done on the beacon. Tool tips over each LED to show description, values and the most recent update time, for example: 
Battery/Status	Battery charge state – a Low battery status can be temporarily overridden	  
Tracked	Tracking controls	
Update (sec)	Tracking update rate	Numeric edit box (single decimal)
Skip Telem	Skip sending telemetry for any commands to this beacon	

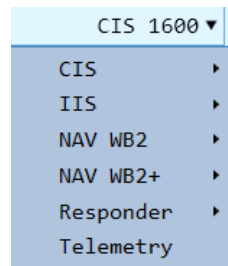
5.1.3 Interrogate and Reply

Depending on the beacon type, clicking on the **Interrogate** drop-down list presents the following menus:

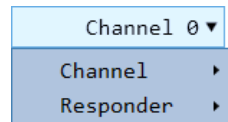
- For 5G and 6G beacons with functionality level that excludes multi-user NAV Channels: **CIS**, **IIS** and **Responder**.



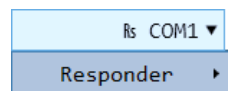
- For 6G beacons with functionality level that includes multi-user NAV channels: **CIS**, **IIS**, **NAV WB2**, **NAV WB2+**, **Responder** and **Telemetry**.



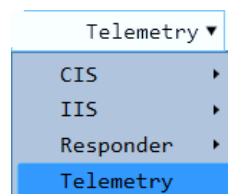
- For WSM or WSM 6 beacons: **Channel1** and **Responder**.



- For Nano Responder beacons: **Responder**.



- For AvTrak6 with Telemetry tracking enabled: **CIS**, **IIS**, **Responder** and **Telemetry**.



5.1.4 Interpreting Link Status Information

The Link Status information from a transceiver or transponder provides four data values that can be useful in determining the status of the acoustic channel. These values are:

- Cross-Correlation (XC)
- Signal-to-Noise Ratio (SNR)
- Amplitude (dBV)
- Interference Level (IFL)

Several of these parameters are linked together. For example, changing the receiver gain (LG) may improve the XC and SNR in cases where the acoustic signal is saturating the receiver.

Wherever possible, it is important to ensure that the system is not saturating. This can be done by adjusting the LG parameter in the CS command to bring the DBV level to within the 'good' range indicated in the table below.

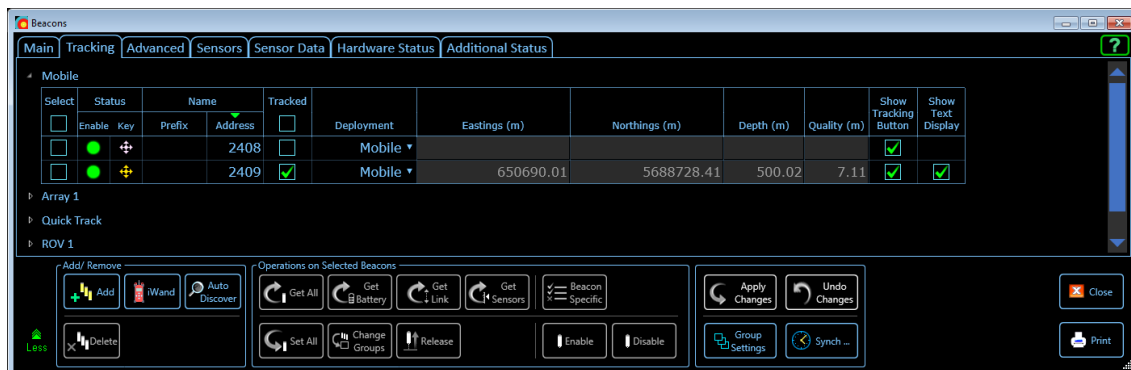
The table below shows a 'traffic light' interpretation and bounds for each of the parameters. The aim is to have all of the parameters within the 'Good' or 'Okay' bounds. Mainly this can be achieved by adjusting the gain of the instrument under test conditions.

Table 5–3 Parameter Bounds for Link Status Information

Parameter	Good	Okay	Difficult	Description
XC WBv1 WBv2 WBv2+	>70 >60 >50	>55 >50 >40	<55 <50 <40	The XC parameter shows how well the received signal matches a replica held inside the instrument. This value will be reduced by a strong multipath environment, for example in shallow water. There is no direct way of improving this figure, except environmentally, but ensure the other parameters are within their "Good" operation ranges.
DBV	–3 to –26	>–36 & >–3	<–6 or >=0	If the signal is either too large (>–3 dB) or too small (<–36) then the system is not optimal. If the dBV value is greater than –3 dB then reduce the gain (increase attenuation). The opposite is true of a signal below –36 dB.
SNR	>12	>6	<6	Signal to noise ratio, the higher the better. Ensure that the system is not saturating (DBV) as this will degrade the SNR. Increase the transponder power level to increase SNR, as long as the DBV value shows the system is not saturating.
IFL	<20	<40	>40	Interference level, maximum correlation level prior to detection. Mainly this will not affect the system performance, but if very high means the likelihood is there are other signals in the water column.

5.1.5 Tracking Tab

The **Tracking** tab, shown below, displays the major tracking parameters, including Deployment and Easting, Northing, Depth positions.



You can use the **Tracking** tab to switch Tracking on or off for one or more beacons, and to select whether or not to show each Tracking button and position display on the main window.

Table 5–4 Beacons Table – Tracking Tab Description

Item	Function	Control Type
Tracked	Controls tracking	
Deployment	Where the beacon is currently situated or attached.	Drop-down List [Mobile , Calibrating , Array and Named Subsea Vehicle]
Eastings (m)	Easting (local or world)	Numeric Label (2 decimals)

Table 5–4 Beacons Table – Tracking Tab Description (continued)

Item	Function	Control Type
Northings (m)	Northing (local or world)	Numeric Label (2 decimals)
Depth (m)	Depth	Numeric Label (2 decimals)
Quality (m)	Tracker Quality	Numeric Label (2 decimals)
Show Tracking Button	If this is a Mobile beacon this field is visible. Allows control over the visibility of the Tracking button for this beacon on the Main UI.	
Show Text Display	If this is a Mobile or Calibrating (not Fixed) beacon this field is visible. Allows control over the visibility of the Position Text Block for this beacon on the Main UI.	

5.1.6 Advanced tab

The **Advanced** tab includes beacon parameters that should rarely need to be adjusted, including: Power, Gain and Telemetry scheme for one or more beacons.



Table 5–5 Beacons Table – Advanced Tab Description

Item	Function	Control Type
Telemetry Transceiver	Transceiver assigned for performing telemetry to this beacon (if applicable)	 Drop-down List
Transceiver/ Power	Transceiver Tx Power	 Drop-down List
Transceiver/ Rx Gain	Transceiver Rx Gain	 Drop-down List
Transceiver/ Telemetry	Transceiver Telemetry Scheme	 Drop-down List
Beacon/ Power	Beacon Tx Power	 Drop-down List
Beacon/ Rx Gain	Beacon Rx Gain	 Drop-down List
Beacon/ Telemetry	Beacon Telemetry Scheme	
Skip Telem.	Skip sending telemetry for any commands to this beacon.	

5.1.7 Sensors Tab

The Sensors tab displays the sensor parameters of each beacon, including Pulse Position mode (depth or attitude), depth sensor style/offset/aiding mode. The Sensors tab is used to configure the depth and attitude sensors for one or more beacons.

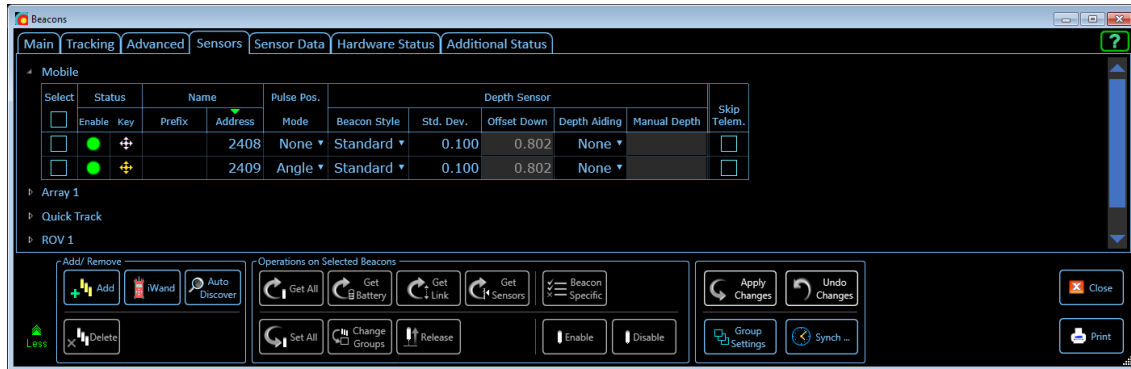


Table 5–6 Beacons Table – Sensors Tab Description

Item	Function	Control Type
Pulse Pos. Mode	Pulse Position Mode to be used during ranging cycles. Select Depth or Angle from the Pulse Pos. Mode drop-down list if sensor measurements are to be integrated into ranging cycles.	Drop-down List [None, Depth, Angle]
Depth Sensor/ Beacon Style	Depth Sensor offset style – allows offset to be adjusted for tilted beacons	Drop-down List [Manual, Standard]
Depth Sensor/ Std. Dev.	Standard Deviation (quality) of depth sensor	Numeric Label (3 decimals)
Depth Sensor/ Offset Down	Depth Sensor Offset to acoustic transducer	Numeric Label (3 decimals)
Depth Sensor/ Depth Aiding	Selects the type of depth aiding to be used when tracking this beacon. When set to Manual, the Manual Depth field (below) is visible	Drop-down List [Manual, Sensor, None]
Depth Sensor/ Manual Depth	Manual depth value editable by the user when the Depth Aiding field is set to Manual	Numeric Label (1 decimal)

5.1.8 Sensor DataTab

The Sensor Data tab displays the sensor values retrieved from each selected beacon when the **Get Sensors** button is clicked (see *Section 5.1.15 "Beacon Operations"*).

Note



This feature is only offered for Sonardyne beacons that are configured for telemetry.



Table 5–7 Beacons Table – Sensor Data Tab Description

Item	Function	Control Type
Temperature	Temperature sensor value	Numeric label (2 decimals)
Depth	Depth sensor value	Numeric label (2 decimals)
Sound Speed	Sound Speed sensor value	Numeric label (2 decimals)
Pitch	Pitch sensor value	Numeric label (2 decimals)
Roll	Roll sensor value	Numeric label (2 decimals)
Heading	Heading sensor value	Numeric label (2 decimals)
Last Update	Date-time of last successful sensor data retrieval	Date-time label

5.1.9 Hardware Status Tab

The Hardware Status tab displays the fixed parameters of each beacon, including: UID, Firmware version and Transducer type.

If a beacon does not support telemetry (or has an incompatible 5G/6G Transceiver) most fields are blank.

If a beacon supports telemetry but has not yet been involved in a telemetry transfer, fields might show 'Unknown'.

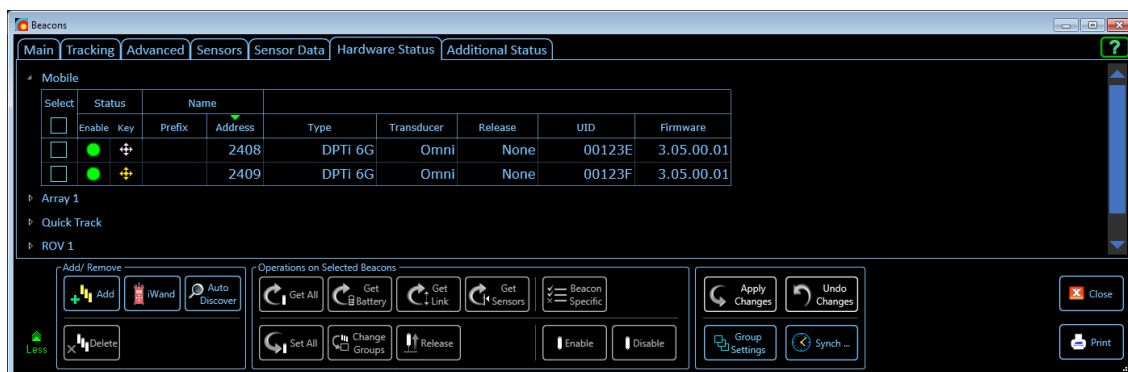


Table 5–8 Beacons Table – Hardware Status Tab Description

Item	Function	Control Type
Type	Beacon type name (e.g. Compatt 6)	Static Label

Table 5–8 Beacons Table – Hardware Status Tab Description (continued)

Item	Function	Control Type
Transducer	Transducer type (Omni or Directional)	Static label
Release	Acoustic release type	Static Label
UID	Beacon UID	Static Label
Firmware	Firmware version	Static Label

5.1.10 Additional Status Tab

The Additional Status tab displays the additional parameters specific to certain types of beacon, e.g. Activity Time and GyroCompatt status.

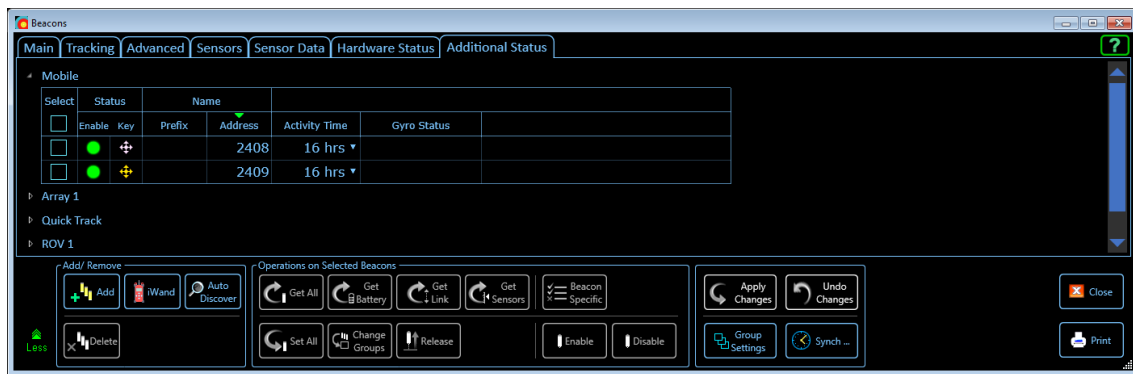
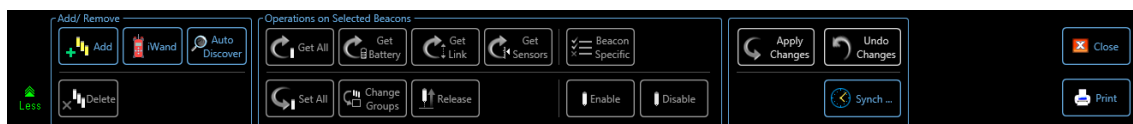


Table 5–9 Beacons Table – Additional Status Tab Description

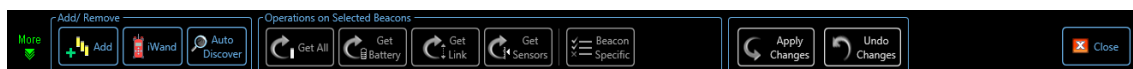
Item	Function	Control Type
Activity Time	Allows selection of the desired stay-awaketime of the beacon	 Drop-down List Range from 2 Secs to 32 days or Always on
Status	Shows the current status of the Lodestar Gyro. Applicable only when the beacon is a GyroCompatt	Static Label: On, Off, UnSettled

5.1.11 Common Commands

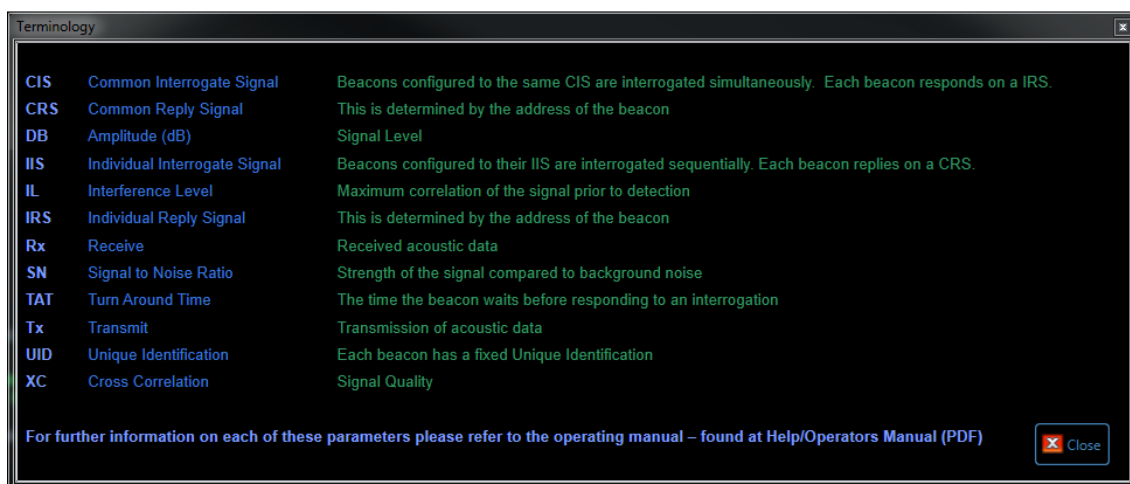
Clicking the  button at bottom left exposes the second row of buttons along the bottom of the window as shown below.



Clicking the  button at bottom left hides the second row of buttons along the bottom of the window.



- Clicking **Add** launches the Add Beacon Wizard (see *Section 5.2 "Add Beacon Wizard"*).
- Clicking **iWAND** launches the iWAND tool (see *Section 5.4 "iWAND Tool"*).
- Clicking **Auto Discover** launches the Beacon Discovery Tool (see *Section 5.5 "Beacon Discovery Tool"*).
- Clicking **Group Settings** allows you to set special behaviour for a beacon group.
- Clicking **Sync** launches the **Acoustic Time Synchronisation** window.
- Clicking **Print** launches the Windows Print dialog box. This is a standard system dialog box that allows you capture and print out the Beacons Window.
- Clicking  shows the Beacon Terminology help window.



- Clicking on **Close** closes the window.

5.1.12 Beacon Selection

The first column in all tables in all tabs is a Beacon **Select** column, consisting of a check box to select a row. When a beacon is selected the entire row is highlighted in dark green, except for disabled fields which are shown greyed out. Using this method to select any beacon in any tab automatically results in the beacon being selected in all other tabs (see below).

Select	Status		Name		Channels		TAT ms	Transceiver RxLink				Beacon RxLink				Battery		Tracked	Update	Skip Telem
☐	Enable	Key	Prefix	Address	Interrogate	Reply		XC	SN	DB	IL	XC	SN	DB	IL	Status	Override	☐	(sec)	
☒				2001	CIS 1600 ▾	IRS 2001 ▾	80.0 ▾									Unknown		☒	2.0	
☐				2002	CIS 1600 ▾	IRS 2002 ▾	120.0 ▾									Unknown		☒	2.0	

There is a **Select All/None** check box in the header of each table's selection column. Toggling this selects All or None of the beacons in that table, across all tabs (see below).

Select	Status		Name		Channels			TAT ms	Transceiver RxLink				Beacon RxLink				Battery		Tracked	Update	Skip
☒	Enable	Key	Prefix	Address	Interrogate	Reply	XC		SN	DB	IL	XC	SN	DB	IL	Status	Override	☐	(sec)	Telem	
☒				2001	CIS 1600 ▾	IRS 2001 ▾	80.0 ▾									Unknown		☒	2.0	☐	
☒				2002	CIS 1600 ▾	IRS 2002 ▾	120.0 ▾									Unknown		☒	2.0	☐	
☒				2003	CIS 1600 ▾	IRS 2003 ▾	160.0 ▾									Unknown		☒	2.0	☐	
☒				2004	CIS 1600 ▾	IRS 2004 ▾	200.0 ▾									Unknown		☒	2.0	☐	
☒				2005	CIS 1600 ▾	IRS 2005 ▾	240.0 ▾									Unknown		☒	2.0	☐	

When at least one beacon is selected by its selection check box, the following buttons are enabled on the button panel, otherwise they are disabled:

- Get All
- Get Battery
- Get Link
- Get Sensors
- Beacon Specific
- Set All
- Change Groups
- Release
- Enable
- Disable
- Delete



5.1.13 Sorting Columns

Columns that have data that can be usefully sorted do allow sorting (see the examples below showing where this feature can be used). To sort the columns, click on a column header that contains sortable data results so that a green chevron (as shown below) appears above the header text. Only one column is sortable at a time, but it is applied to all tables on all tabs (as applicable).

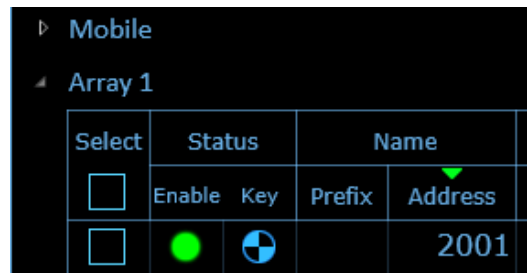
Select	Status		Name		Channels			Transceiver RxLink				Beacon RxLink				Battery		Tracked	Update	Skip
☒	Enable	Key	Prefix	Address	Interrogate	Reply	TAT ms	XC	SN	DB	IL	XC	SN	DB	IL	Status	Override	☐	(sec)	Telem.
☒	☒	☒		2001	CIS 1600 ▾	IRS 2001 ▾	80.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐
☒	☒	☒		2002	CIS 1600 ▾	IRS 2002 ▾	120.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐
☒	☒	☒		2003	CIS 1600 ▾	IRS 2003 ▾	160.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐
☒	☒	☒		2004	CIS 1600 ▾	IRS 2004 ▾	200.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐
☒	☒	☒		2005	CIS 1600 ▾	IRS 2005 ▾	240.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐

Clicking on the chevron reverses the sort order.

Select	Status		Name		Channels				Transceiver RxLink				Beacon RxLink				Battery		Tracked	Update	Skip
☒	Enable	Key	Prefix	Address	Interrogate	Reply	TAT ms	XC	SN	DB	IL	XC	SN	DB	IL	Status	Override	☐	(sec)	Telem.	
☒	☒	☒		2005	CIS 1600 ▾	IRS 2005 ▾	240.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐	
☒	☒	☒		2004	CIS 1600 ▾	IRS 2004 ▾	200.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐	
☒	☒	☒		2003	CIS 1600 ▾	IRS 2003 ▾	160.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐	
☒	☒	☒		2002	CIS 1600 ▾	IRS 2002 ▾	120.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐	
☒	☒	☒		2001	CIS 1600 ▾	IRS 2001 ▾	80.0 ▾	☒	☒	☒	☒	☐	☐	☐	☐	Unknown		☒	2.0	☐	

5.1.14 Beacon Groups

All tabs show separate collapsible tables for Mobile, Array and ROV etc. Each table is independently collapsible by clicking on the chevron next to the table title, as shown below.



Mobile				
Array 1				
Select	Status		Name	
☐	Enable	Key	Prefix	Address
☒				2001

5.1.15 Beacon Operations

Assuming at least one beacon has been selected in the table then these buttons are enabled:

- Get All
- Get Battery
- Get Link
- Get Sensors
- Beacon Specific
- Set All
- Change Groups
- Release
- Enable
- Disable
- Delete

Depending on what beacon(s) have been selected, the following action occurs when a specific operation button is pressed:

1. If all selected beacons are capable of the operation, the operation is performed. A confirmation dialog box may be displayed if the operation makes fundamental changes to beacons.
2. If some selected beacons are capable of the operation and others are not, the operation is performed on those that support the operation. The user is not informed that some of the beacons were not capable. A confirmation dialog box may be displayed if the operation makes fundamental changes to beacons that support the operation.
3. If all selected beacons are NOT capable of the operation, the operation is NOT performed. A dialog box is displayed to explicitly tell the user that nothing happens.
4. If all selected beacons allow telemetry but have their **Skip Telemetry** check box checked, a dialog box is displayed to explicitly tell the user that no telemetry will occur (that is, the change will be a local UI change only).

Beacon Buttons

- **Get All.** This sends commands via telemetry to request all configuration data from all selected beacons to populate appropriate columns across all tabs of the Beacons table.
- **Get Battery.** This requests battery status from all selected beacons and populates the Battery Status column appropriately.
- **Get Link.** This requests ALS link status from all selected beacons and populates the **Beacon RxLink** column appropriately. 'Traffic lights' are shown:

Transceiver RxLink				Beacon RxLink			
XC	SN	DB	IL	XC	SN	DB	IL

Hover the mouse cursor over each LED to reveal a tooltip giving values and last update time, forexample:

Beacon 2005
Interference Level = 25%
Last Updated: 2014/11/28 14:18:23

- **Get Sensors.** This sends commands via telemetry to request all sensor data from all selected beacons and populates the Sensor Data columns appropriately.
- **Beacon Specific.** Clicking on this button launches the **Beacon Specific Properties** dialog box; see *Section 5.1.19*.
- **Set All.** This sets all fields across all tabs to all selected beacons, some of which may require telemetry.
- **Change Groups.** This launches the **Change Groups** dialog box; see *Section 5.1.17*.
- **Release.** If more than one beacon is selected, a dialog box is display to tell the user that only one beacon can be released at a time. If only one beacon is selected, a second release confirmation window is shown:



For beacons that require emergency release, the following window is shown instead:



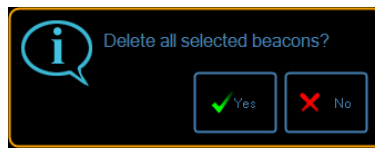
- **Enable.** This enables all selected beacons. The user must confirm the action. The green LED shows the beacon is enabled, the red LED shows that the beacon is disabled  .
- **Disable.** This disables all selected beacons. The user must confirm the action.



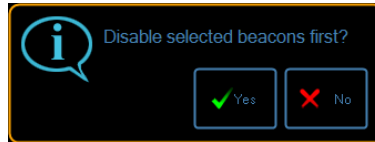
For beacons that require emergency release, the following dialog box is shown instead:



- **Delete.** This deletes all selected beacons from the system setup. A confirmation dialog box is displayed as follows:

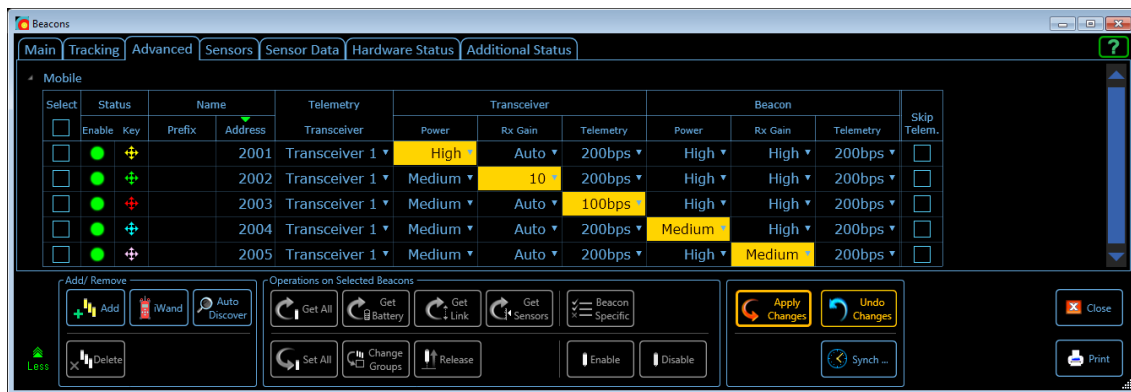


If at least one of the beacons to be deleted supports telemetry, then the following dialog box is shown.



Changing Field Values

If you edit one or more fields in the Beacons table across one or more tabs, the background colour of the edited fields changes to orange and the **Apply Changes** and **Undo Changes** buttons are enabled (see below).



- Click the **Undo Changes** button to revert all modified (orange) fields to their original values. The **Apply Changes** and **Undo Changes** buttons become disabled and all the orange field backgrounds revert to black.
- Click the **Apply Changes** button to apply all modified (orange) fields to their respective beacons. The **Apply Changes** and **Undo Changes** buttons become disabled, the table reflects the changes, and the orange backgrounds revert to black.

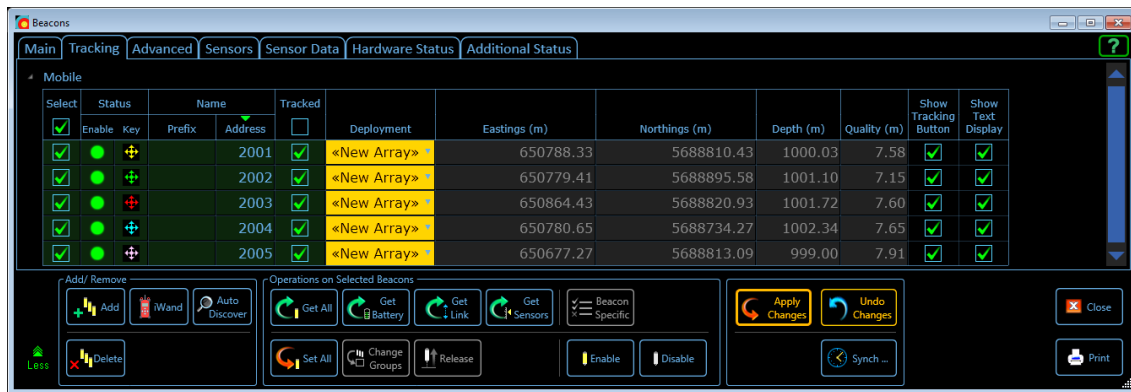
When applying changes, if the **Skip Telemetry** check box is checked for a beacon that is to be updated, then the physical beacon is not updated. Only the software representation of the beacon is changed.

5.1.16 Bulk Changes

The following example explains and shows the bulk change feature. The example assumes we wish to change the Deployment of some Mobile beacons to 'New Array'.

- Select the appropriate beacons by using the check box.
- Change the Deployment of any one of the selected beacons to the desired value (New Array).

All selected beacons change to the new Deployment value as shown below:



3. Click **Apply Changes**.

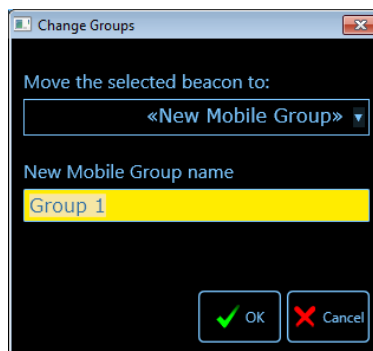
Note



Bulk editing is only available on certain table fields.

5.1.17 Change Groups Dialog Box

Clicking on the Change Groups button launches the Change Groups dialog box as shown below.



If the **Tools>Options>General** dialog box **User Defined Beacon Groups** checkbox is selected, the **Change Groups** dialog box allows selected beacons to be moved from any of the following source groups:

- Mobile
- Existing User Defined Mobile
- Discovered
- iWAND
- Remote Control

to one of the following destination groups:

- Mobile
- Existing User Defined Mobile
- « New Mobile Group»

If the **Tools>Options>General** dialog box **User Defined Beacon Groups** checkbox is not selected, the **Change Groups** dialog box only allows selected beacons to be moved from the following predefined mobile groups:

- Discovered
- iWAND
- Remote Control

back to

- Mobile

If the **Tools>Options>General** dialog box **User Defined Beacon Groups** checkbox is unselected, all User Defined Beacon groups are automatically removed from the job. Any beacons contained within them are automatically moved to the predefined Mobile group. An appropriate popup message will warn that this will happen.

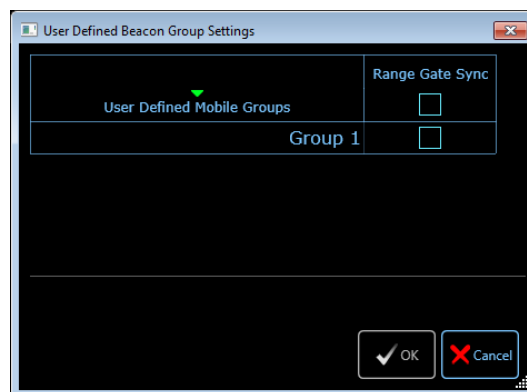
Note

 New user defined mobile group names should be prevented from conflicting with any of the pre-defined group names, existing user defined mobile group names, Mobile, Array or Subsea vehicle names.

Clicking **OK** on the dialog box applies all orange (modified) values; clicking **Cancel** closes the dialog box with no changes being applied.

5.1.18 User Defined Beacon Group Settings Dialog Box

Clicking on the **Group Settings** button launches the **User Defined Beacon Group Settings** dialog box. This shows a table of all currently user-defined mobile groups.



The names of all user-defined mobile groups are editable, and the text changes to orange when modified.

Note

 User defined mobile group names should be prevented from conflicting with any of the pre-defined group names, existing user defined mobile group names, Mobile, Array or Subsea vehicle names.

Each user-defined mobile group row in the table has a checkbox called Range Gate Sync (see above) to allow/disallow all of the beacons contained in the group from sharing the same approximate range gate during tracking. By default the check box is unchecked.

Clicking **OK** on the dialog box applies all orange (modified) fields in the table, clicking **Cancel** closes the dialog box with no changes being applied.

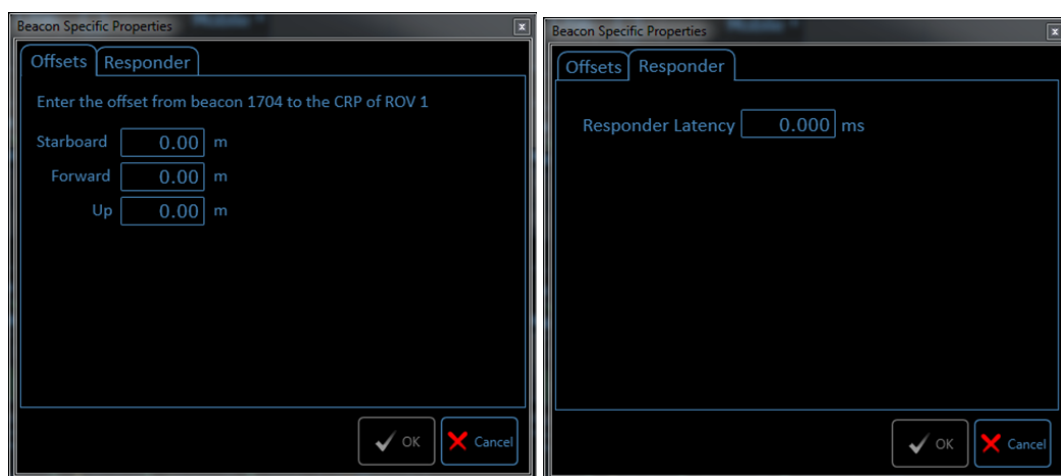
5.1.19 Beacon Specific Properties Dialog Box

Clicking on the **Beacon Specific** button launches the **Beacon Specific Properties** dialog box (shown below) for editing special parameters that are rarely used and very specific to certain types of

beacon. The following beacon types are examples that require this feature:

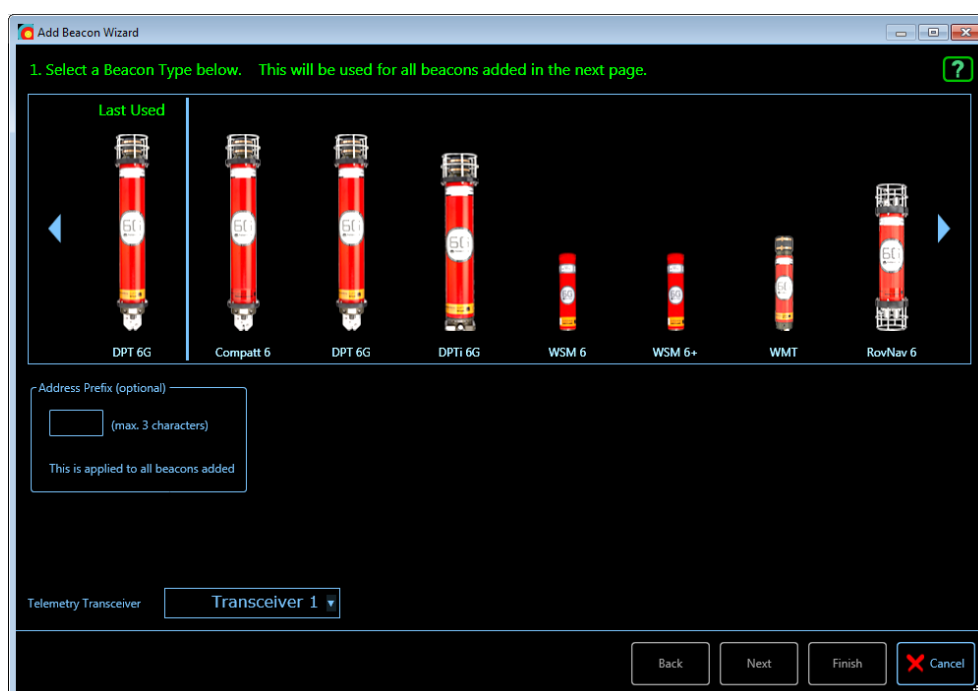
- GyroCompatt (5 & 6).
Requires enable / disable buttons for the Gyro, and also display current status of the Gyro.
- Any beacon attached to a subsea vehicle (e.g. ROV).
Requires Starboard, Forward and Up numeric fields to define the offset of the beacon to the CRP of the vehicle.
- Beacon using Responder Trigger
Requires a numeric field to define Responder latency (ms).

Since a beacon can fall into one or more of the above categories, the dialog box provides tabs for each of the beacon type specific features above. Tabs that do not apply are hidden.



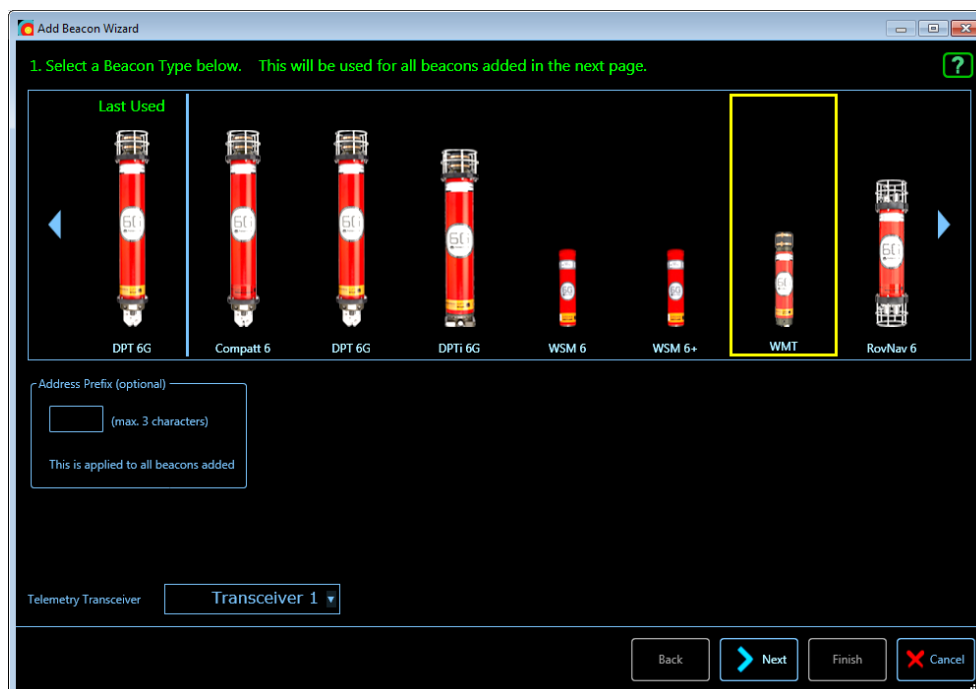
5.2 Add Beacon Wizard

Click the **Add** button on the **Beacons** window to display the **Add Beacon Wizard**. This wizard allows you to add multiple beacons of the same type to the current setup.



The **Cancel** button at bottom right is always enabled. This allows you to cancel the add beacon operation and return to the main **Beacons** window.

5.2.1 Beacon Type



The first window of the wizard, shown above, allows you to select:

- **Beacon Type** - You can scroll the beacon type selector left and right with the mouse, and click on a beacon to select it. Note that the list of beacons available is determined by the settings in the Security Key (dongle).
- **Beacon Address Prefix** is an optional user-defined three-character prefix for naming the beacon. This applies to all beacons added.
- **Telemetry Transceiver** allows the user to choose which telemetry transceiver to use for all beacons being added.

Click **Next** to proceed to the Beacon Address window. The **Next** button is enabled only after you have selected a beacon type.

The **Finish** and **Back** button on the wizard are always disabled on this first window.

5.2.2 Beacon Address



The Beacon Address selection window allows you to choose the beacon address.

Addresses are shown as a table with tabs:

- Each tab presents addresses for a specific address band.
 - WB1 for Sonardyne Wideband 1.
 - WB2 for Sonardyne Wideband 2.
 - WB2+ for Sonardyne Wideband 2+.
 - QuickSet 1 or 2 for Sonardyne Quicksets.
 - HPR for Kongsberg HPR400.
- Depending on the beacon type selected, more than one tab may be accessible because some beacons support multiple band types.
- Pre-existing beacon addresses are permanently highlighted in pink.
- Addresses reserved for pulse position mode of pre-existing beacons are permanently highlighted in light brown as shown in the example above. One extra cell is used for pulse-position depth; two extra cells are used for pulse-position angle.
- Select new beacon addresses within the active tab by clicking on the address cells of the beacons you wish to add. The cell changes to green when selected.
- Clicking on a selected (green) cell deselects it.
- Certain address ranges are not recommended for new jobs (1701...1714, 1801...1814, 1901...1914 and 3101...3114). These address cells are shown with a dark red background with an appropriate key that warns the user of their use.

Final beacon settings are carried out within the Beacons Table and using the Beacon Specific Properties dialog box.

It is not possible to select pre-existing address cells (beacon addresses or pulse position mode cells). If the tab is changed and new cells are selected, the selected cells on the previous tab become deselected.

Three radio buttons are provided at the bottom of the window to specify what should happen after the beacons are created:

1. **Get None** – Don't do any telemetry to the beacon after creation.

On returning to the Beacons Table, all fields will show normal colour (not amber).

2. **Get Beacon Identity** (default selection) – If the beacon supports telemetry, obtain the identity of the beacon after creation.
 - a. For Sonardyne 6G beacons the transceiver sends an FS command (and possibly a SUB command) to the physical beacon.
 - b. For Sonardyne 5G beacons this results in a TS command being sent.
 - c. All fields that have not been updated by the above commands show a User Modified state (AMBER).
 3. **Get All Beacon Parameters** – If the beacon supports telemetry, retrieve all beacon parameters from the physical beacon and update all relevant fields in the table.
 - a. For Sonardyne 6G this results in FS, VS, CS commands being sent.
 - b. For Sonardyne 5G this results in TS command being sent.
 - c. All fields are updated in the table, so all cells for the created beacons should be in normal state (not AMBER).
- The **Clear** button clears all selected cells.
 - The **Back** button on the wizard is always enabled, so you can go back to the previous window and edit its contents.
 - When the **Finish** button is clicked, the beacon(s) is created according to the settings provided, and the Wizard closes.

Refer to the Frequency Chart (see *Figure 5–1*) for guidance on optimising USBL accuracy vs. range and avoidance of other acoustic systems operating in the vicinity.

Copyright © 2015 Sonardyne International Ltd



5.3 Optimum Choice of Wideband Signals for USBL

5.3.1 Overview

In Sonardyne Wideband systems, the carrier frequency of coded reply signals is linked to the beacon address. Choosing the most appropriate address to use for USBL tracking is always a compromise between competing factors. The most important factor is to ensure that there is good signal compared to the noise (SNR), but the frequency of the Wideband carrier is also important to get the best performance. In general, higher frequencies provide both better precision, and accuracy; however, higher frequencies also suffer greater absorption, and therefore reduced SNR.

5.3.2 Wideband Choices

Wideband2 signals, which are available in all 6G instruments, should be used unless there are specific operating circumstances that require another option. In situations where there is likely to be significant reverberation, high noise or at extremely long range, then Wideband2+ may be useful (Wideband2+ signals have twice the duration of a Wideband2 signal, and so use twice the battery power).

Wideband1 signals should only be used when working with 5G systems. When adding a new beacon in Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP the address selector lays out beacon addresses that use the same carrier frequency in columns.

A range of addresses at the top and bottom of the band that are not generally recommended for use are shaded in red below.

WB1 WB2 WB2+

Wideband 2 is the default for 6th Generation (6G) instruments

1701	1801	1901	2001	2101	2201	2301	2401	2501	2601	2701	2801	2901	3001	3101
1702	1802	1902	2002	2102	2202	2302	2402	2502	2602	2702	2802	2902	3002	3102
1703	1803	1903	2003	2103	2203	2303	2403	2503	2603	2703	2803	2903	3003	3103
1704	1804	1904	2004	2104	2204	2304	2404	2504	2604	2704	2804	2904	3004	3104
1705	1805	1905	2005	2105	2205	2305	2405	2505	2605	2705	2805	2905	3005	3105
1706	1806	1906	2006	2106	2206	2306	2406	2506	2606	2706	2806	2906	3006	3106
1707	1807	1907	2007	2107	2207	2307	2407	2507	2607	2707	2807	2907	3007	3107
1708	1808	1908	2008	2108	2208	2308	2408	2508	2608	2708	2808	2908	3008	3108
1709	1809	1909	2009	2109	2209	2309	2409	2509	2609	2709	2809	2909	3009	3109
1710	1810	1910	2010	2110	2210	2310	2410	2510	2610	2710	2810	2910	3010	3110
1711	1811	1911	2011	2111	2211	2311	2411	2511	2611	2711	2811	2911	3011	3111
1712	1812	1912	2012	2112	2212	2312	2412	2512	2612	2712	2812	2912	3012	3112
1713	1813	1913	2013	2113	2213	2313	2413	2513	2613	2713	2813	2913	3013	3113
1714	1814	1914	2014	2114	2214	2314	2414	2514	2614	2714	2814	2914	3014	3114

← Longer Range High Elev. USBL → USBL → (33kHz)

Key: Already in use
 Reserved for Pulse Position Mode
 Addresses not recommended

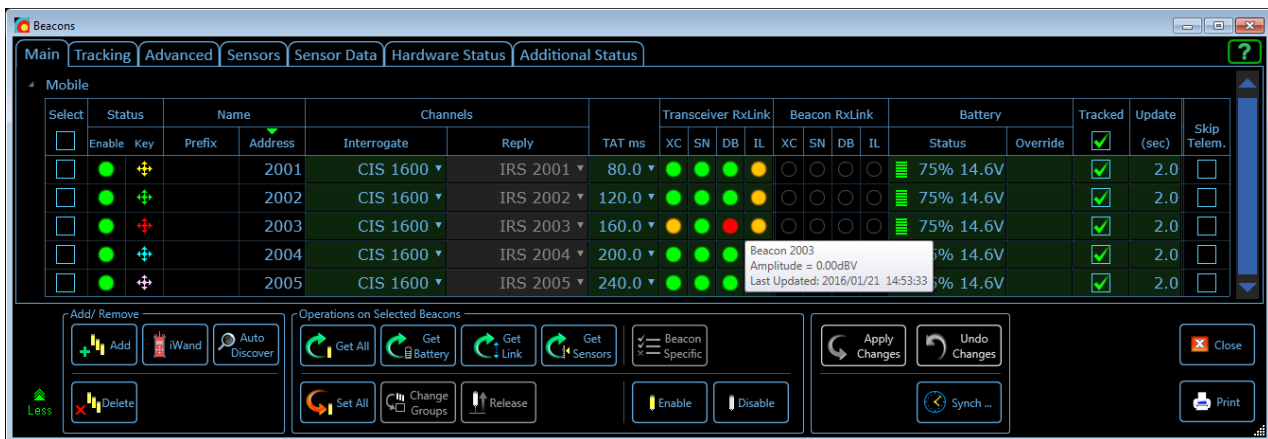
5.3.3 Address Choices

It can be difficult to predict what the SNR is going to be before deploying a beacon, and currently Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP does not provide an automatic way to reconfigure a beacon's address after it has been deployed, and so it is sometimes necessary to select an address that will give best performance based on the application, and the expected operating depth. As a general rule, high elevation tracking applications (such as towfish tracking) ought to use addresses in the range 20xx-24xx, and USBL applications tracking beacons mostly below the vessel should aim to use addresses between 27xx and 30xx. Omni-directional beacons should provide sufficient signal level to use Wideband address families with higher frequency carriers to operating depths of 1500 m or more, and directional beacons track up to 2500 m. If the expected operating depth is more than these limits, then lower address families may give better SNR. Refer to individual beacon operating manual for instructions on how to change the address.

5.3.4 Diagnostics

The Beacons Table in Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP provides useful received signal diagnostic ‘traffic light’ indicators from the transceiver on every update, and from the beacon on request (select the check box on the left of a row, and click **Get Link**). The traffic light indicators include the amplitude (DB), and SNR (SN) of signals being received from each beacon. Green is good, amber is okay, but red indicates that performance may be difficult. By hovering the cursor over the traffic light indicators, a readout popup shows the current levels (see below).

Assuming that the received signal level is not saturating the USBL transceiver’s receiver (check DB light is not red), SNR can be improved by increasing the output power of the beacon. If the transceiver’s DB light is red, which indicates that the receiver is being saturated, check the transceiver gain, and consider reducing it to avoid saturation. It is possible to tune the transceiver power, and beacon gain in the same way – adjust beacon gain and transceiver output power so that the DB light is not red, and the SNR is good.



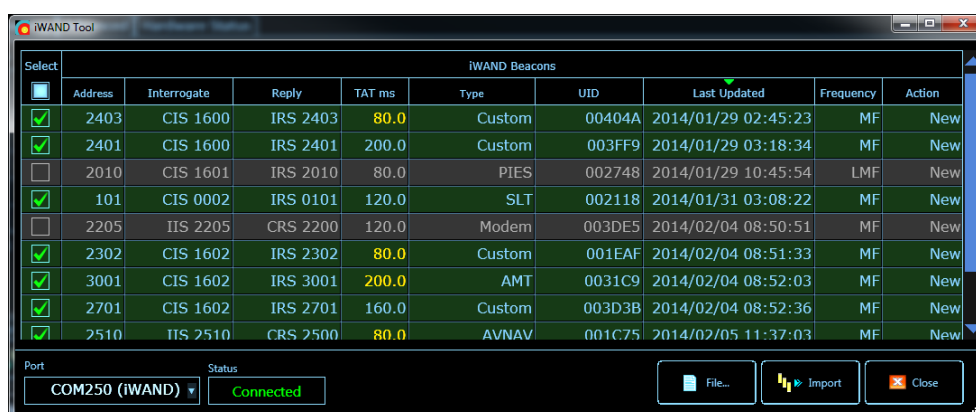
5.4 iWAND Tool

Clicking the **iWAND** button on the **Beacons** window launches the **iWAND Tool** as shown below. This tool allows multiple beacon data to be imported into the current setup.



If no iWAND is connected the **Port status** field shows **Connecting**.

When an iWAND is connected through RS232 or USB to the Navigation Computer, the **Port** field automatically updates, and after a short time shows the status **Connected**. The available beacons for import are listed in the table, for example as shown below.



If there are conflicting beacon addresses or TATs in the imported data, a warning message is shown:

If there are conflicting beacon Addresses in the imported data, the relevant row(s) are enabled but the **Select** check box is only checked for one of the conflicting addresses (see **2101** below). The remaining conflicting addresses are highlighted in red. A tooltip indicates the problem if the mouse cursor is hovered over it.



If there are conflicting TATs in the imported data, the relevant rows(s) are enabled. The conflicting TAT is highlighted in orange (see below). A tooltip indicates the problem if the mouse cursor is hovered over the relevant row.



Beacons that are not supported, or are not enabled in the Security Key (dongle), are disabled (greyed out) in the table as shown above. It is not possible to Select these beacons for import.

All other supported, non-conflicting beacons have their **Select** check box automatically checked as shown above. You can use the **Select** column to check/uncheck beacons for import.

You can click on the header area of any column to sort the whole table by the data in that column. The sorted column is indicated by a green chevron in the column header. Clicking on the green chevron toggles the sort order.

Clicking the **Import** button imports all beacons that have their **Select** field checked. The **iWAND Tool** closes and the **Beacons** window updates with the new beacons that have been imported.

When a beacon is created by using iWAND Import, only key beacon settings are specified by the iWAND. The rest are defined by system defaults. Specifically, the telemetry transceiver defaults to the first available 6G transceiver that is in the setup.

Clicking the **File** button launches a dialog box that allows you to select an iWAND data file (XML). When this is done, data from the file appears in the table in exactly the same way as if it came from the iWAND itself (see previous figures).

Click the **Close** button at any time closes the **iWAND Tool** and returns control to the **Beacons** window.

The prefix for all imported iWAND beacons in the Beacons Window defaults to:

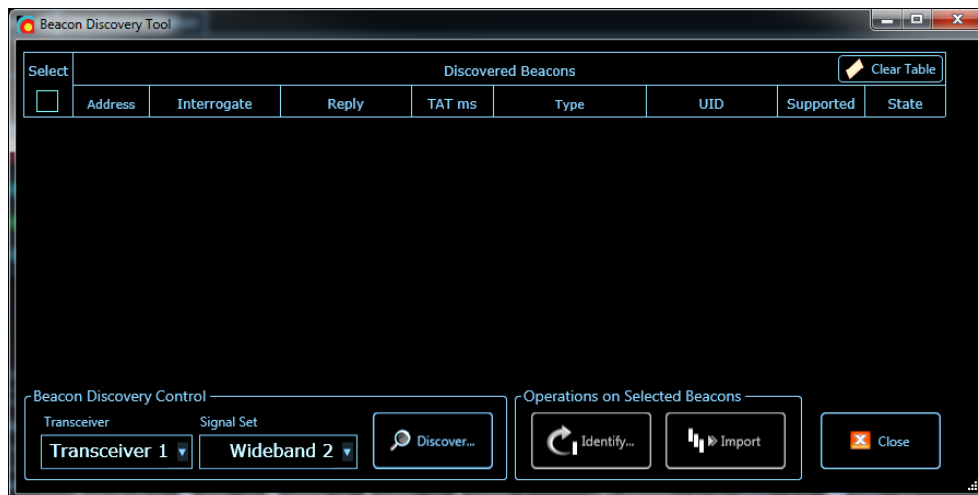
iW.

You can edit this prefix if necessary.

5.5 Beacon Discovery Tool

Clicking on the **Auto Discover** button on the **Beacons** window launches the **Beacon Discovery Tool** window. This allows the acoustic discovery of any Sonardyne 6G beacon within the current Environmental Operating Range of a selected transceiver.

On launch, all controls are enabled (buttons/ combo boxes, and so on), except for the **Identify** and **Import** buttons.



Click **Transceiver** and select the preferred transceiver to use for the discovery. Only 6G transceivers are listed, and the first available one is automatically selected as default.

Click on the **Signal Set** control and choose the -Sonardyne signal set to use when discovering beacons. The default signal set is Wideband 2.

The workflow order is:

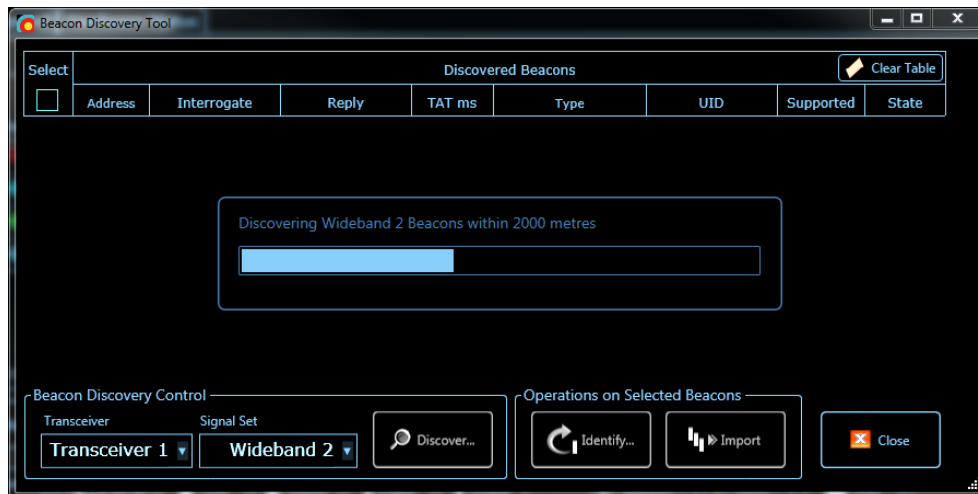
1. Discover the beacon(s).
2. Identify the beacon(s).
3. Import the beacon(s) to the setup.

These are described in detail in the next sections.

Clicking the **Close** button when the tool is not busy performing a Discover or Identify operation causes the window to close. Control is then returned to the **Beacons** window.

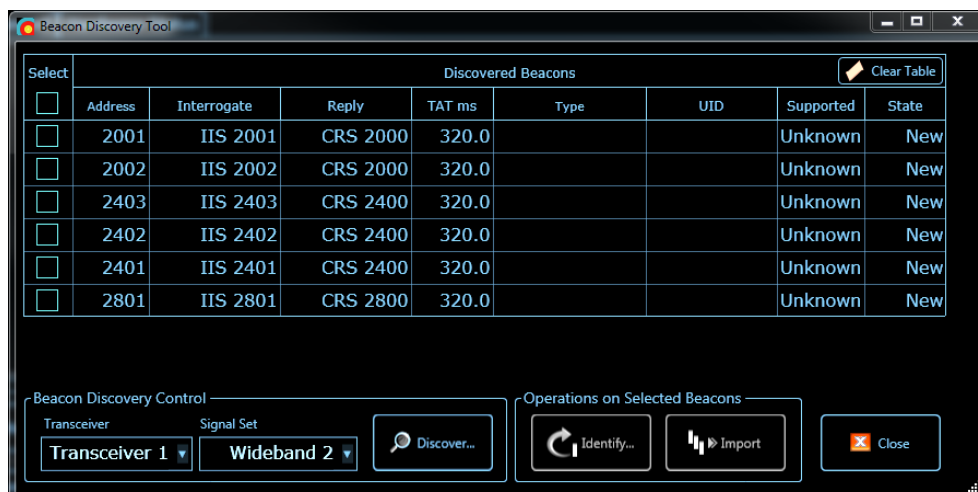
5.5.1 Beacon Discovery Operation

Click **Discover** to start the beacon discovery process using the selected transceiver and the selected signal set. A dialog box shows a progress bar and **Cancel** button (see below). The discovery process uses the **Max Operating Range** value as defined in the Environmental settings.



When the beacon discovery progress bar reaches the end, the progress window closes, and the **Discovered Beacons** table updates with all 6G beacons discovered during that cycle (see below).

Repeated clicking of the **Discover** button merges any newly found beacons with results of those discovered on previous tries. That is, discovery is cumulative over successive discovery cycles.



Newly discovered beacons that already exist in the setup are shown as completely greyed out rows in the table (see above). Additionally:

- The **Select** field is disabled. No operations can be performed on existing beacons.
- The **Address** field is the discovered address.
- The **State** field shows **Exists**.
- The Supported field shows **Yes**.
- All other fields are filled in (as in the main **Beacons** window).

Newly discovered beacons that do not yet exist in the setup are shown with the row not greyed out (see above). Additionally:

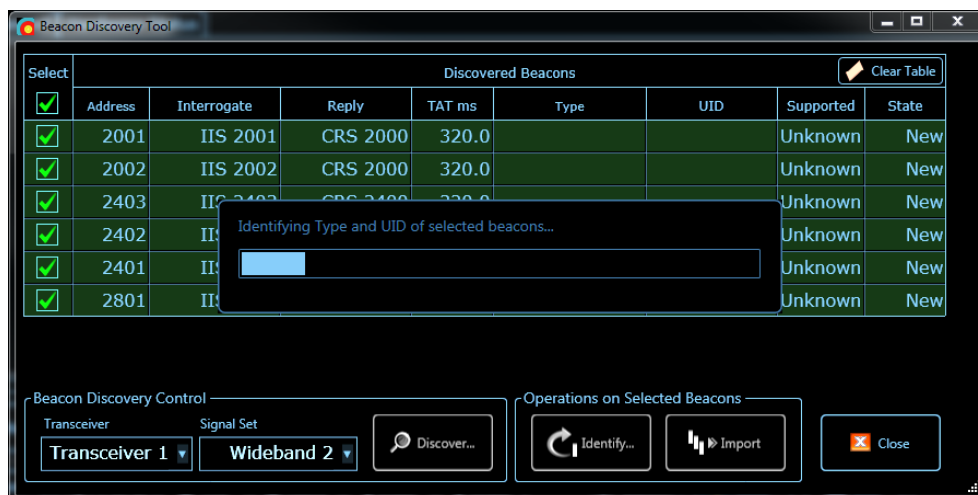
- The **Select** field is enabled, so that Identify and Import operations can be performed.
- The **Address** field is the discovered address.
- The **State** field shows **New**.
- The **Supported** field shows **Unknown**.
- The **Interrogate*** field shows an IIS signal for the discovered address.
- The **Reply*** field shows a CRS signal for the discovered address.
- The **TAT ms*** field shows 320 because of the IIS
- The **Type** field is empty at this stage
- The **UID** field is empty at this stage

* The **Interrogate**, **Reply**, and **TAT ms** fields default to IIS/CRS values to avoid the need to send any telemetry to the beacons in order to start tracking immediately.

Clicking the **Clear Table** button clears all data from the **Discovered Beacons** table.

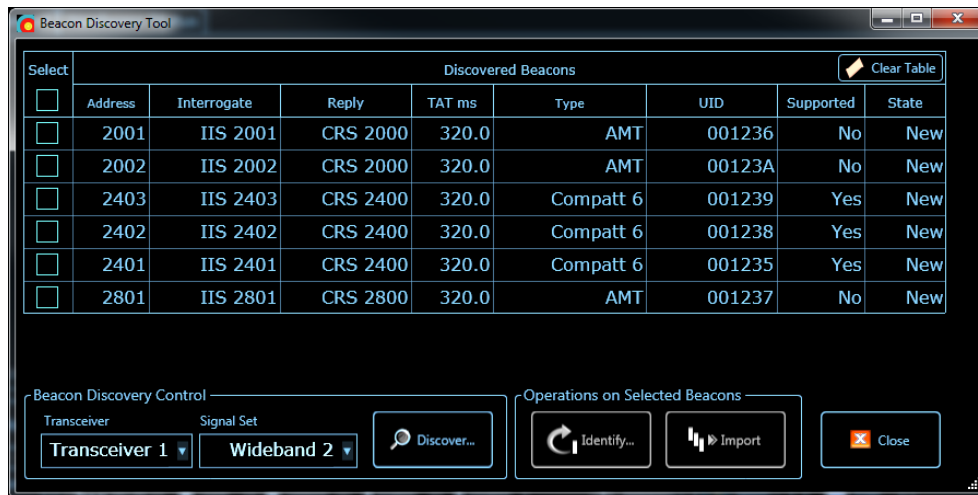
5.5.2 Beacon Identification.

You may optionally select specific beacons, and click the **Identify** button. A dialog box shows a progress bar and **Cancel** button (see below). This causes an FS telemetry command to be sent sequentially to each selected beacon that has a current Supported status of Unknown. Note that if the Supported status is Yes/No, then it implies that the beacon has already been identified (no need to repeat). The reply from the FS is used to update the Type and UID columns of the respective beacons in table.



When the progress bar reaches the end, the progress dialog box closes and the **Discovered Beacons** table updates with the **Type** and **UID** fields filled in for all beacons that were selected. The **Supported** field updates to:

1. **Yes** if the beacon is supported (as shown below).
2. **No** if it is not supported (as shown below).



If an error occurs in identifying any beacon, the **Type** and **UID** fields remain blank, and the **Supported** field remain **Unknown**.

5.5.3 Beacon Import

Beacon import is possible on any selected beacon in the **Discovered Beacons** table, regardless of whether or not the **Identify** process has been done.

Note



Beacons whose State is set to Exists, are not selectable, and so are not importable.

Certain assumptions are made when importing a beacon, depending on whether **Identify** has been performed and whether the identified beacon is **Supported** by the application. These are as follows:

- If the **Identify** process has not been performed on a beacon, then it is always imported as a generic **Compatt6**. A warning message is displayed to indicate this.
- If the **Identify** process has been performed on a beacon, but its type is not supported, then it is always be imported as a generic **Compatt6**. A warning message is displayed to indicate this.
- If the **Identify** process has been performed on a beacon, and its type is supported, then it is always imported as the type indicated without any message to the user.
- If a mixture of **Identified** / **Non-Identified** / **Supported** / **Unsupported** beacons are selected for import, a message is displayed to indicate that at least one beacon will be imported as a **Compatt6** for the appropriate reason.

After the Import has completed, the **Beacon Discovery Tool** window closes and the imported beacons are shown in the **Mobiles** section of the **Beacons** window.

The prefix for all discovered beacons in the **Beacons** window defaults to the special:

D character.

You can edit this subsequently if necessary.

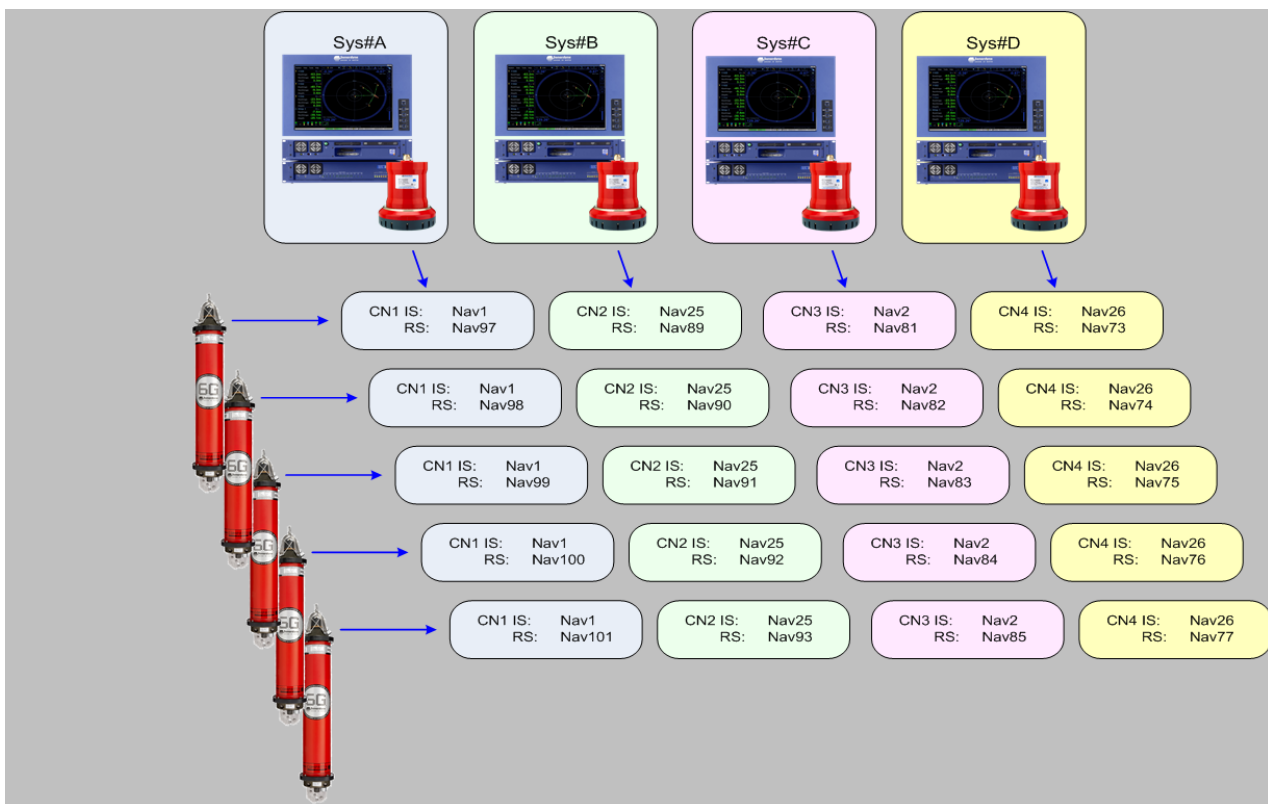
All imported beacons have their Skip Telemetry check box unchecked in the **Beacons** window.

5.6 Multi-User Shared Arrays and Advanced Navigation Setup

5.6.1 Overview

Normally, beacons can be shared between multiple LUSBL or LUSBL aided DP-INS systems using timing windows to interleave interrogations. 6G Multi-User mode adds the ability to separate the operation of the systems in signal space, thus reducing the need for accurate timing, and removing the possibility of one system detecting the reply signals from the other.

Each 6G Compatt in an LUSBL array can support up to 4 independent connections in addition to its normal individual (IIS) and common (CIS) interrogation modes. These connections can be visualised as 'virtual beacons' that can be assigned to independent systems, and can be interrogated asynchronously to each other. The systems can be installed on one or more vessels. Each system uses its own unique interrogation and reply signals to avoid interference.

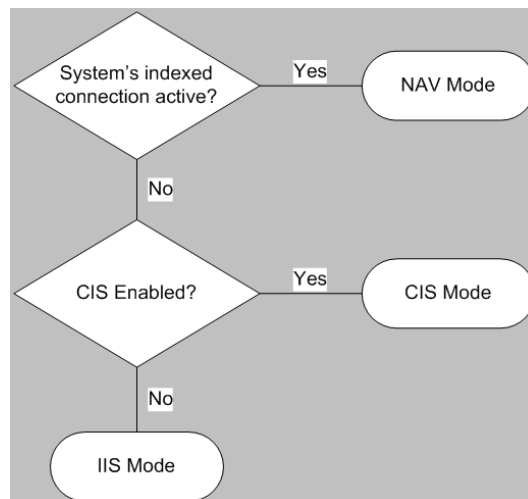


Note

 Multi-User mode has to be enabled in the 6G Compatt and the Security Key (dongle). It is not available in previous generation beacons.

Adding and configuring 6G Multi-User beacons is largely unchanged for the user. The 6G multi-user mode uses a set of WB2 and WB2+ NAV signals (called NAV WB2 and NAV WB2+) for acoustic interrogation and replies, and these work in the same way that the system already deals with IIS and CIS beacon modes.

When requesting a beacon's status, the decision about which mode the system defaults to is as follows:



Note



A 6G Compatt's CIS channel is still a available even while the NAV channels are active.

Wideband 2

For Wideband 2, the list of interrogation signals in NAV mode is:

- NAV1
- NAV25
- NAV2
- NAV26
- NAV3
- NAV27
- NAV4
- NAV28
- Advanced

If the user chooses Wideband2 signals, then the choice of reply signals is also Wideband2. The indices in the first row of the table below are the default interrogation signals. The default choice of reply signals are the set of signals in the same column as the selected interrogation signal.

LO			HI		28	4	27	3	26	2	25	1
1	9	17	25	33	41	49	57	65	73	81	89	97
2	10	18	26	34	42	50	58	66	74	82	90	98
3	11	19	27	35	43	51	59	67	75	83	91	99
4	12	20	28	36	44	52	60	68	76	84	92	100
5	13	21	29	37	45	53	61	69	77	85	93	101
6	14	22	30	38	46	54	62	70	78	86	94	102
7	15	23	31	39	47	55	63	71	79	87	95	103
8	16	24	32	40	48	56	64	72	80	88	96	104

Wideband 2+

For Wideband 2+, the list of interrogation signals in NAV mode is:

- NAV129
- NAV153
- NAV130
- NAV154
- NAV131
- NAV155
- NAV132
- NAV156
- Advanced

If the user chooses Wideband2+ signals, then the choice of reply signals is also Wideband2+. The indices in the first row of the table are the default interrogation signals. The default choice of reply signals is the set of signals in the same column as the selected interrogation signal.

				156	132	155	131	154	130	153	129	
129	137	145	153	161	169	177	185	193	201	209	217	225
130	138	146	154	162	170	178	186	194	202	210	218	226
131	139	147	155	163	171	179	187	195	203	211	219	227
132	140	148	156	164	172	180	188	196	204	212	220	228
133	141	149	157	165	173	181	189	197	205	213	221	229
134	142	150	158	166	174	182	190	198	206	214	222	230
135	143	151	159	167	175	183	191	199	207	215	223	231
136	144	152	160	168	176	184	192	200	208	216	224	232

Note

 **Wideband 2+ are double length signals and hence use twice the battery power. Wideband2+ should be reserved for special applications, particularly reverberant environments.**

Each system is manually configured with a connection index that is unique to that system. This is the index of the connection that this system uses in all shared multi-user beacons. The index is set-up at commissioning time, and is clearly visible in the status bar at the bottom of the main UI.



The system supports creating, editing and deleting the connection that is allocated to it, but cannot interfere with any other system's connection (but the system does not block manual commands, or commands from the PAN port that modify connections).

The system supports:

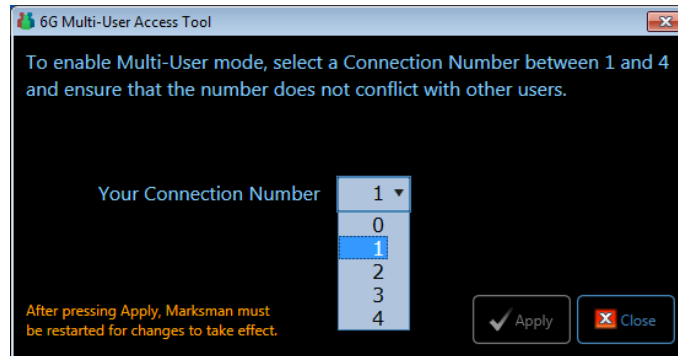
- Configuration of the subscription connections on deck via iWAND.
- Getting the current status of the beacons acoustically.
- Setting up the connections acoustically.

5.6.2 Shared Array/Multi-User Setup

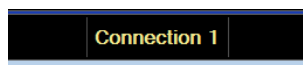
First time Connection

Each system using a shared array of multi-user 6G Compatt beacons needs a unique connection number to be setup.

1. From the Windows **Start** menu, run the **6G Multi-User Access Tool**.



2. Select the next free number in the range 1-4 from the **Your Connection Number** drop-down list. This is used to access the allocated connection on all shared multi-user 6G Compatts.
3. Click **Apply** and then **Close** to complete the connection setup.
4. Start the Marksman/Ranger 2 system software – the assigned connection number appears in the status bar at the bottom of the userinterface.



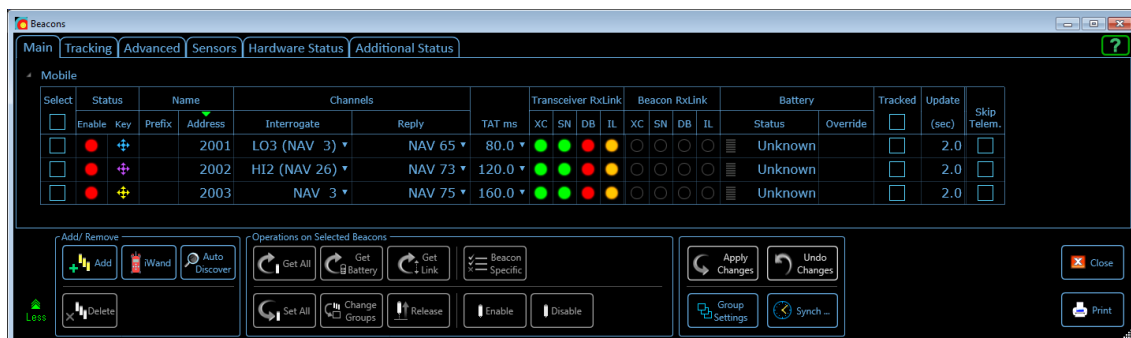
Adding and Configuring Multi-User Beacons

Refer to *Section 5.2 "Add Beacon Wizard "* to add the Compatts.

5.6.3 Advanced Navigation Mode Setup

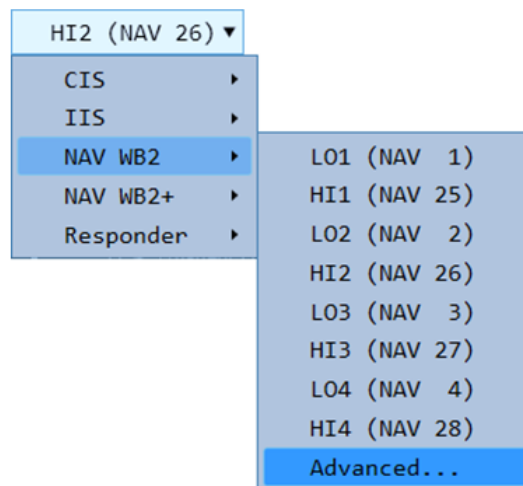
Sonardyne 6G Compatt beacons can support a multi-user mode where a single beacon can operate in up to 4 different systems. Alternatively, the 4 connections on a Compatt 6 can be configured for more complex operations in Advanced mode, where the user is free to choose the Interrogate and Reply signals from the full set of available Navigation signals.

In the following example assume that 3 beacons have been added to the job, all of which use multi-user (NAV) interrogate/reply channels, as shown below.

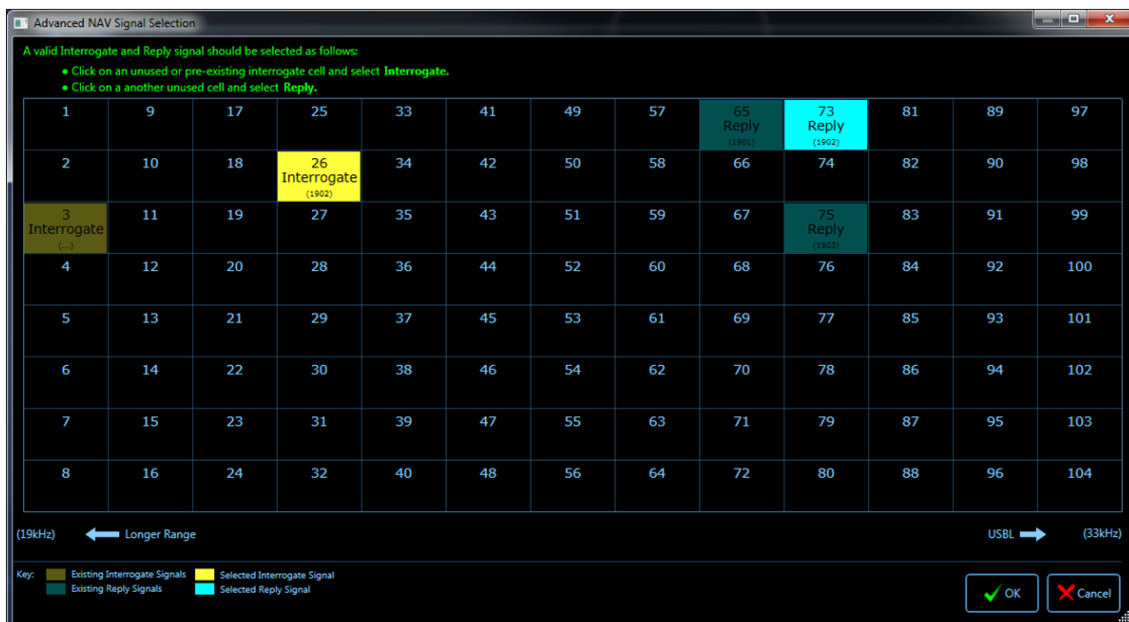


Wideband 2

Click **HI2 (NAV 26)** and select **Advanced**:



The **Advanced NAV Signal Selection** dialog box opens in Wideband 2 mode, as shown below:



The grid shows all NAV signal numbers for Wideband2 [1... 104] in the row/column order as laid out above.

The grid shows existing beacon NAV Interrogate signal cells coloured dark yellow. The word **Interrogate** together with the beacon address using that signal are also shown in the cell. If more than one beacon is using an existing interrogate cell, the beacon address is shown as: “...” in the cell.

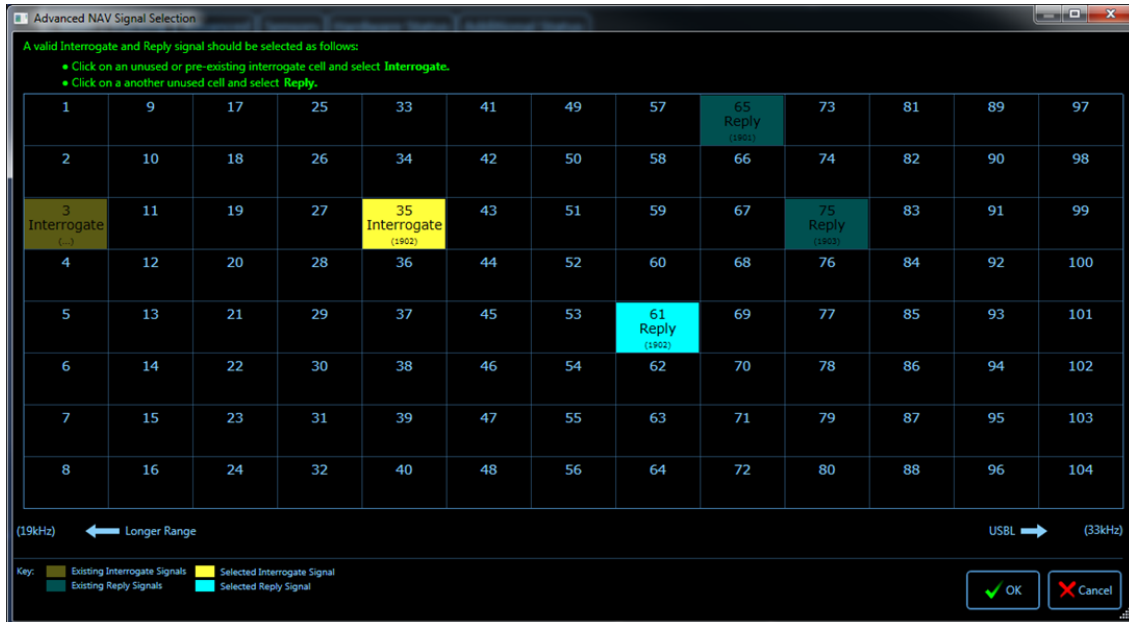
The grid shows existing beacon NAV Reply signal cells coloured dark cyan. The word **Reply** together with the beacon address using that signal is also be shown in the cell.

The grid shows the current beacon’s selected NAV interrogate signal coloured bright yellow. If the current beacon is not using any Wideband 2 NAV signals, then the grid does not show any bright yellow cell. The word Interrogate together with the beacon Address using that signal is also shown in the cell. If more than one beacon is using an existing interrogate cell, the beacon address is shown as: “...” in the cell.

The grid shows the current beacon’s selected NAV reply signal coloured bright cyan. If the current beacon is not using any Wideband 2 NAV signals, then the grid does not show any bright cyan cell. The word **Reply** together with the beacon address using that signal is also shown in the cell.

A NAV Interrogate signal can be selected by clicking on any pre-existing OR unused cell and selecting Interrogate from the drop-down list.

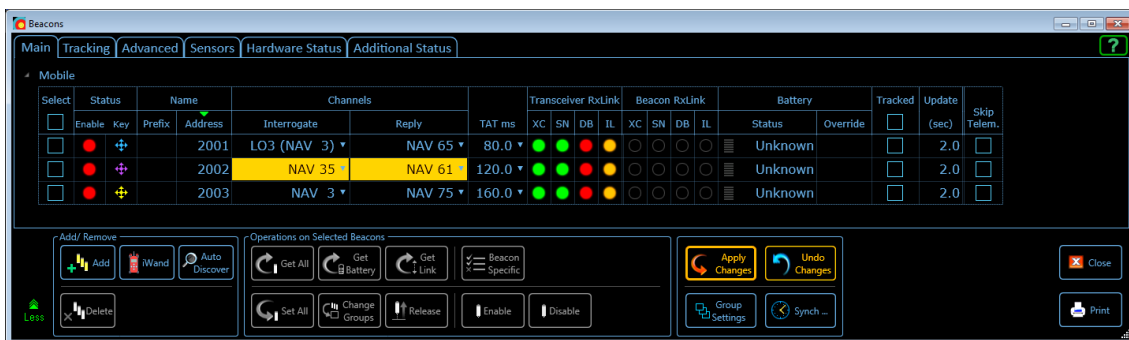
A NAV Reply signal can be selected by clicking on any unused cell and selecting **Reply** from the drop-down list. Existing Reply signal numbers can not be used.



The **Cancel** button is always enabled. Clicking **Cancel** closes the dialog and returns control to the Beacons Table, without any changes being made.

The **OK** button is only enabled if both an **Interrogate** (bright yellow) and **Reply** (bright cyan) have been selected.

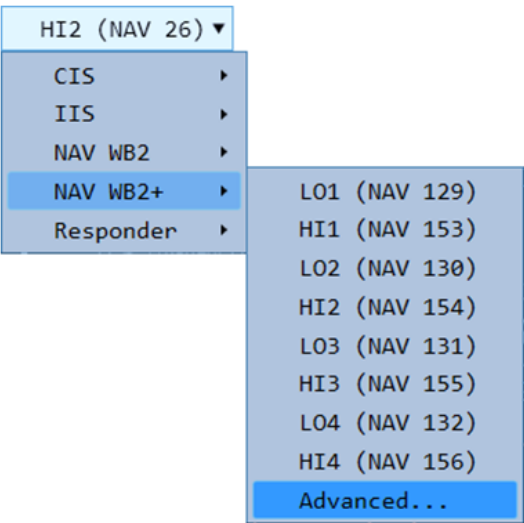
Clicking **OK** closes the dialog box and returns control to the Beacons Table, with the Interrogate and Reply boxes changing to amber colour according to the selections made in the advanced dialog box. See the following examples.



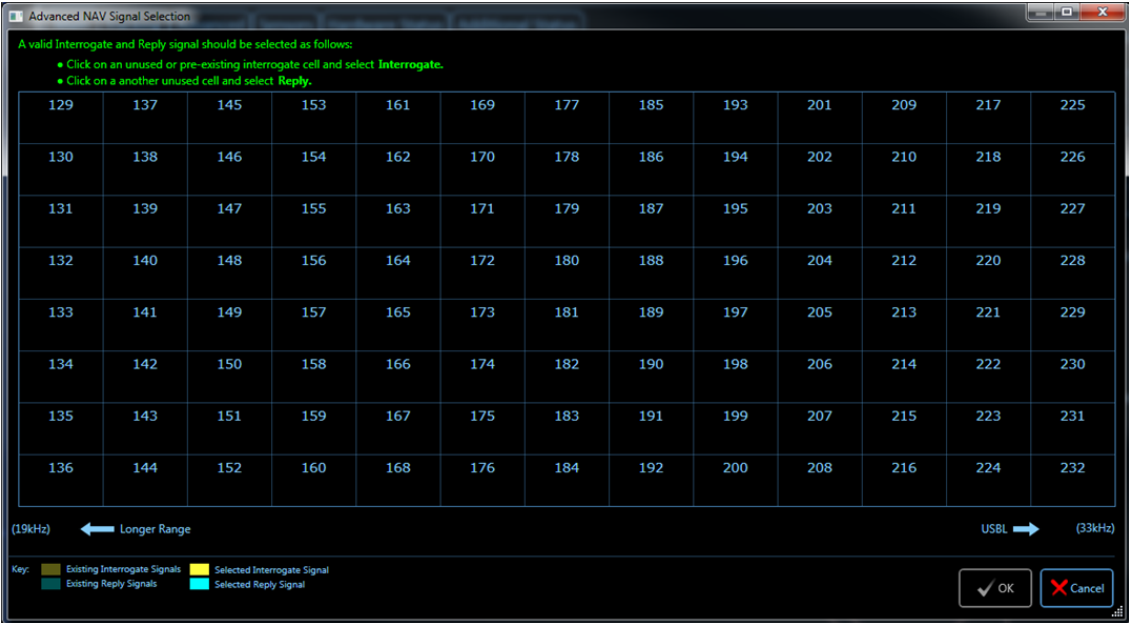
Clicking the amber **Apply** button confirms the changes to the beacon.

Wideband 2+

Click **H12 (NAV 26)** and select **Advanced**:



The **Advanced NAV Signal Selection** dialog box opens in Wideband 2 mode, as shown below:



The grid shows all NAV signal numbers for Wideband 2+ [129...232] in the row/column order.

Section 6 – Application Procedures

6.1 Introduction

This chapter includes a series of procedures for performing common acoustic positioning tasks with the system. Each procedure in this chapter includes the instructions you need to set up the system and to perform the specific procedure.

Note

 **There are certain set-up tasks that are common to many of the procedures included in this chapter. Section 4 "Common Procedures" explains and describes these common set-up tasks.**

The software is able to manage communications between multiple transceivers and multiple target objects. This gives much improved operational flexibility when the system is being used in a complex configuration. Some of the procedures described in this chapter take advantage of this flexibility.

For simplicity, the descriptions in this chapter are limited to include only the information needed to perform each procedure. If you require more information about the software dialog boxes, see *Appendix A "User Interface Description"*.

6.1.1 Before you begin

All the procedures in this chapter assume that:

- the system has been installed correctly
- you are starting each of these applications with a new setup that contains no targets or Instruments
- you have made a written record of the addresses for each of the beacons to be used in the setup, and
- you have arrived on station and deployed all the transceivers, transponders, and targets required for the application.
- The alignment of **each** USBL transceiver has been properly calibrated to the attitude and heading sensors (see *Appendix J "CASIUS Data Collection Methods"* or calibration checks).

If any of these prerequisites is not true, resolve it now.

All these procedures also assume that the system operator is familiar with the rules and methods for selecting menu items, moving the cursor around the dialogs and using the fields and controls on those dialogs.

Switch on the system and wait until the main screen is displayed.

Note

 **Depending on the way your Navigation Computer has been configured and which software version you are running, the software may appear slightly different when you use it. However, the controls will function as described in this manual.**

6.2 USBL Mobile Beacon Tracking

6.2.1 Application Summary

In this scenario a USBL system is required simply to report the position of a mobile transponder (typically installed on an ROV). Position is reported in terms of eastings, northings and depth with respect to the vessel datum. If GNSS position and gyrocompass heading reports are available to the

system, the positions of both the vessel datum and of the mobile transponder are reported in absolute co-ordinates.

The output can be made available to a dynamic positioning system and to a survey package.

There are two types of beacon available in the system:

- **Transponder** — the mobile beacon is completely remote. It is interrogated acoustically and replies acoustically.
- **Responder** — the beacon is triggered by an electronic interrogation through a hard-wired link or umbilical, and replies acoustically.

6.2.2 Navigation Set-up

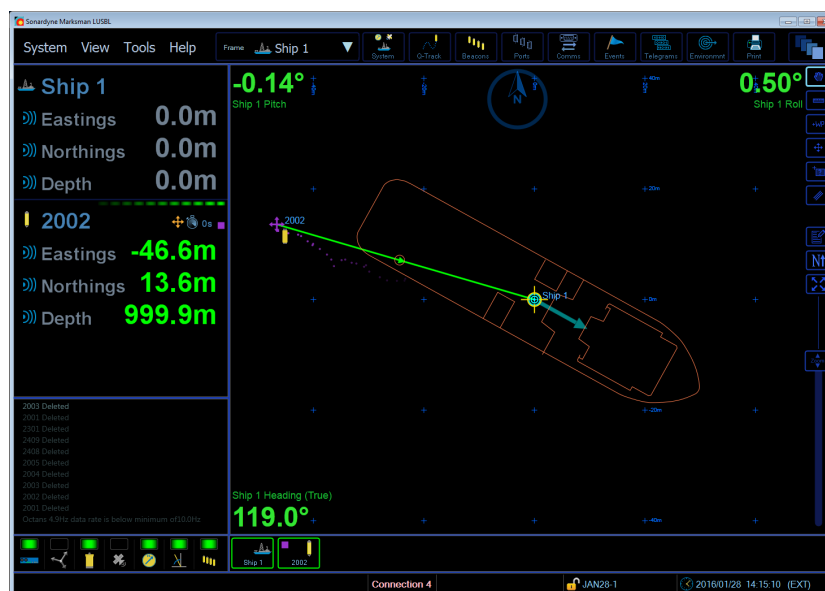
If a template exists, use it to create the setup.

If there is no template, select **System > Setup** to display the **System Setup** window and refer to *Section 4 "Common Procedures"* to add the instruments used in the setup.

6.2.3 Navigate

Select the main screen and follow the callout instructions below.

1. Select the Ship frame for vessel-relative tracking.
2. Enable the Instruments on the ship for use in tracking.
3. Click to enable beacon tracking.
4. Wait for a short time while a series of measurement cycles complete and the vessel and beacon positions are displayed. In this example the system has no GNSS input and shows the beacon position relative to the vessel.



Note

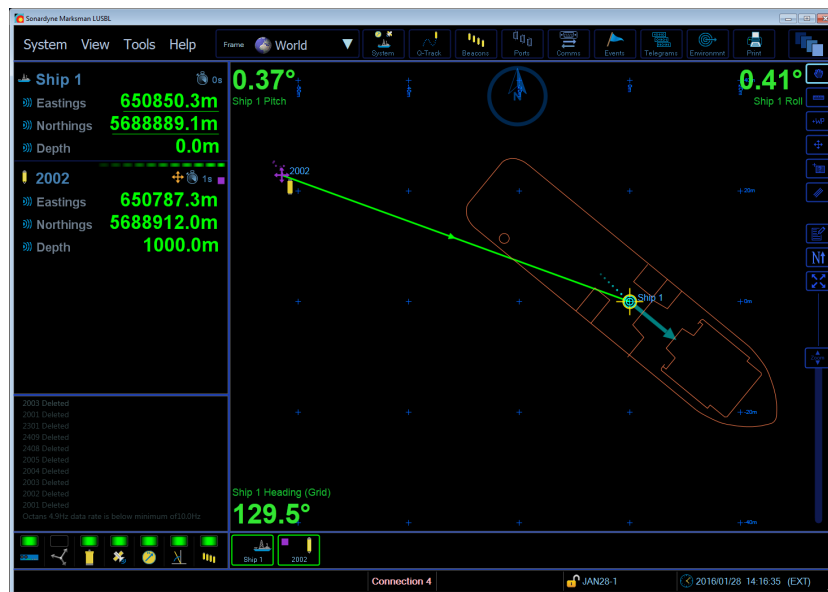
The intermittent radial line from the vessel to the beacon that represents the measurement cycle is green when range measurements are successful, and red when range measurements are in error. Also note that the position information shown is in green figures when the measurements are fresh, but decay towards orange figures if the measurements are not updated.

Refer to the description of the main window in *Appendix A "User Interface Description"* to set the options for north/bow up, centring or pinning an object on the chart, measuring distances on the chart, zooming the chart, and switching between day and night mode.

6.2.4 GNSS Input

The example shown above uses input from a gyrocompass but not from a GNSS system, and provides only basic tracking information for the beacon relative to the vessel's datum. You can add a GNSS Instrument to the setup to provide more detailed position reports.

When the system receives input from a GNSS receiver, the display shows the vessel and beacon positions using real-world co-ordinates, for example in the following screen the frame is set to World.



In this operating mode, the tracked targets show a 'snail trail' to indicate a history of the target position over the previous 16 updates. This trail fades with time so that the display does not become cluttered.

6.3 ROV Tracking

6.3.1 Application Summary

You can use the system to position an ROV with respect to the vessel.

When tracking an ROV it is important to consider the following carefully:

- Where is the beacon positioned on the vehicle, and how is it configured?
- The beacon needs to be positioned such that it has a clear line of sight to the USBL so that the signals do not become shielded when the ROV manoeuvres.
- It is common for ROVs to produce noise that can prevent a beacon from being interrogated as a transponder. To avoid this being a problem, it is recommended to configure beacons on ROVs as responders, and to trigger them electrically.

6.4 Towfish Tracking

6.4.1 Application Summary

You can use the system to position a towfish while a vessel is towing it.

Towfish are commonly tracked at high elevations. This can make the signals difficult to detect, and make the estimated depth less precise.

The following recommendations apply when using this application:

- Use depth aiding in this application. Sonardyne beacons can be configured to report depth using a second reply signal, or a manual depth can be used.
- For very long layback tracking, it is sometimes necessary fit an adaptor flange to a standard transceiver so that it angles the transceiver face towards the target. Although this technique can be helpful in increasing the signal level received from the beacon when tracking a target directly astern of the vessel, it can also result in the introduction of additional noise from the vessel, and so limit the transceiver's ability to track targets.
- Use GNSS input. Generally a towfish is towed a fixed distance behind the vessel, and so does not appear to move very much with respect to the vessel. Using GNSS to track the vessel allows the system to compensate the towfish measurements for the true velocity of the beacon through the water.

6.5 Simple DP

6.5.1 Application Summary

In shallow water, a simple mobile beacon can be enabled and used for DP to help control the position of the vessel. The safe working depth for using a simple USBL mobile beacon for DP purposes depends on the quality of the attitude and heading sensors. With Sonardyne's Lodestar it is possible to use a simple USBL mobile beacon for DP in depths up to 1000 metres. Generally, more than one beacon should be used so that the DPS can maintain control, even if data from one beacon is lost.

Many DP systems require that a flag is set in the telegram that confirms that the beacon is stationary on the seabed. Use the Output Telegram Editor to set the mobility field to 'Fixed' for a beacon that is on the seabed if required by the DPS.

6.6 Optimised USBL

6.6.1 Application Summary

In deep water, or for long-range tracking, it is important to use a high-quality AHRS to achieve good accuracy and stability. Sonardyne's Lodestar GyroUSBL integrates a USBL transceiver together with a Lodestar AHRS for near-perfect alignment and time-synchronisation.

Operation of a Lodestar GyroUSBL-based system is the same as for a standard USBL system.

See *Section 7 "Optimised USBL and DP INS"* for details.

6.7 LUSBL Tracking for DP

6.7.1 Application Summary

When the system is required to estimate the position of the vessel relative to more than one transponder on the seabed, the transponders can be added to an array. Sonardyne recommends laying a **minimum** array of five beacons, to ensure that the integrity of the position estimate of the vessel does not become degraded if measurements from one or more of the beacons in the array are missed.

The **array beacons** can either be calibrated with respect to each other, or calibrated with respect to the GNSS. The system can then use the measurements from all of the **beacons** in the resulting array to estimate the position of the vessel. This position is considerably more stable than the position of USBL mobile beacons and can be used as an input to DP to full ocean water depth.

When using GNSS, all beacons added to the array are calibrated with respect to the GNSS.

CAUTION

 Take care to ensure that the GNSS is disabled in the system after the calibration completes, so that the resulting position estimate is derived purely from the acoustic measurements.

When not using GNSS, the position of the first beacon added to an array is held fixed, and the positions of subsequent beacons added to the array are then calibrated with respect to the first beacon.

6.7.2 General Navigation Set-up

1. If a template exists, use it to create the setup.

If there is no template, select **System > Setup** to display the **System Setup** window and refer to *Section 4 "Common Procedures"* to add the instruments used in the setup.

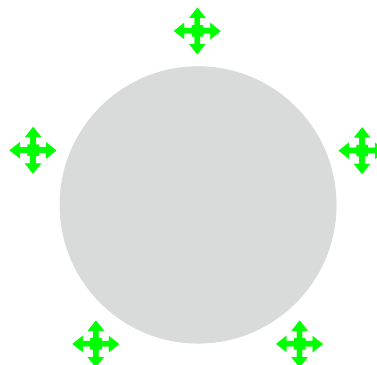
2. Add the beacons to the setup and begin to track them.

Deployment

1. Continue to track the beacons as mobiles while the ROV places them in a suitable position.

The usual beacon arrangement is a five-pointed star (pentagon) such as the example pattern shown below. The main operating area is inside the pentagon.

Figure 6–1 Example 5-Beam Array Deployment Pattern



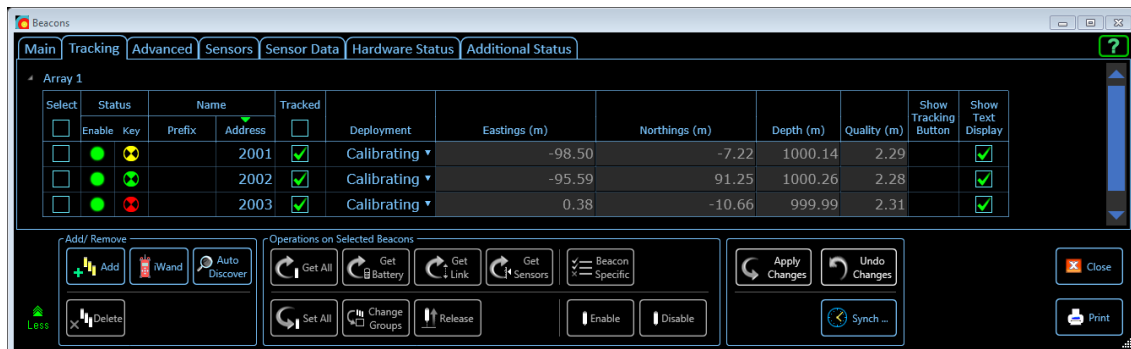
2. When the beacons are all deployed, confirm that they are all tracking correctly and are stable as mobiles.

Note

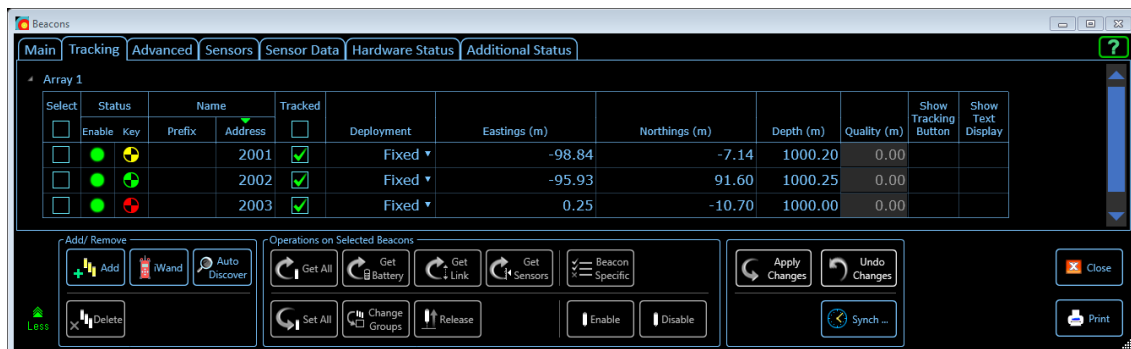
If the transceiver has been moved or re-installed, or if the VRU or gyrocompass has changed, then you must run a CASIUS calibration using one of the beacons (with the beacon set as a mobile). See *Appendix J "CASIUS Data Collection Methods"* for an explanation of the CASIUS calibration process.

Beacon Calibration

1. Open the Beacons table and change the INS Beacons from **Mobile** to **Array**. This will begin the process of calibrating their position.



2. Allow the calibration to run for a minimum of one hour (or until the desired precision is reached and the Quality figure has stopped decreasing).
3. Open the Beacons table and change the INS Beacons from **Calibrating** to **Fixed**.



6.8 DP INS

DP INS is very similar to 'LUSBL tracking for DP', but with the addition of a Lodestar INS for faster position update and superior ride-through during acoustic drop-outs. The number of beacons in the array can also be reduced to three.

6.8.1 Setup

The setup uses a Lodestar GyroUSBL (Gyro-GDT or GyroHPT) instead of the regular transceiver.

6.8.2 Deployment and Calibration

Deployment and calibration are as for a 'LUSBL for DP' (see *Section 7 "Optimised USBL and DP INS"* for details).

6.9 Multiple Systems Tracking Independently

6.9.1 Application Summary

A vessel can operate with more than one acoustic system, and they can share sensors, and transponders without necessarily impacting on their independence. Each system tracks using measurements made only on that system, and so the solution produced by one system has no influence on the solution produced by the other(s).

When sharing transponders in an array, the failure of a single transponder could reduce the robustness of all systems. Therefore, it is recommended that the minimum number of transponders in the array should increase from 5 to at least 6, so that a single transponder failure does not result in all systems that share the array operating below Sonardyne's minimum recommended array size.

To avoid one system transmitting signals while another system is attempting to receive it is useful to synchronise them. This is achieved in Sonardyne systems by synchronising timing between the systems using the Acoustic Synchronisation tool. The systems are set to track at the same rate, but with individual offset times to separate their signals from each other.

The systems generally synchronise independently to UTC time from independent GNSS receivers, so there is no connection between the systems. However, it is possible for the systems to share the same GNSS, or to use one system to set the time from one to the other. Although it may be simpler to use one system to send the time to the others, it does have the weakness that the sending system does not know whether it is synchronised to the remote systems, and so cannot raise an alarm if it is no longer receiving time; however, each of the receiving systems would raise alarms if the sending system stopped transmitting.

The NSH has an extremely good clock, and so after the offset to UTC has been measured, the systems can continue to run independently of the UTC time source for many days without losing synchronisation. If a system loses the UTC source, an alarm is raised so that the operator is aware, and so that the UTC source can be restored.

6.9.2 Set-up

1. Add a Time of Day (TOD) device to each system that is to be synchronised. Refer to *Section 4.16 "Configuring System Devices"* for instructions on how to do this.
2. Select the required **Window** and **Offset** for each system to ensure adequate separation of interrogate and reply signals.

Note that a system does not have to use every interrogation window that is allocated to it, and so it is possible to configure the Window on all systems, but choose to track a particular target on one system at any multiple of the Window width that is less than 30 s. For example, if the selected window width was 5 s, an operator may wish to track an MRAMS beacon at a 15 s rate. This is achieved by changing the update period of the MRAMS beacon. The UI will automatically snap to the nearest multiple of the Window. See *"Acoustic Synchronization"* in *Appendix A "User Interface Description"* for more information.

3. If a BOP interface is required, ensure that the **Schedule Commands** option is ticked on the **Main** tab of the PAN device that the BOP connects to.
4. If sharing transponders in the array, and using the same interrogation signal in more than one system, it is necessary to ensure that the offset between the systems is longer than the blocking period set in the transponder (usually more than 0.4 s).

6.10 Specialist Tracking Applications

6.10.1 iUSBL

In this application the iUSBL transceiver is installed on a subsea vehicle, such as a towfish, and is usually mounted horizontally looking backwards to track beacons mounted on streamers towed behind the towfish.

It is difficult to run a procedure such as CASIUS to estimate the alignment between the USBL transceiver and the attitude sensors in this application, and so typically the iUSBL transceiver is mounted on a plate with a Sonardyne Lodestar that has been carefully calibrated using a CMM or equivalent machine to measure the alignment of the USBL to the Lodestar axes.

6.10.2 Follow Sub

This is an application where an ROV might be carrying out a pipeline survey or similar exercise. A beacon is mounted on the vehicle, and enabled into the DPS as the sole reference. The DPS attempts to maintain a constant offset between the vessel position and the beacon on the ROV, and so as the ROV flies down the pipeline the vessel follows.

Some DPS installations require that the beacon telegram flags that the beacon is stationary before they will allow the telegram to be selected for positioning. If this is the case it is necessary to set that beacon's mobility to 'Fixed' in the telegram properties.

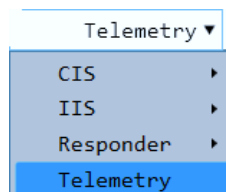
6.10.3 AUV Tracking (6G Only)

In this application, an AvTrak6 beacon is mounted on an AUV with one of its serial ports connected to the AUV control system. The HPT sends SMS messages to the AvTrak6, and computes its USBL position from the acknowledgment. The computed position is then sent to the AvTrak6 as the payload of the next SMS message.

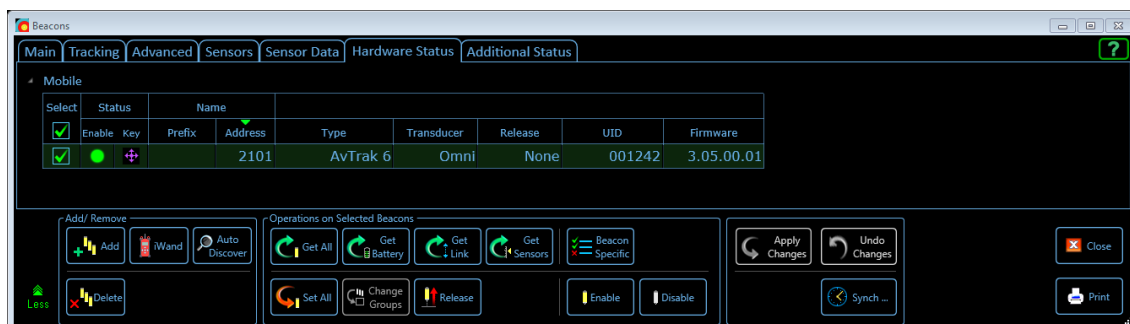
Note

 This technique uses telemetry for tracking, and is exclusive of normal ranging. When one, or more AvTrak 6s are put into Telemetry tracking mode, tracking of all other beacons is automatically turned off.

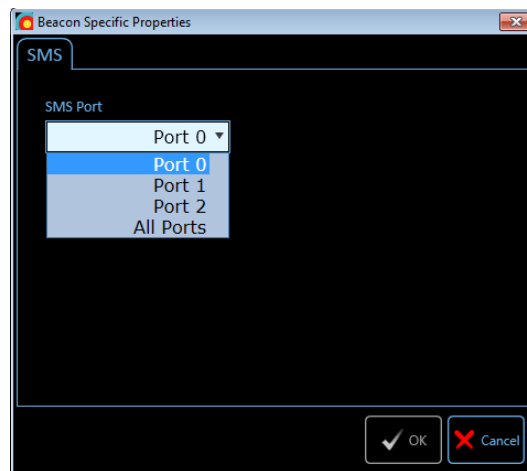
1. Set the AvTrak6 in Telemetry tracking mode (see *Section 5 "Beacons"*):



2. Select the AvTrak and click the **Beacon Specific** button.

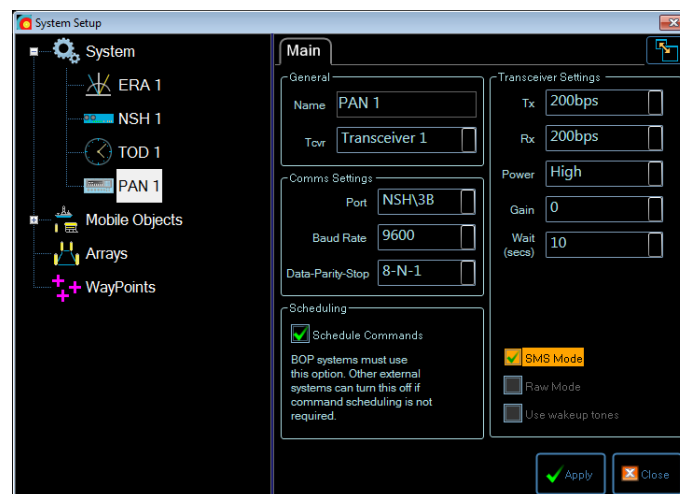


3. Select the AvTrak serial port on the drop-down list.



If the AUV control system needs to send occasional status messages, it can send these to the AvTrak6 as SMS messages, and they will be sent as the acknowledgment to the next incoming position message from the surface.

If a PAN port is added to the system, and the **SMS Mode** option is ticked, then the SMS messages received from the AvTrak6 will be routed out of that port. In the same way, SMS commands can be sent into the PAN port and these will be interleaved with the normal SMS traffic.



Since this tracking technique uses telemetry messages for tracking, it is important to optimise the telemetry settings for best performance. In particular, it is recommended that the fastest reliable transmit speed is used

Section 7 – Optimised USBL and DP INS

7.1 Introduction

This section describes how to set up and operate a system for DP INS or Optimised USBL operation. It is valid for systems version 3.01 and later.

Note

 The hardware and software are exactly the same for Optimised USBL and DP INS systems. In fact, a DP INS system is an Optimised USBL system where the Lodestar has been enabled to allow inertial positioning.

7.2 Installation and Set-up

7.2.1 Hardware Connections

The following devices must be interfaced to the system.

- NSH

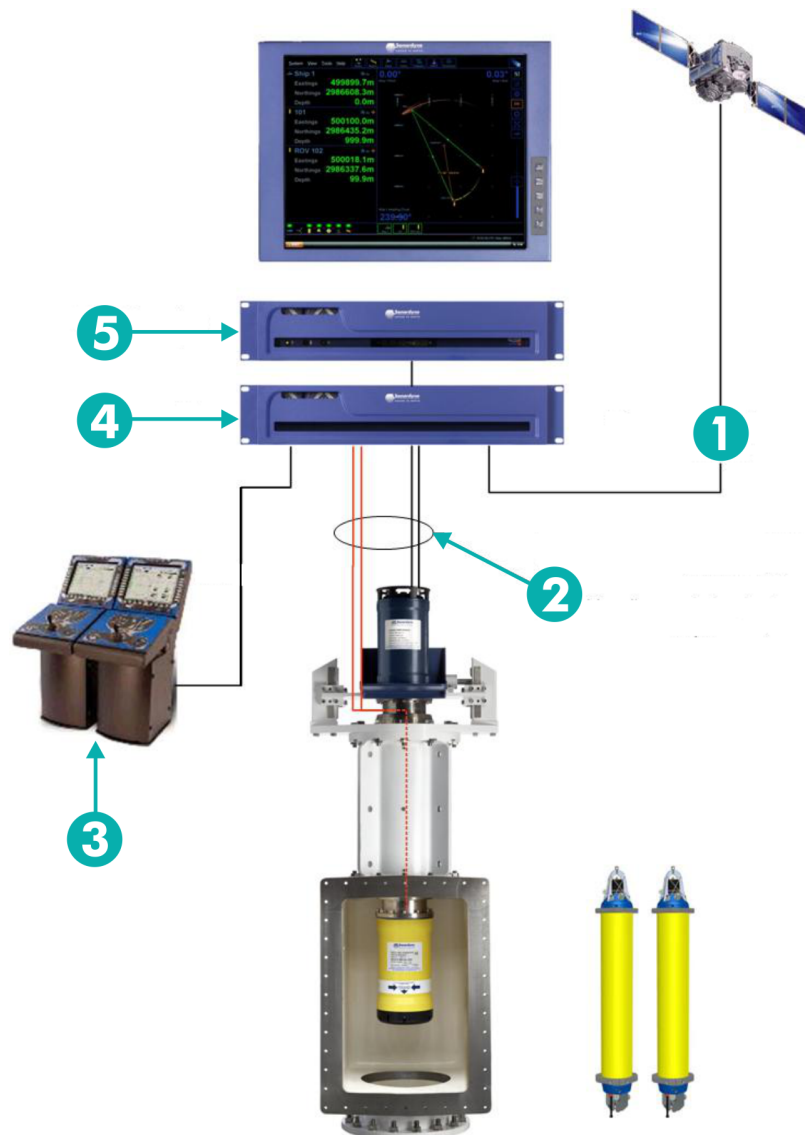
The NSH provides power and communications to the Lodestar and transceiver, and communicates with the Navigation Computer over Ethernet. Make sure there is an Ethernet cable connected between the correct ports on the rear of the Navigation Computer and the NSH (refer to *Section C.3 "Hardware Installation"*).

- GNSS

A GNSS receiver provides position information that is used to calibrate the transponder on the seabed and latitude compensates the Lodestar AHRS. The GNSS receiver output should be connected to an NSH serial port, and should include GGA and VTG telegrams. If desired, the UTC time and PPS can also be interfaced. The 1PPS signal from the GNSS receiver should be connected to an NSH trigger input.

7.2.2 Installations with Separate USBL Transceiver and LodeStar Units

Figure 7-1 DP INS / Optimised USBL System with Separate Lodestar / Tcvr



Item	Description
1	GGA used to latitude compensate AHRS and calibrate transponder position
2	Tcvr and Lodestar have independent power and communications to NSH. Refer to wiring diagram for details of through-ship cabling
3	DP Telegram
4	NSH
5	Navigation Computer

Figure 7-2 Detail of Lodestar and Bracket Mounted on a Carriage

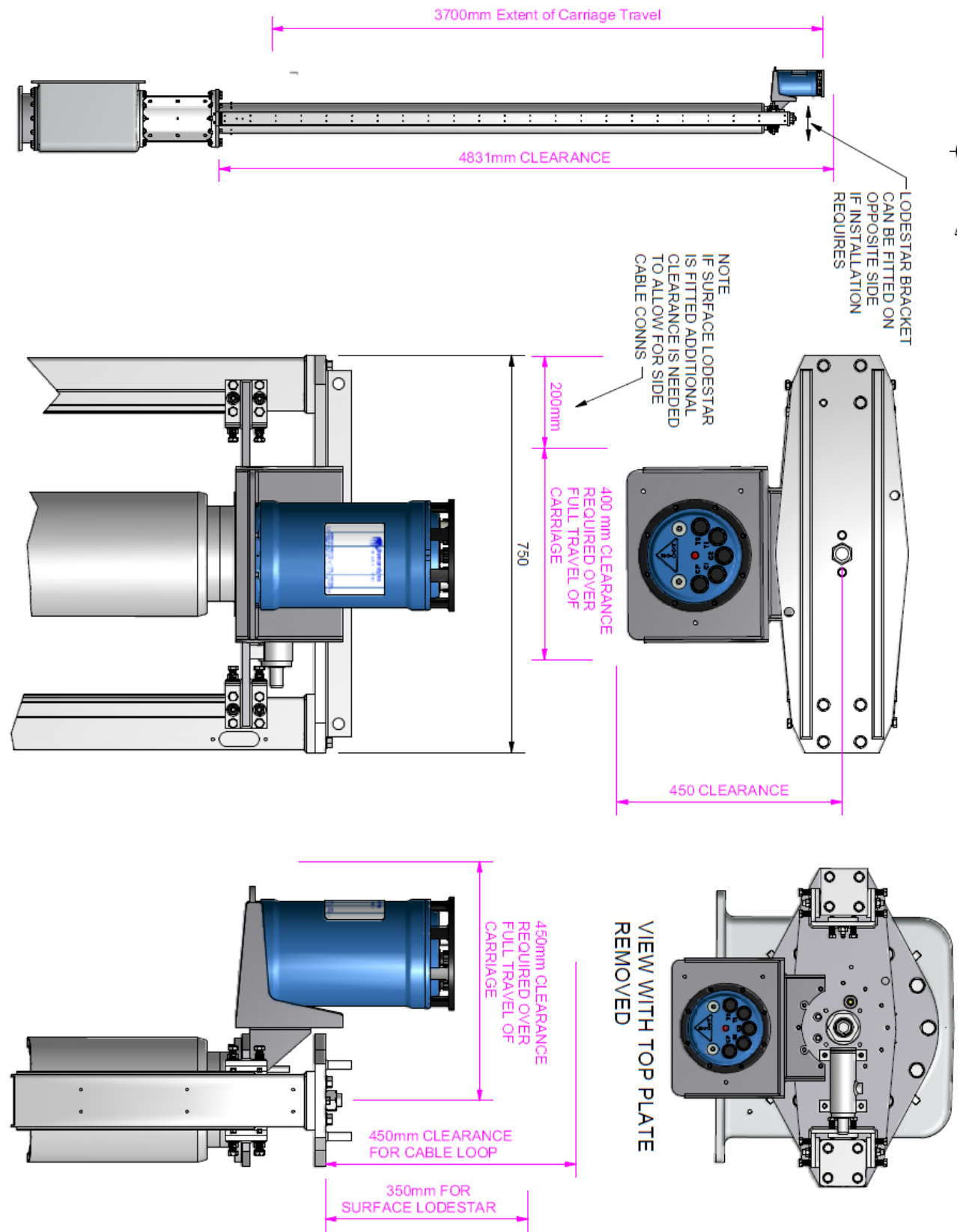
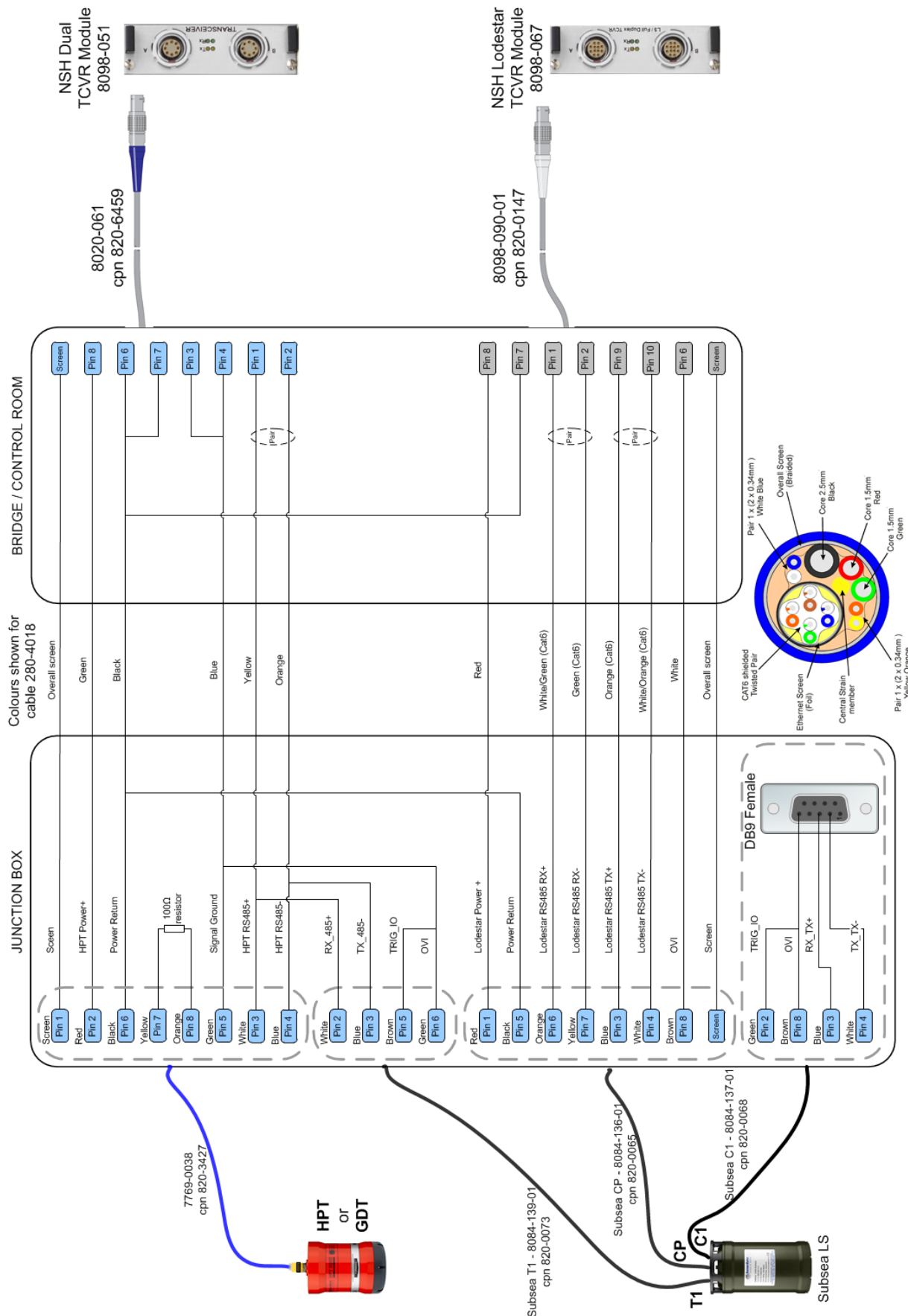


Figure 7-3 Separate Lodestar / Tcwr Wiring Diagram



A GDT or HPT transceiver should be connected directly to an NSH Transceiver card in the usual way, and the Lodestar to an NSH Lodestar card. The NSH Lodestar card provides 48 V power and full duplex RS485 comms (see *Appendix D "Interface Cables"*). The transceiver card supplies 48 V and half-duplex RS485 comms. Note that the transceiver comms is split in the junction box and sent across to the Lodestar so that it can listen to the commands being sent by the Marksman system. Lodestar does not send any commands to the transceiver.

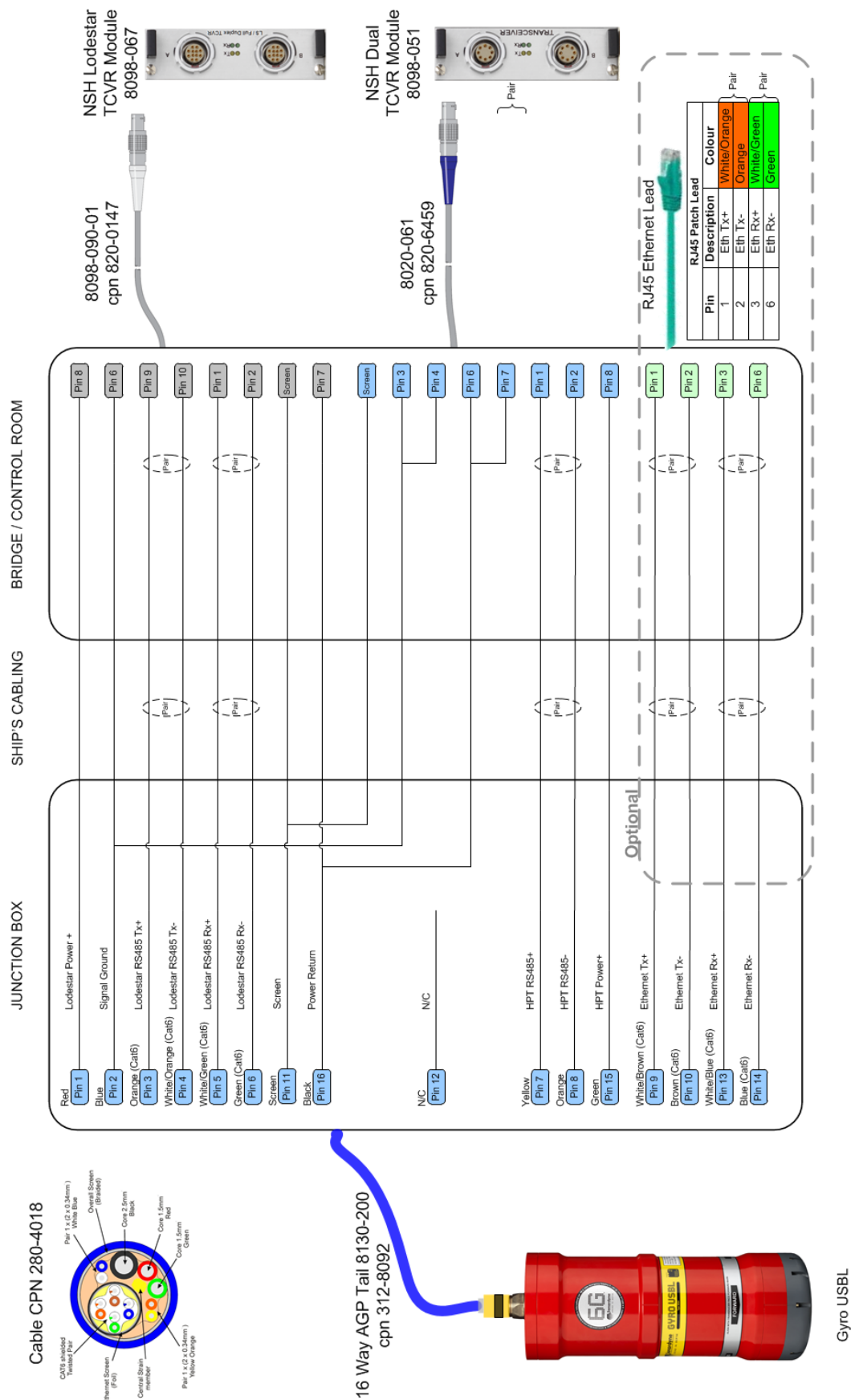
Also note the 'Cable Detect' connections that can be seen at the NSH tails on the bridge. These links are very important because they activate RS485 termination. Without termination the RS485 comms will present problems.

The through-ship cabling should be suitable for the application: Comms wires carry RS485 comms at 115200 baud or less. The power wires carry 48 V at 25 W to each device. Sonardyne suggests using two Cat6 cables for RS485 comms, where one cable is for the Lodestar and the other for the Transceiver. Additionally, two suitable pairs of copper conductors are required to power the Lodestar and Transceiver independently. See *Section D.3 "Cable Diagrams for DP INS/Optimised Applications"* for drawings of cables used in DP INS installations.

7.2.3 Installations with Combined Lodestar GyroUSBL Unit

A GyroUSBL unit is available that houses both a Lodestar and an HPT USBL transceiver. It requires the use of a 16-way GyroUSBL cable wired as shown in *Figure 7–4*.

Figure 7-4 GyroUSBL Wiring Diagram



7.3 Software Setup

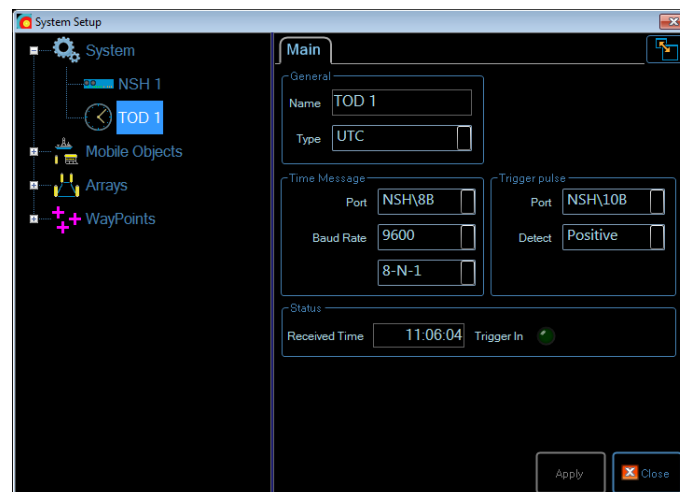
Click **System > New** to create a new job. Some systems will have been configured with template jobs, which means that new jobs have certain default instruments in them. If the template job is correctly configured for DP INS then no further setup should be necessary and you can proceed straight to the operational procedure.

7.3.1 Create the Job and Add the NSH

1. Click **System > Setup** or the **System** button to open the **System Setup** window.
2. Right-click on **System** and select **NSH**.
3. The software attempts to connect by using the default NSH IP address. If the connection is successful, the **System Setup** dialog box shows the Firmware version of the NSH.



4. Right-click **System** and select **Add TOD**.



5. Select the **Time Message Port** and the **Baud Rate** to match the GNSS port.
6. Select the **Trigger Pulse Port** to the appropriate NSH port for the 1PPS signal.
7. Click **Apply** and check that the trigger LED flashes once per second and the **Received Time** field shows the decoded TOD data.

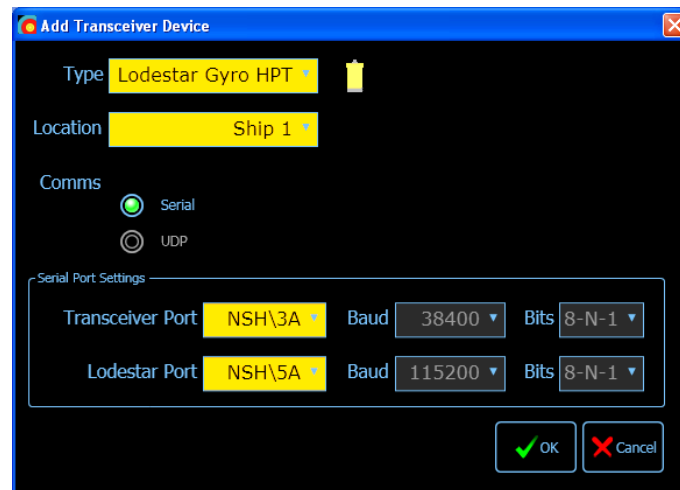
7.3.2 Add the GNSS

1. Click **System > Setup** or the **System** button to open the **System Setup** window.
2. Right-click the vessel and select **Add GNSS**.
3. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the GNSS.
4. Enter the **Starboard**, **Forward** and **Up** offsets.
5. Check the TOD sync by confirming the time of arrival of UTC messages matches the time in the GNSS data string.
6. Click **Apply**.

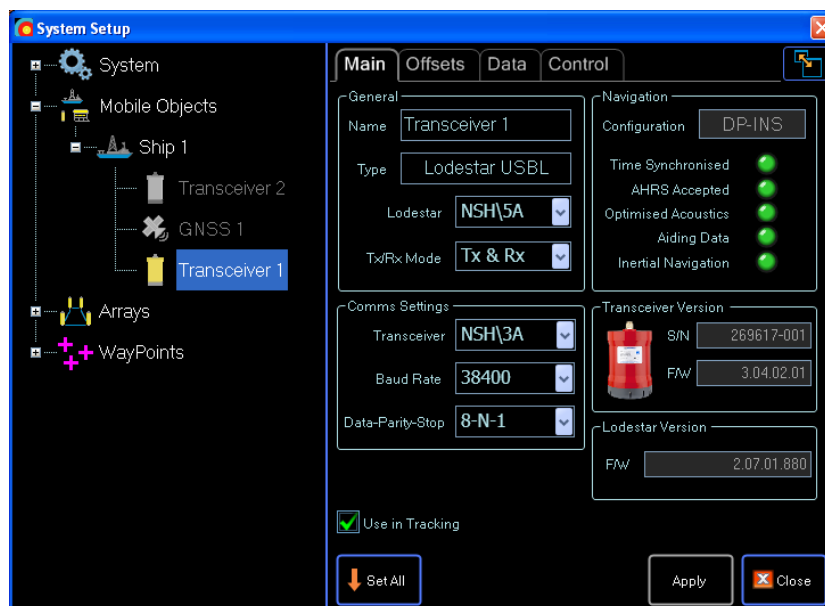


7.3.3 Add a Combined Lodestar and USBL Transceiver Device

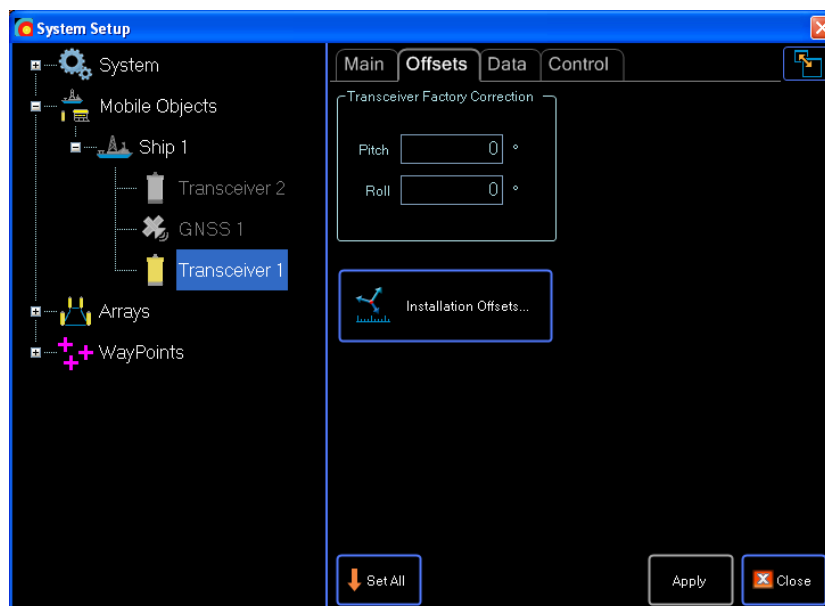
1. Right-click the vessel and select **Add Transceiver**.
 - a. Select a **Lodestar Gyro HPT** device type for either:
 - a Lodestar GyroUSBL, or
 - a separate Lodestar INS and HPT transceiver.
 - b. Select a **Lodestar Gyro GDT** device type when you are using a separate Lodestar and GDT USBL.
2. Select the **Port**, **Baud Rate** and **Data-Parity-Stop** to match the communication parameters used by the Lodestar and transceiver.



- After a short delay the display should report the Lodestar serial number and firmware version, although the LEDs shown below will not show green yet. The system auto-detects the Transceiver type. After a short delay the display should report the Transceiver serial number and firmware version.



4. Select the **Offsets** tab.



5. Click the **Installation Offsets** button and check all the various offsets are set correctly.



6. If a surveyed ship's gyro and VRU are available, calibrate the Lodestar to these sensors using the Attitude and Heading Calibration Tools (refer to "Attitude and Heading Calibration" in Appendix A "User Interface Description"). Use of this tool configures the **Pitch**, **Roll**, **Heading** offsets for the Ship to Lodestar.
7. Configure **Starboard**, **Forward** and **Down** offsets for the CRP to Transceiver using measured or surveyed values.
8. Configure Starboard, Forward and Down offsets for the Lodestar to Transceiver or CRP to Lodestar using measured values, depending on whether the Lodestar is mounted in a GyroUSBL, or on the transceiver pole, or on the bridge.
9. Calibrate the **Pitch**, **Roll**, **Heading** for the Transceiver to Ship using the CASIUS Calibration Tool (refer to Section A.10.3 "CASIUS").

It should now be possible to follow the procedure for arriving at location.

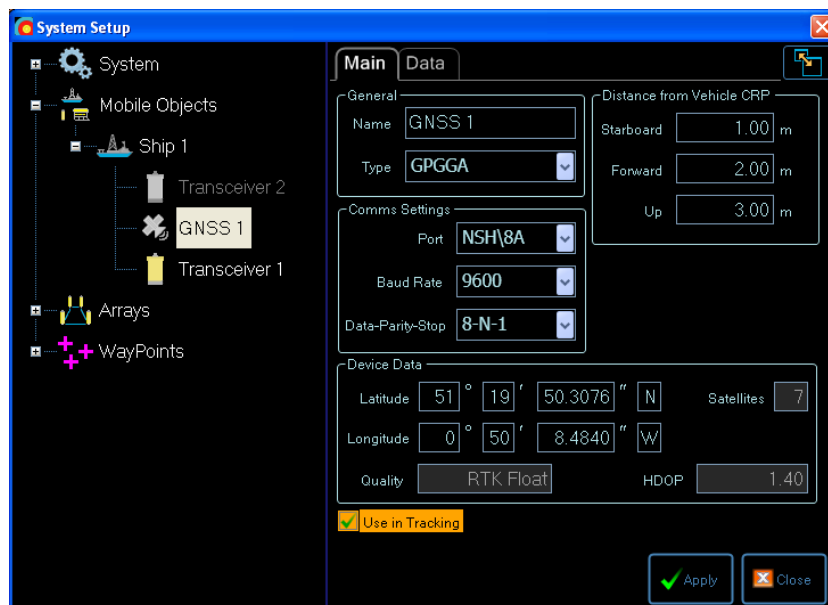
7.4 Suggested Procedure – Arriving on Location

The following is a suggested operational procedure that is suitable for use when arriving on location at a site where DP INS is to be used as a PME. What follows assumes that the system has a job with all

necessary hardware connected and interfaced to the system.

7.4.1 Procedure

1. Arrive at Location.
2. Lower the transceiver deployment pole fully when the vessel speed is within limits.
3. Switch on the Navigation Computer and the NSH. The system is usually configured to start automatically. However, if it does not, double-click on the software icon on the Navigation Computer's desktop.
4. Click **System > Setup** or the **System** button to open the **System Setup** window.
5. Select **GNSS** and select the **Use in Tracking** check box.



6. Check that the NSH, INS, Transceiver, GNSS, Heading and VRU status indicators are all solid green as shown in the example below.



7. Open the Geodesy dialog box (**Tools>Geodesy**) and click **Reset** to update the current operating UTM zone.

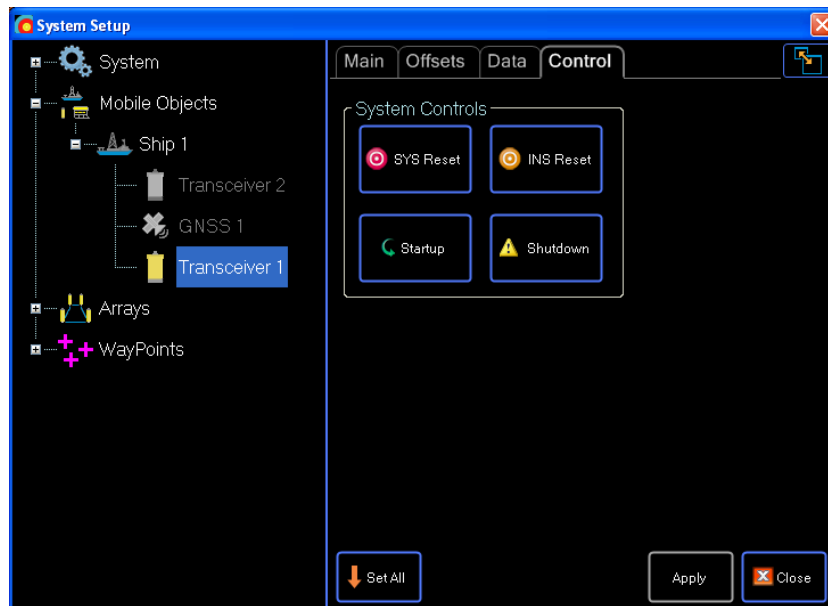
7.4.2 Reset the Lodestar

1. Open **System Setup** and select the **Lodestar Tcvr** device.
2. Select the **Control** tab, click the **System Reset** button and then confirm.

Note



This will restart the Lodestar, making it unavailable for 15 minutes while it settles.



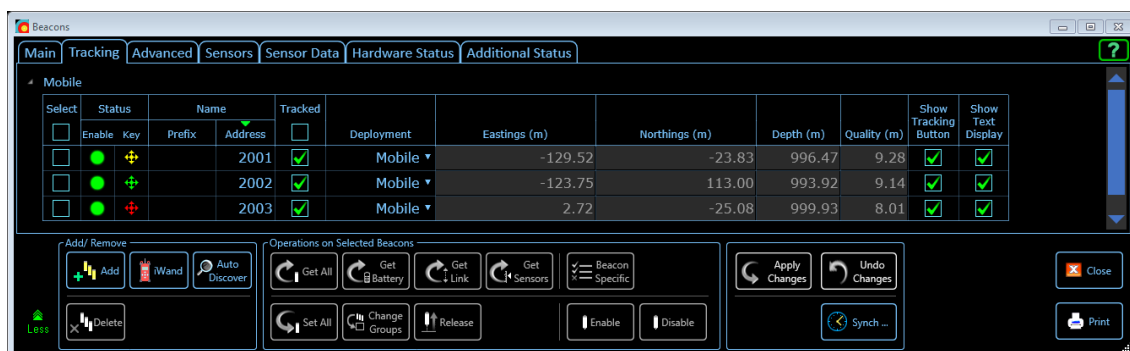
Alarms will be raised when the Lodestar is reset, warning that it is not ready for use. Heading and Attitude indicators will flash orange during this time. These will clear automatically when Lodestar has settled.

3. Deploy the INS beacons. If the seabed Beacons are not already deployed then have them placed on the seabed. The deployment pattern is determined by the number of Beacons.

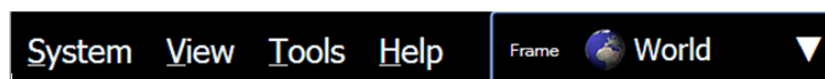
Note

 Do not proceed further until the alarm warning that Lodestar attitude is not settled has cleared.

4. Check the Lodestar and Transceiver Installation Offsets are still correct, as described in step 5 in *Section 7.3.3 "Add a Combined Lodestar and USBL Transceiver Device"*
5. If necessary, add the INS Beacons to the system. If they are already in the system then ensure they are 'mobile' in the beacons table, for example:



6. Start tracking the INS Beacons.
7. Change the **Reference Frame** drop-down list at the top of the Marksman screen to **World Frame**.



- Check that the INS Beacon positions are stable and that the system is displaying UTM coordinates for the Vessel and for the Beacons.

INS Beacon Position Calibration

Refer to Section 6.7.2 "Beacon Calibration".

De-select GNSS For Use In Tracking

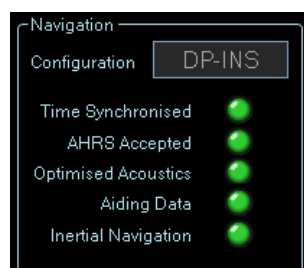
- Open **System Setup** and select the GNSS device.
- Deselect the **Use in Tracking** check box (note the GNSS status LED now shows blue):



- Wait for the INS position to establish.

When the Beacons are changed to be 'fixed' the system automatically begins to send acoustic aiding data to the Lodestar unit.

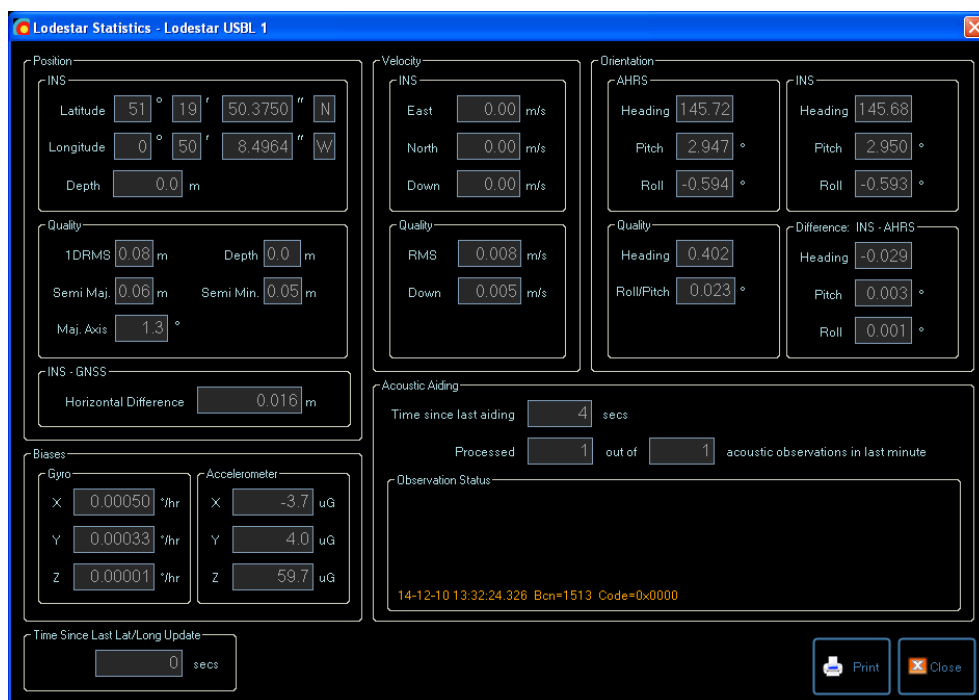
- Status LEDs in System Setup Lodestar should show:
 - Time Synchronised** – Lodestar and system clocks are in sync.
 - AHRS accepted** – the system is getting AHRS data with good time-stamps from Lodestar.
 - Optimised Acoustics** – automatically illuminates when Lodestar reports that it is correctly detecting transceiver comms and is able to publish attitude values time-synchronised with the acoustics.
 - Aiding Data** – the Lodestar is accepting acoustic aiding.
 - Inertial Navigation** – illuminates when the Lodestar INS has settled, is receiving acoustic position aiding, and is publishing inertial positions.



- The vessel INS position will be displayed on the main window in blue.



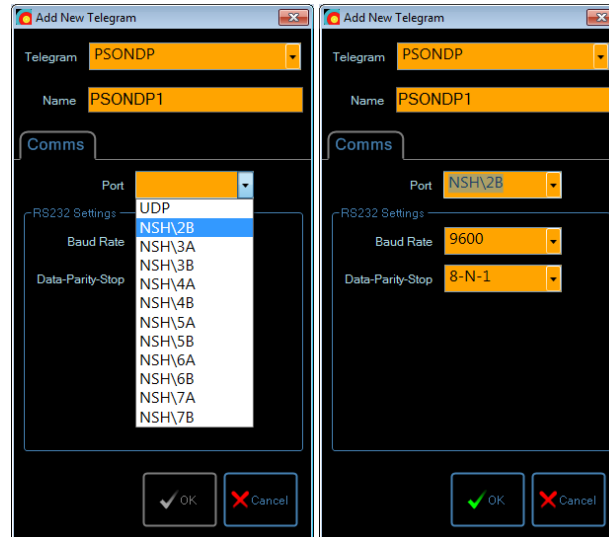
6. Select **Lodestar** from the **View** menu to check the correct operation of the Lodestar AHRS and INS.



7. Select INS Position in the DP Desk.
8. When DP-INS is tracking well, add a DP telegram to publish the vessel position to the DP desk.
9. Click **Telegrams**.

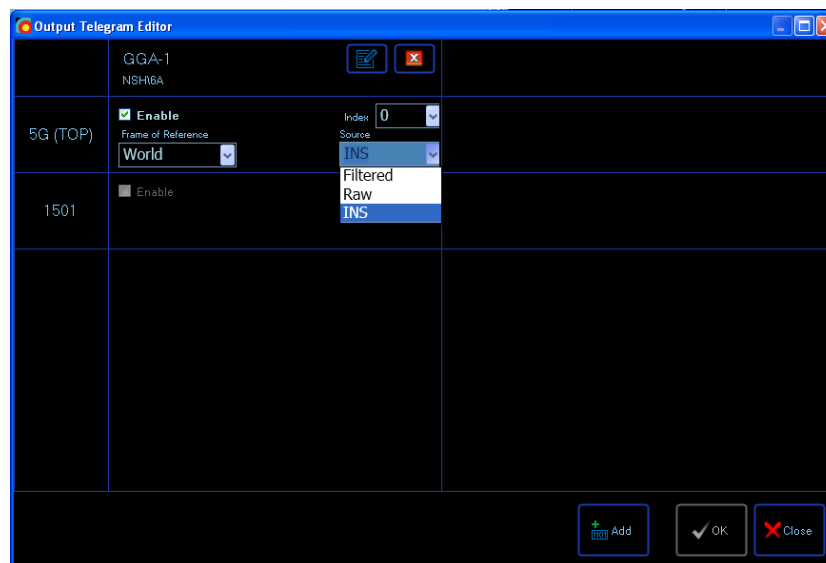


10. Click **Add**.



Note

 Sonardyne's recommended DP telegram type is the \$PSONDP (described in *Section F.11 "PSONDP - Sonardyne DP Report"*), which carries enhanced INS quality data. However, in cases where this is not accepted, choose a suitable alternative. Set up the comms as required by the DP desk, but note that the INS position is published at approximately 5 Hz, so a fast baud rate may be necessary.



It is now possible to select the vessel INS position for use in the DP desk. Use the Comms Viewer to monitor the telegram output if diagnostics are required. Make sure the **Source** is set to **INS** for the inertial position. Selecting **Filtered** or **Raw** will cause the acoustic position to be sent instead of inertial.

7.5 Simultaneous Operations

When running simultaneous operations with a second USBL system on board it might be necessary to enable time synchronization. To enable time synchronization:

1. Select the beacon dialog box and click **Time Sync** on the main tab.
2. Select the **Enable Acoustic Time Synchronization** check box.
3. Ensure the Survey system is set up with a 5 second window and a 2.5 second offset. Ensure the bridge system is set up with a 5 second window and a 0 second offset.

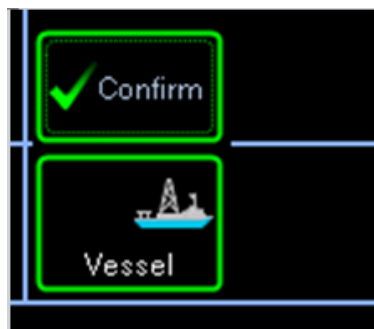
Note

 This will make all update rates five seconds. You will no longer be able to change the update rate without changing the Acoustic Window on this dialog box.

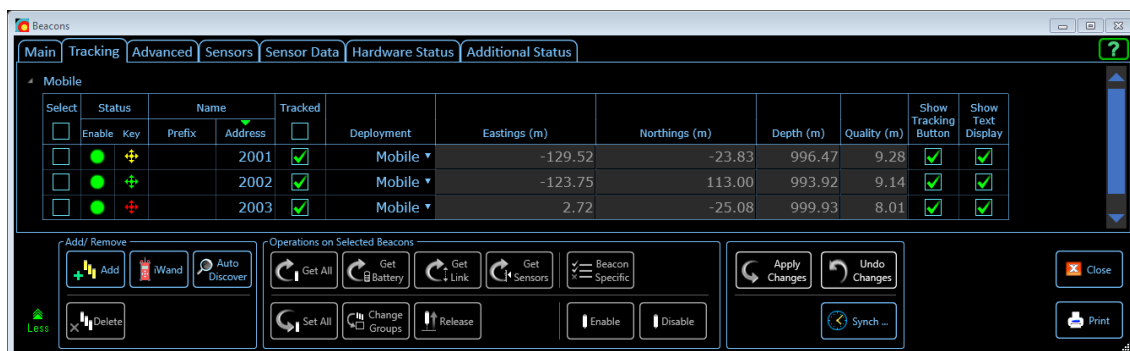
7.6 Suggested Procedure – Leaving a Location

The following is a suggested operational procedure that is suitable for use when leaving a location where DP INS has been deployed.

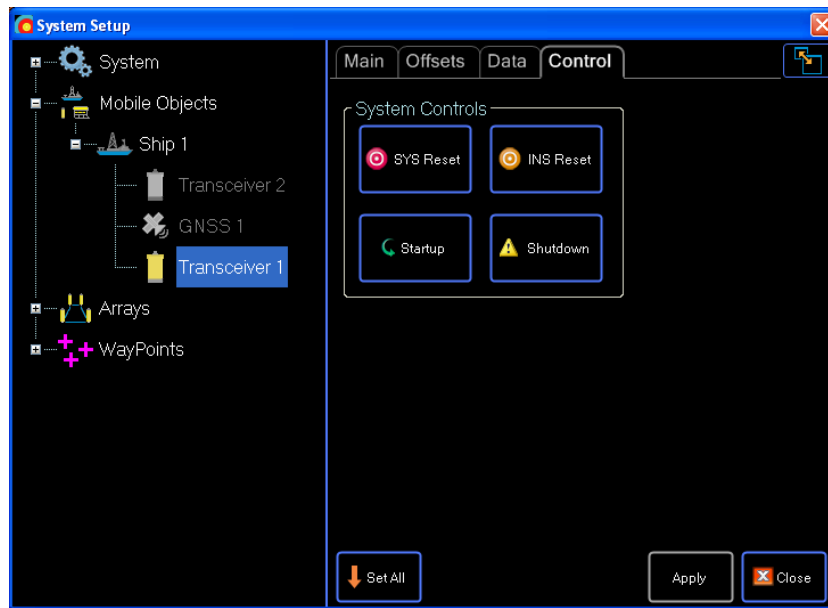
1. De-select INS from the DP Desk.
Make sure the DP desk is not using the INS position as a reference.
2. Click the **Vessel** tracking button and then click **Confirm** to stop acoustic positioning.



3. Open the Beacons table and change all INS Beacons from **Array** to **Mobile**.



4. Release the beacons or retrieve them using the ROV.
Beacons can now be tracked as mobile targets as they float to the surface if desired.
5. Open System Setup and select the Tcwr device. Select the Control tab and click the button to 'Shutdown' LodeStar.



6. Confirm the shutdown request.
7. Raise the Transceiver Deployment Pole fully before beginning a transit.
Make sure the transceiver deployment pole is fully raised before beginning a transit.

Section 8 – Dual-Redundant LUSBL System

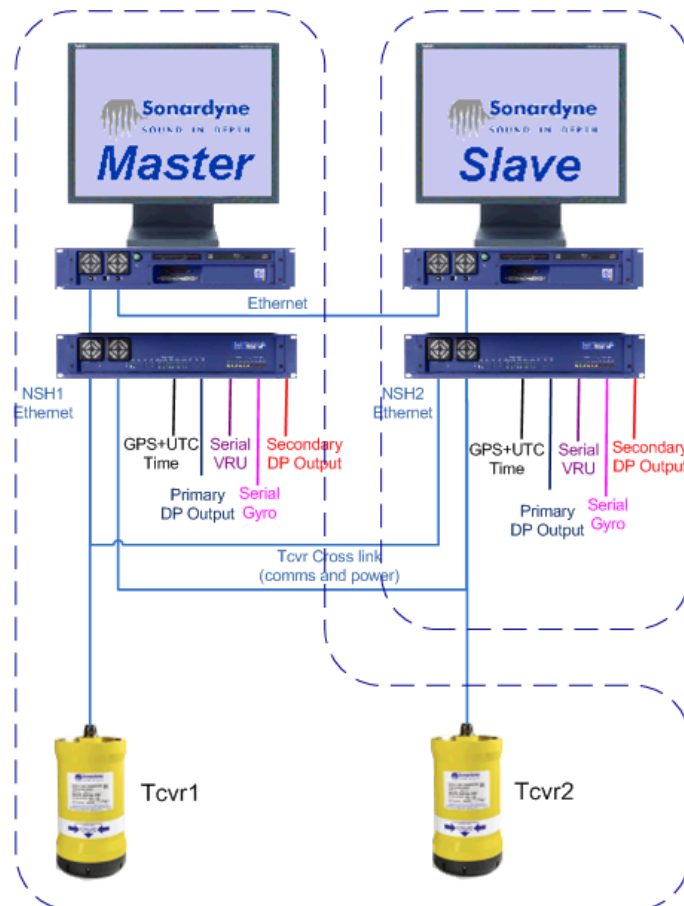
This section explains the differences which apply to the installation, operation and maintenance of the Dual-Redundant version of the LUSBL system variant.

8.1 Description

In the Dual-Redundant version of the system, two complete sets of LUSBL equipment (Navigation Computer, NSH and Transceiver) are operated in tandem. The two sub-systems are cross-linked in such a way that, if a failure of any major element occurs, system operation will continue without the need for operator intervention. From the operator's point of view, operation of the Dual-Redundant version is essentially identical to that of the standard version. A block diagram of a typical system is shown in *Figure 8–1*.

In operation, one of the sub-systems operates as the Master and performs all normal system functions. The second sub-system monitors the function of the Master and will commandeer system operation and take the role of a new Master if it detects that the old Master is not functioning.

Figure 8–1 Block Diagram of a Typical Dual-Redundant LUSBL System



8.2 Hardware Implications

The only hardware differences between a Dual-Redundant system and a Dual-Independent or Single system are in the cross-link connections.

In the Dual-Redundant version, two Transceiver output ports are available on each NSH – one is connected directly to the local Transceiver and the other is connected through the remote NSH to the remote Transceiver (see the block diagram in *Figure 8–1*).

In addition, on each Navigation Computer, an Ethernet port is allocated to act as a communications interlink to pass data between the two sub-systems, in particular, the heartbeat messages (see below) and job transfers.

Note

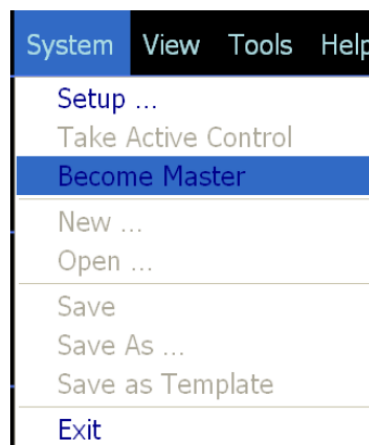


The system Security Key must be set to enable the Dual-Redundant system software to run.

8.3 Functional Implications

Inter-system monitoring is carried out by means of a continual stream of messages passing between the two sub-systems. These heartbeat messages are used to achieve a number of functions, as follows:

- On start-up, a sub-system (the local sub-system) waits for a period equivalent to 8 heartbeats, during which time it listens for heartbeats from the other (remote) sub-system. If no heartbeats have been received over this period, the local sub-system assumes the role of Master and operates the LUSBL system on its own.
- If, subsequently, the remote sub-system is powered-on, it will always become the Slave sub-system.
- If, on start-up, a sub-system receives heartbeats from another sub-system within the 8 heartbeat period, then the sub-system having the lower hardware signature value (MAC-ID and other hardware) automatically becomes Master.
- During the start-up phase, the Master transfers its version of the job to the Slave and then maintains control of both the job and the Transceiver link for as long as it remains Master. All normal system operation is executed by the Master.
- If the operator subsequently makes changes to the job, the Master automatically transfers the new job to the Slave.
- At any time, the operator may force a Master/Slave changeover using the System > Become Master command. If this happens, the Slave waits for the next heartbeat from the current Master and then sends its own response heartbeat indicating that it is waiting to become Master. This will then indicate to the current Master that it must complete any outstanding job transfers immediately, prevent the operator making any further changes, and then confirm that it has become Slave.



Similarly, if, after a few seconds, the current Slave detects that it is no longer receiving heartbeats from the current Master and that there is no activity on the Transceiver link, it will assume that the Master is no longer in control and will generate a Level 1 alarm and will automatically become the new Master itself.

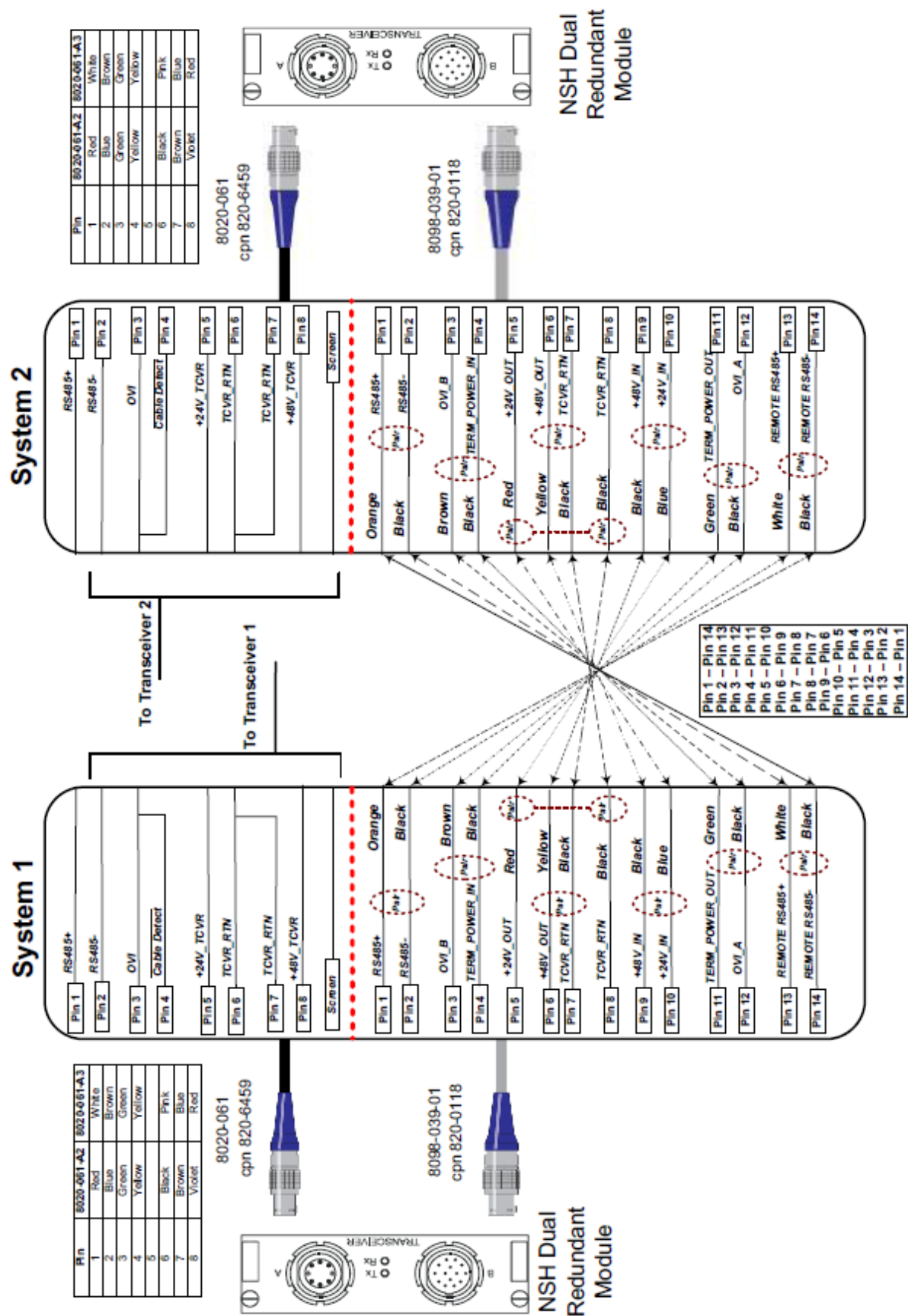
The Level 1 alarm triggers an audible alarm and displays a warning message in the main display area. The audible alarm may be silenced by acknowledging the alarm, but the warning message will remain until the fault is cleared. However, in the case of a Dual-Redundant system, operation may be continued with normal performance until it is convenient to halt the system and clear the fault.

8.4 Installation and Configuration

For the most part, installation procedures and connections required for a Dual-Redundant version of the LUSBL are as previously described for a standard system (except, of course, there are two sets of equipment to be installed).

1. Connect one Transceiver to each NSH.
2. Wire the second Transceiver (cross-link) port on each NSH to the second Transceiver port on the other NSH (see *Figure 8–2* for wiring details).

Figure 8–2 Dual-Redundant System Transceiver Wiring



1. Connect all other instruments to both NSHs.

Note



All devices must be connected to the same ports and the same slots on both NSHs.

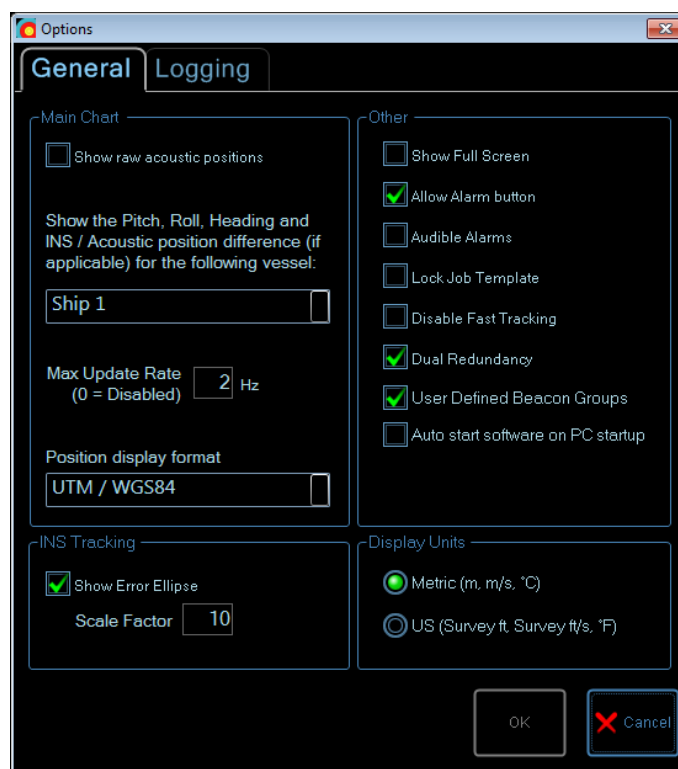
2. Connect the second Ethernet port on one Navigation Computer to the corresponding port on the other Navigation Computer.
3. Make sure the system Security Key (the 'dongle') has been set to enable the Dual-Redundant software. The dongle is likely to be installed inside the Nav PC.
A 'Security Key Authentication Failed' alarm is raised if the dongle is not set correctly.
4. Start the software on both sub-systems.
5. Check the **Tools > Options > Enable Dual-Redundancy** system option is ticked.

Note



If this option is not ticked, the system will run in Dual-Independent mode instead of Dual-Redundant mode.

If the option is changed, shutdown and restart the software on the two sub-systems. One will become Master and the other will become Slave.



6. On the Master sub-system, create a New Job.
7. Enter the two Transceivers into the job, together with their communication port settings, offsets, and other relevant parameters. For example, if the local Transceiver is on port 3A, then the cross-linked remote Transceiver will appear on port 3B. Check for correct connection by using the built-in diagnostics features.
8. Enter the remaining instruments and use the built-in diagnostics features to test that each is working.

9. Save the job, and save it again as a Template so these settings are available to new jobs.
 10. Confirm that the job details entered on the Master have been copied automatically to the Slave.
- The system is now ready to add Transponders to the job as required.

8.5 CASIUS Calibration

The CASIUS calibration for a Dual-Redundant system is exactly the same as for a standard system, except that:

- it can only be run from the current Master, and
- the CASIUS export needs to be repeated for each Transceiver in order to generate the corrections specific to each Transceiver

Note



The Slave automatically collects its own CASIUS data, but to export data it must first become Master.

8.6 Operation

Operating a Dual-Redundant LUSBL is very similar to operating a standard one.

1. System start-up is essentially normal, except that two sub-systems have to be powered-on instead of one. As described earlier, the two sub-systems will arrange automatically which of them is to become Master and which is to become Slave. Subsequently, operation proceeds in much the same way as a standard system.
2. The operator will be aware at all times, by observing the status display (bottom line) on the User Interface, whether or not his local sub-system is currently Master or Slave and, if system operation is normal, there will be no need to change the Master/Slave situation.



3. If, however, there is a need to make some changes to the job, the operator will have to switch his local sub-system over to Master status (by using the Become Master command), if it is not already in that state. They will then be able to make whatever changes are needed

The changes to the job made on the Master will be communicated automatically to the Slave.

4. If a sub-system failure occurs, the system will continue operating normally without operator intervention, although the operator is made aware that a failure has occurred by means of an audible alarm and a warning message on his screen. A failure of the Master is seen like this on the Slave:



A failure of the Slave is seen on the Master like this:



5. If such a message does appear, the operator should note the contents of the message and whether their local station is currently the Master or the Slave. They should then move to the remote station and note the same information on that sub-system (if applicable). The audible alarm may be switched off by acknowledging the alarm, but the warning message will remain until the fault is cleared.

Section 9 – Riser Angle Monitoring

9.1 Introduction

This section describes Marine Riser Angle Monitoring System (MRAMS) and Electrical Riser Angle (ERA) system software utilities that support monitoring of the relative attitude of a Riser and a Blow Out Preventer (BOP) during drilling operations. When correctly configured, the systems calculate the angular difference between these two elements and display a course to steer that minimises the stress at the joint between the riser and the BOP.

In order to use the MRAMS option it is necessary to have two Sonardyne DPTi transponders: one attached to the Riser and the other attached to the BOP. Both transponders should have a clear line of sight to the transceiver on the surface, and both must be aligned to the forward mark on the BOP.

Note

 If the two transponders are not correctly aligned to the forward mark of the BOP then the course to steer indicated by the system will be incorrect.

The MRAMS software display can also be used in conjunction with a **Signal Tower** warning system, where the MRAMS alarms are represented visually and audibly on the signal tower. To use this feature, the signal tower must first be added as a device (refer to *Section 4.16.5 "Signal Tower"*).

9.2 Marine Riser Angle Monitoring System (MRAMS)

Add the BOP and Riser transponders to the system by using the same method as used for other beacons (refer to *Section 4 "Common Procedures"*). Confirm that the system can track these beacons before you continue.

For both the BOP and the riser transponders, select either **Pulse Position Angle** or **Telemetry** as the data collection method. Telemetry is usually the appropriate setting to use for the BOP because its attitude changes very slowly.

Note

 Telemetry data collection is normally used when the update rate of a transponder's pitch and roll data is slower than 1 minute. If Pulse Position data collection is used then pitch and roll measurements are collected every time the transponder is positioned by the USBL system. In this mode the data collection rate is determined by the Update Rate in the Transponder properties or Beacons table.

9.2.1 MRAMS Software Configuration

1. Select **Tools > Riser Angle Monitoring** to display the **Riser Angle Monitoring (MRAMS)** dialog box.
2. Drag the **Riser Angle Monitoring** dialog box to the second screen and maximise it.
3. Click **Configure** on the **Riser Angle Monitoring** dialog box to display the **MRAMS Configuration** dialog box.

Figure 9–1 MRAMS Configuration Dialog Box

The screenshot shows the MRAMS Configuration dialog box with the following settings:

- General:**
 - ☒ Enable MRAMS
 - ☒ Raise Warning Alarm when: $|BOP^\circ - LFJ^\circ| > 0.8^\circ$
 - ☒ Raise Critical Alarm when: $|BOP^\circ - LFJ^\circ| > 2.0^\circ$
- BOP:**
 - Beacon: BOP 101
 - Collection Method: Telemetry
 - Update Rate: 111 Secs
 - Heading: 0.000°
 - Calibration Offsets:
 - Pitch: -1.000°
 - Roll: 1.000°
 - Use Last Reading button
- LFJ:**
 - Beacon: LFJ 102
 - Collection Method: Pulse Position
 - Update Rate: 6 Secs
 - Calibration Offsets:
 - Pitch: -1.000°
 - Roll: 1.000°
 - Use Last Reading button

Note: Go to the System Editor / Beacon Sensor Page to change MRAMS collection parameters.

Buttons: Calibrate Using New Data, OK, Cancel

4. Select the transponder that is assigned to the BOP from the **Beacon** drop-down list in the **BOP** frame.
5. Select the transponder that is assigned to the Riser from the Beacon drop-down list in the **LFJ** frame.
6. Set the required update rates for the BOP and the Riser transponders (if using telemetry).

Note

If using the **Pulse Position Angle** method, set the update period in the same way as for any other mobile beacon (refer to **Section 4 "Common Procedures"**).

7. Set the initial BOP heading.
8. Leave **Pitch** and **Roll** offsets at zero.
9. If it is necessary to generate alarms when the difference between the BOP attitude and the Riser attitude exceeds defined limits:
 - Click the **Warning Alarm** check box and enter an angular alarm limit in degrees.
 - Click the **Critical Alarm** check box and enter an angular alarm limit in degrees.
10. Select the **Enable MRAMS** check box to enable the automatic MRAMS function.
11. Click OK to accept changes and close the **MRAMS Configuration** dialog box.

9.2.2 MRAMS Calibration

To calibrate the BOP and Riser attitudes, the BOP should be suspended in the water under the vessel at a depth where there is a clear line of sight between the transceiver and the transponders.

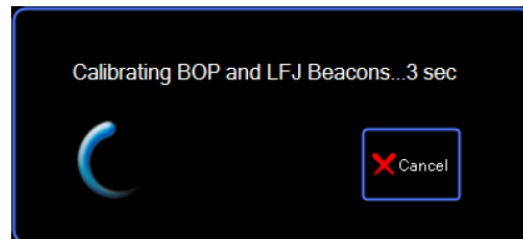
Note

The automatic MRAMS function must be switched off.

The system may then be calibrated as follows.

1. Click **Configure** on the **Riser Angle Monitoring** dialog box to display the **MRAMS Configuration** dialog box.
2. If the **Enable MRAMS** check box is selected, deselect it and click **OK**. The dialog closes. Click **Configure** again to reopen the dialog box.
3. Click **Calibrate** to begin measuring the BOP and Riser angles.

A dialog is displayed while this measurement continues:



When the measurement completes, the software displays the results on the MRAMS Configuration dialog, for example:



The Pitch and Roll offsets for the BOP and the Riser will now have been updated to give measured angles of 0 degrees.

4. Click **OK** to accept the new offsets.

BOP Heading

The BOP can now be lowered to the seabed and connected to the well head. After the BOP is connected it is necessary to enter the BOP heading into the Heading field so that it can correctly calculate the 'course to steer' for the vessel.

CAUTION

 **Risk of equipment malfunction. Failure to enter the correct heading of the BOP after it is latched on the seabed will cause the system to report an incorrect course to steer to minimise the differential angle.**

Set the BOP heading as follows:

1. Click **Configure** on the **Riser Angle Monitoring** dialog box to display the **MRAMS Configuration** dialog box.
2. Type the heading of the BOP into the **BOP Heading** field.
3. Click **OK** to close the **MRAMS Configuration** dialog box.

9.2.3 MRAMS Output Telegram

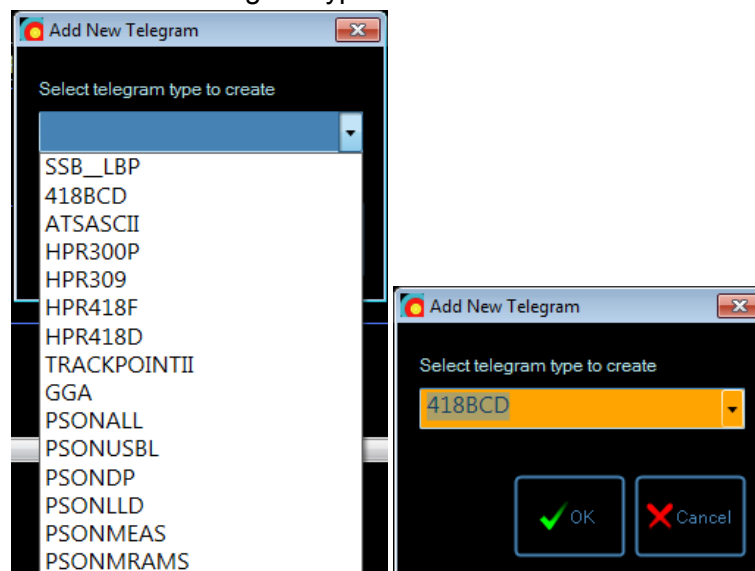
When MRAMS is working well, it is possible to add a DP telegram carrying MRAMS data. The usual choice of HPR309, 418 or 418BCD or SSB depends on the DPS configuration, but note that these telegrams require the LFJ beacon to be tracked in Pulse Position Angle mode.

The Sonardyne PSONMRAMS telegram can also be used. This has the advantage that it does not need the system to be tracking a beacon.

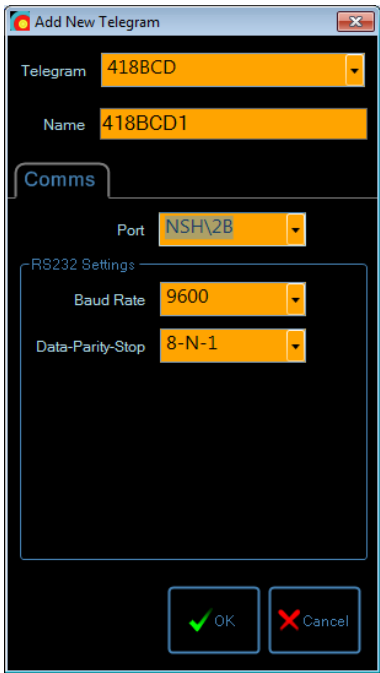
1. Click on the **Telegrams** button.



2. Click **Add**, select the chosen telegram type and then click **OK**.



3. Set up the communications port.



The 'Add New Telegram' dialog box contains the following fields and controls:

- Telegram:** A dropdown menu showing '418BCD'.
- Name:** A text field containing '418BCD1'.
- Comms:** A tabbed interface with the 'Comms' tab selected.
- Port:** A dropdown menu showing 'NSH\2B'.
- RS232 Settings:** A group box containing:
 - Baud Rate:** A dropdown menu showing '9600'.
 - Data-Parity-Stop:** A dropdown menu showing '8-N-1'.
- Buttons:** 'OK' (with a green checkmark) and 'Cancel' (with a red X).

4. Enable the Riser beacon only and click **OK**.



The 'Output Telegram Editor' dialog box displays a list of telegram entries with the following details:

Name	Type	Port
418BCD-1	418BCD	NSH2B

Below the header, there is a table of telegram entries:

Ship	Enable
Ship 1	☐
1702	☐
1703	☐
1704	☐
1705	☐
1706	☐
BOP 101	☐
LFJ 102	☒

For the 'LFJ 102' entry, additional settings are visible:

- Mobility:** Auto
- Index:** 101
- Frame of Reference:** Ship 1
- Orientation:** Bow Up
- Source:** Filtered

At the bottom, there are buttons for '+ Add', 'OK', and 'Close'.

The output telegram will now carry the MRAMS differential pitch and roll data each time the Riser position updates.

Refer to *Section 4.20 "Configuring Output Telegrams"* for more details on Telegram setup.

9.2.4 MRAMS Operation

Controlling Data Collection

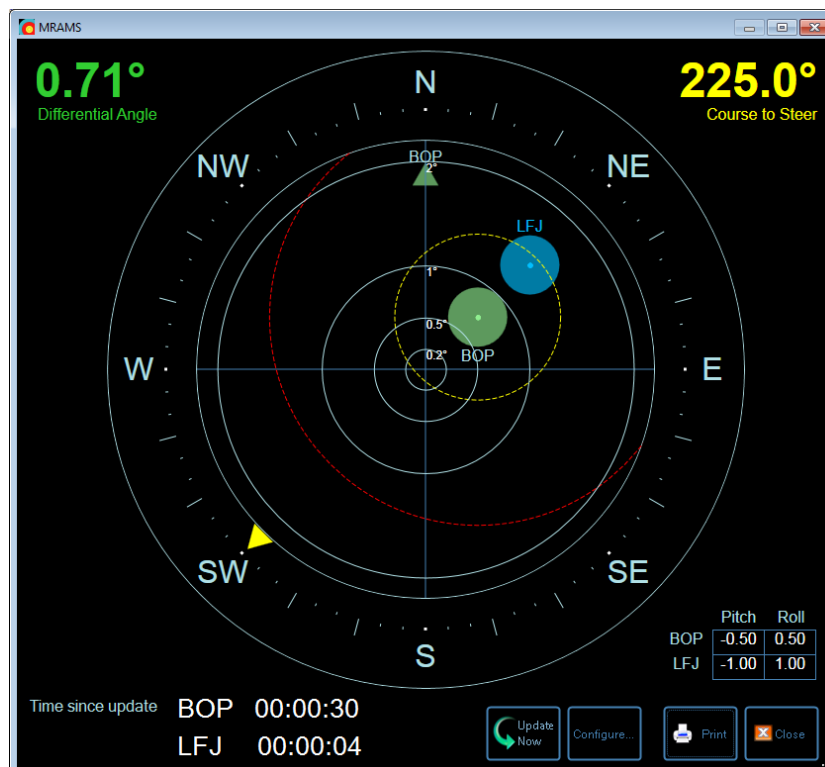
If the data collection technique is set to Telemetry then data is collected whenever the MRAMS function is enabled. In this mode it is not necessary to track the transponder in order to collect and display attitude data.

If the data collection technique is set to **Pulse Position Ranging** then data is collected whenever the transponder is being tracked and the automatic MRAMS function is enabled. If the transponder is not being tracked then a warning is displayed in the **Riser Angle Monitoring** dialog box.

You can manually request a reading from the transponder using telemetry by clicking the **Update Now** button on the main MRAMS window.

The MRAMS Display

Figure 9–2 Riser Angle Monitoring Display



The Bubble Gauge in the centre of the screen shows the angles of the BOP and of the Riser, with a blue arrow to indicate the BOP heading as entered in the **MRAMS Configuration** dialog box. The dotted red and yellow circles at the centre of the screen show the **Warning** and **Critical** alarm limits. The small yellow arrow and the yellow data field at the top right-hand corner of the screen indicate the course to steer.

The top left-hand field indicates the differential angle between the BOP and the Riser.

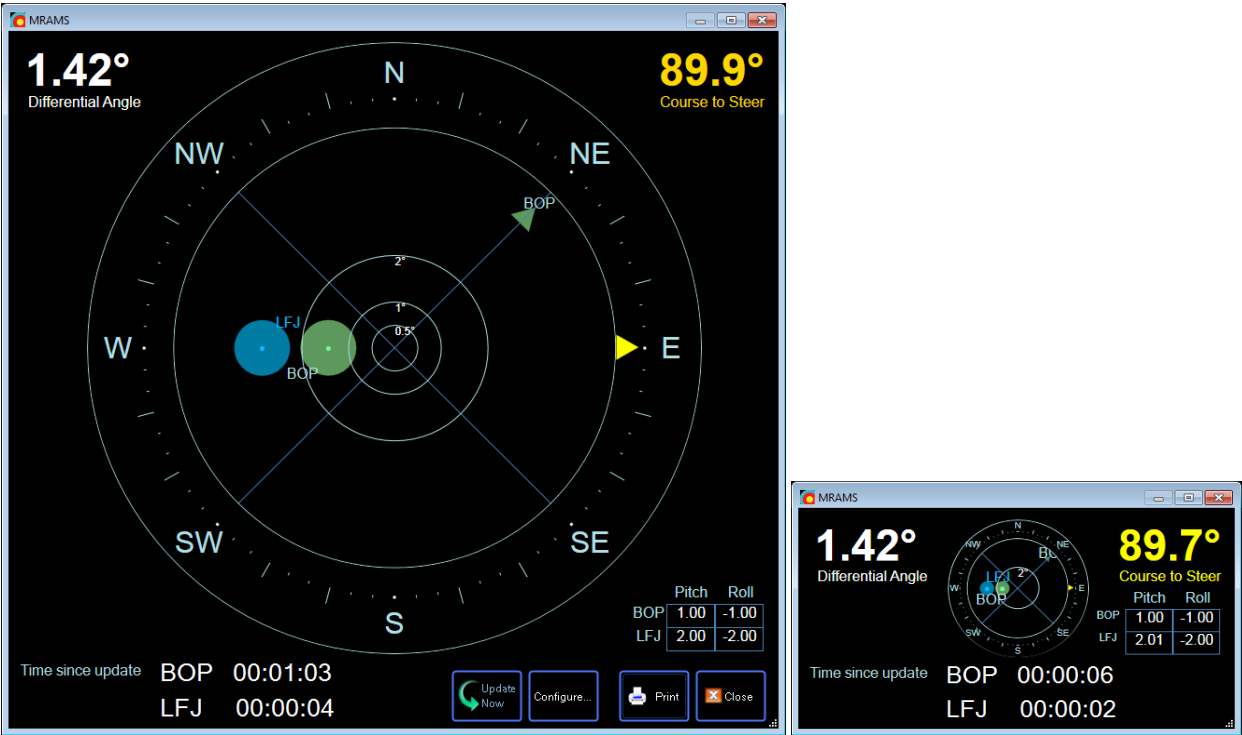
The bottom right-hand field indicates the pitch and roll of both the BOP and the Riser.

The MRAMS Reduced Display

Where screen space is limited, the MRAMS display window can be resized (using standard Windows techniques of dragging a corner) to a very small display. The key parameters are maintained using a large font that can be read from a distance.

All other functions, such as alarms, remain the same.

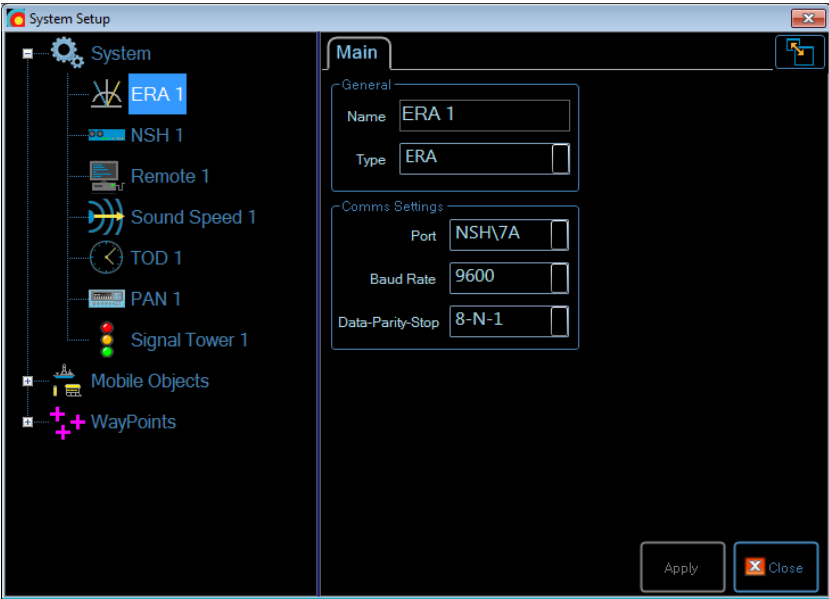
To close the window, click the Quit button at the top right-hand corner.



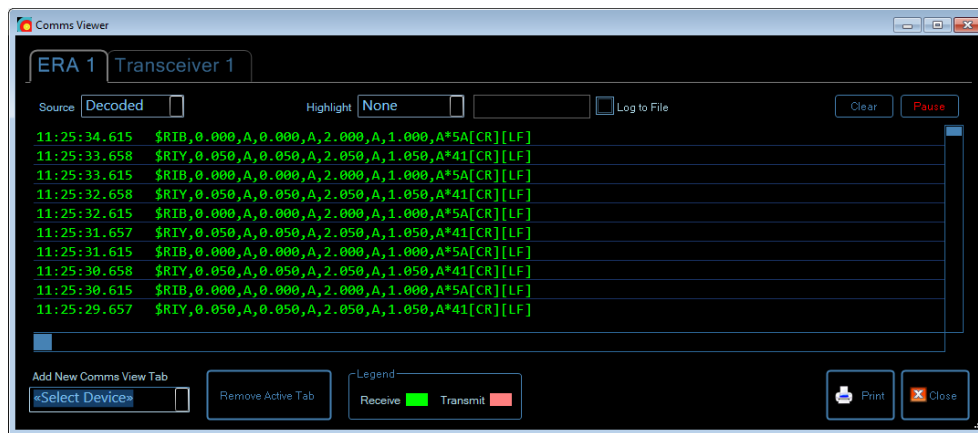
9.3 Electrical Riser Angle (ERA) Monitoring

9.3.1 ERA Software Configuration

1. Add an ERA device to the system setup as described in *Section 4.4 "Adding Objects "* and *Section 4.16.2 "Electronic Riser Angle (ERA)"*.



- Check that comms from both **Blue** and **Yellow** ERA sensors is being received correctly using the Comms Viewer.



9.3.2 ERA Operation

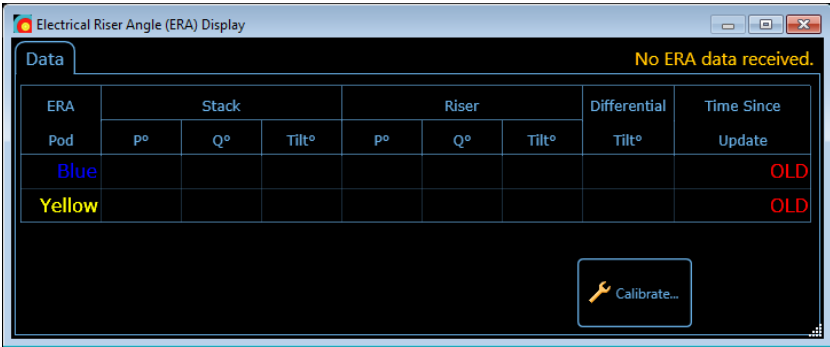
Once an ERA device is added to the system setup, the ERA display can be viewed at any time from the **Tools** menu.

The ERA display shows:

- the Blue P and Q angles and the calculated tilt for the BOP Stack
- the Blue P and Q angles and the calculated tilt for the BOP Riser
- the Blue differential tilt
- the Blue time since last update
- the Yellow P and Q angles and the calculated tilt for the BOP Stack
- the Yellow P and Q angles and the calculated tilt for the BOP Riser
- the Yellow differential tilt
- the Yellow time since last update

ERA Pod	Stack			Riser			Differential	Time Since Update
	P°	Q°	Tilt°	P°	Q°	Tilt°	Tilt°	
Blue	1.03	1.93	2.19	0.03	-0.07	0.08	2.24	00:00:01
Yellow	1.08	1.98	2.26	0.08	-0.02	0.08	2.24	00:00:01

If ERA comms is lost or corrupted, a warning is displayed as shown below.



9.3.3 ERA Calibration

To calibrate the ERA, click **Calibrate**.

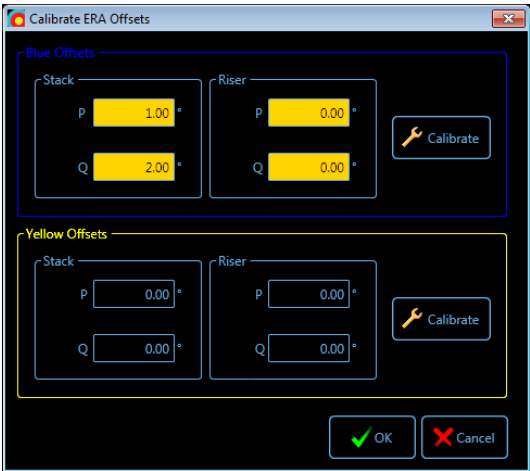
Note

 When calibrating the ERA, ensure that the stack is in a vertical rest position.

There are two calibration methods available.

Either:

1. Enter the **P** and **Q** values for **Stack** and **Riser** manually, or,
2. Click both **Calibrate** buttons for the system to take an average of numerous readings.



Section 10 – Riser Profile System

10.1 Introduction

This section describes the Riser Profiling System (RPS) that is integrated into the software.

In order to use the RPS, a set of Compatt6 beacons must first be attached along the length of the riser at regular intervals. Typically this involves ten beacons spaced 200 to 300 metres apart.

The RPS gathers the following information about the condition of the riser at each beacon location:

- Depth
- Riser pitch / roll inclination
- Temperature
- Water current direction and speed (but only if the beacon has an Aqua-Dopp™ current meter fitted)

The RPS requests this information via acoustic telemetry either on demand, or automatically at predefined intervals.

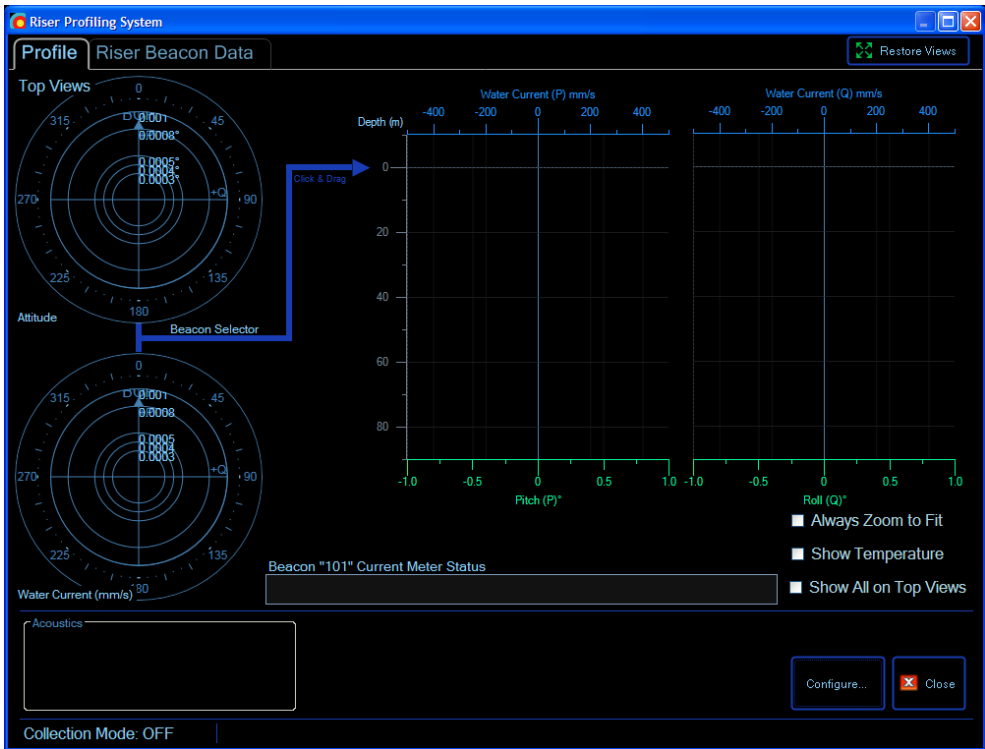
10.2 RPS Configuration Prerequisites

The RPS assumes that a job has already been created that is suitable for the installation configuration you are using. Therefore you must have: the following

- An HPT Transceiver attached to the surface vessel and configured for use.
- All required Compatt6 beacons added to the job as **Mobile Objects**. These must correspond to the beacons that are physically fitted to the riser. Note that, when each beacon is initialized, its sensing capabilities (Depth, Inclination, Temperature and Water Current) are automatically detected for use by the RPS.

10.3 Starting RPS

To start the RPS display, choose **Tools > Riser Profiling** Profiling from the main menu. At this point, the display will be empty as shown below. Note that the **Collection Mode** in the status bar is OFF.



10.4 Software Configuration

Click **Configure** on the RPS window to display the **Riser Profile Configuration** window (shown below). The Beacons tab shows all Compatt6 type beacons that are available for use in RPS. By default, each beacon is not assigned for use in RPS (which is why the **Use As** column shows **None** in all entries).

The screenshot shows the Riser Profile Configuration window. The window is titled "Riser Profile Configuration" and has three tabs: "Beacons", "Riser", and "Advanced". The "Beacons" tab is active, displaying a table of beacons. The table has columns: Beacon, Use As, Manual Depth, Depth (m), * Heading Offset*, Pitch Offset*, and Roll Offset*. The "Use As" column shows "None" for all beacons. The "Pitch Offset*" and "Roll Offset*" columns show "0.0" for all beacons. A "* Relative to Riser Heading" note is at the bottom left. Buttons for "Sort", "OK", and "Cancel" are at the bottom right.

Beacon	Use As	Manual Depth	Depth (m)	* Heading Offset*	Pitch Offset*	Roll Offset*
101	None	☐			0.0	0.0
102	None	☐			0.0	0.0
103	None	☐			0.0	0.0
104	None	☐			0.0	0.0
105	None	☐			0.0	0.0
106	None	☐			0.0	0.0
107	None	☐			0.0	0.0
108	None	☐			0.0	0.0
109	None	☐			0.0	0.0
110	None	☐			0.0	0.0

Set each Use As dropdown to Riser, and set a default Heading Offset value of 0.0.



The image shows the 'Beacons' tab of the 'Riser Profile Configuration' window. It contains a table with 10 rows of beacon data. Each row has columns for Beacon ID, Use As, Manual Depth, Depth (m), * Heading Offset°, Pitch Offset°, and Roll Offset°. All 'Use As' values are set to 'Riser' and all 'Depth (m)' values are empty. The 'Heading Offset' for all beacons is 0.0. Below the table, there is a note '* Relative to Riser Heading', a 'Sort' button, and 'OK' and 'Cancel' buttons.

Beacon	Use As	Manual Depth	Depth (m)	* Heading Offset°	Pitch Offset°	Roll Offset°
101	Riser	☐		0.0	0.0	0.0
102	Riser	☐		0.0	0.0	0.0
103	Riser	☐		0.0	0.0	0.0
104	Riser	☐		0.0	0.0	0.0
105	Riser	☐		0.0	0.0	0.0
106	Riser	☐		0.0	0.0	0.0
107	Riser	☐		0.0	0.0	0.0
108	Riser	☐		0.0	0.0	0.0
109	Riser	☐		0.0	0.0	0.0
110	Riser	☐		0.0	0.0	0.0

During normal operation of the RPS, each beacon's depth is retrieved automatically via acoustic telemetry.

It is possible that telemetry may fail from one or more beacons, resulting in an invalid depth entry for it.

To work around this problem, the RPS Configuration window allows manual entry of depth.

To enter a manual depth for a beacon, select the Manual Depth check box in the relevant row of the table, then enter the depth in metres in the corresponding Depth field, for example:



The image shows a single row from the 'Beacons' table, specifically for beacon 104. The 'Manual Depth' checkbox is checked, and the 'Depth (m)' field contains the value '403.0'. The other fields are 'Riser', '0.0', '0.0', and '0.0'.

Now click on the **Riser** tab.



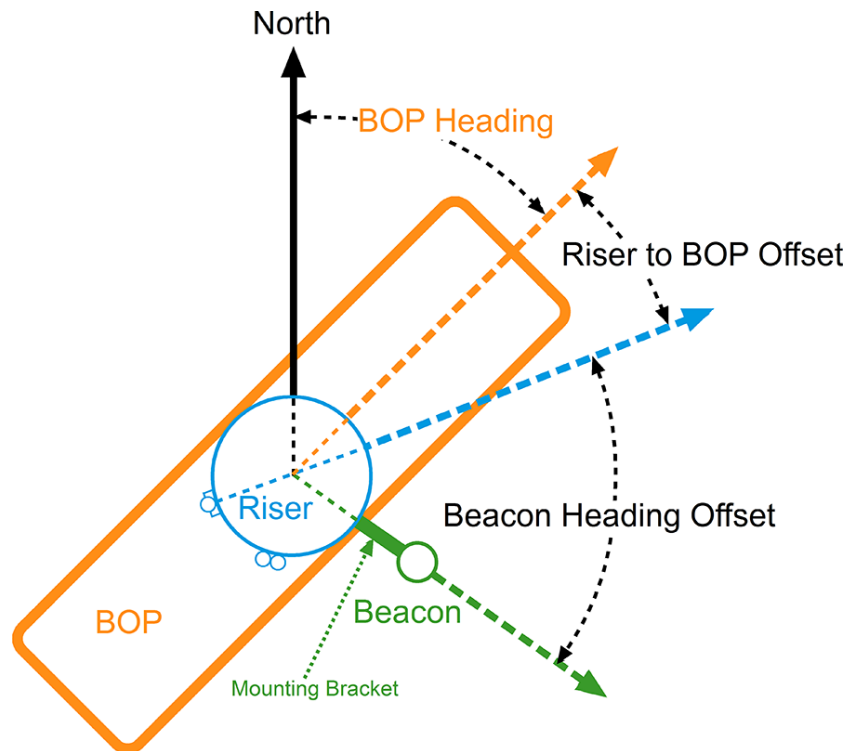
The image shows the 'Riser' tab of the 'Riser Profile Configuration' window. It contains two main sections: 'Data Collection' and 'Alarms'. The 'Data Collection' section has fields for 'Collection Mode' (OFF), 'Beacon Retry Limit' (3), 'Automatic Repeat Period' (2 hrs), and 'Use Inter-Beacon Spacing' (checked, 10 mins). The 'BOP Heading' section has fields for 'Absolute Heading' (0°) and 'Riser to BOP Heading Offset' (Heading Offset, 0°). The 'Alarms' section has a checkbox for 'Raise Alarm when:' and a field for '|Riser Angle°| > 0.6°'. 'OK' and 'Cancel' buttons are at the bottom right.

Before you modify any fields, obtain the following information from external sources (for example, via external measurements or mechanical drawings):

- BOP Heading
- Riser to BOP Heading Offset
- Beacon Heading Offsets

Figure 10–1 shows the physical relationship of these values.

Figure 10–1 Relationship between BOP and Beacon Parameters



Set the relevant values into the BOP Heading and Riser to BOP Heading Offset fields.

The **Beacon Heading Offsets** must be entered individually for each beacon.

To do this, select the Beacons tab and enter the values for each beacon **Heading Offset** (where 0.0 exists as a default). Note that these values are relative to the Riser Heading as shown above, not the BOP Heading.

10.4.1 Set the Collection Mode

The Collection Mode determines when to collect the data from all the riser beacons.

- **OFF** – The RPS will not perform any data collection.
- **Manual** – The RPS will collect data from the riser beacons only when the **Get Profile** button (on the main RPS display) is clicked. Note that this button is visible only when manual mode is selected. In this mode, the data collection will proceed as fast as possible with no delay between each beacon.
- **Auto** – The RPS will automatically collect data from all configured riser beacons (that is, where **Use As** is set to **Riser** on the **Beacons** tab). Collection occurs on a periodic basis using the time periods and spacings specified below:

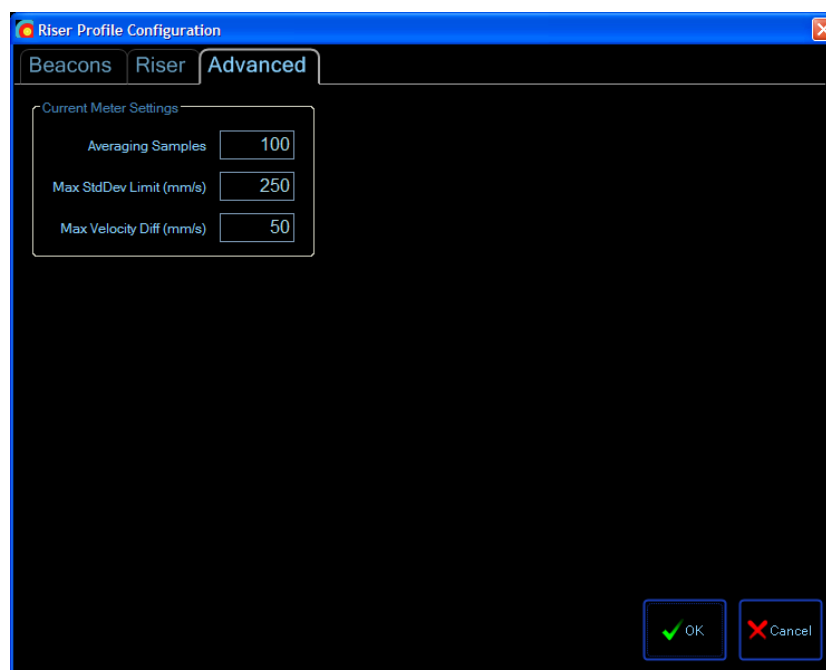
- **Automatic Repeat Period** – This is the time period for a full riser beacon measurement cycle. All riser beacon data will be collected and updated at this rate.
- **Use Inter-Beacon Spacing** check box – When checked, this feature helps minimize the impact of the acoustic telemetry on any acoustic tracking that may be occurring at the same time.
 - If this is not checked, then the RPS will collect all riser beacon data as quickly as possible, with no delay between each beacon.
 - If it is checked then the Inter-Beacon Spacing dropdown will be visible. This allows you to select the delay between each beacon command during the data collection cycle.

If Marksman is not required to perform any acoustic tracking, leave this check box unchecked.

Set the **Beacon Retry Limit**. If a beacon fails to respond to acoustic telemetry requests, then the RPS system will retry this number of times before abandoning it for the current measurement cycle. The default value of 3 should be good enough for most circumstances.

Set the inclinometer alarm threshold. If an alarm is required to be raised when any riser beacon's inclination exceeds a pre-set threshold, select the Raise **Alarm When** check box and set the **Riser Angle** alarm threshold.

Click on the **Advanced tab** on the configuration window.



This tab allows advanced configuration of some AquaDopp™ Current Meter settings. These should be left at their default values unless specific advice is given to change them.

Click **OK** on the Riser Profile Configuration window.

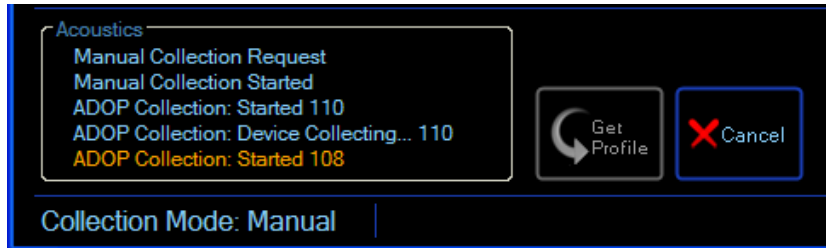
The RPS is now configured for use.

10.5 Operation

10.5.1 Manual Data Collection Mode

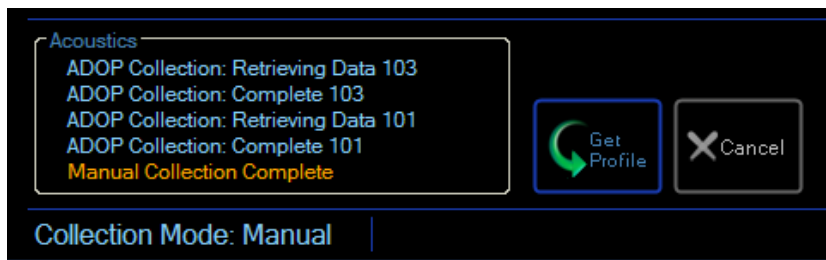
If you configured the RPS for Manual Collection, the **Get Profile** button will be displayed on the main RPS window.

Click the **Get Profile** button to retrieve the latest data from all riser beacons. Data will be retrieved as quickly as possible. The current state of collection is shown in the small Acoustics status window, for example:



You can abort the operation at any time by clicking the **Cancel** button.

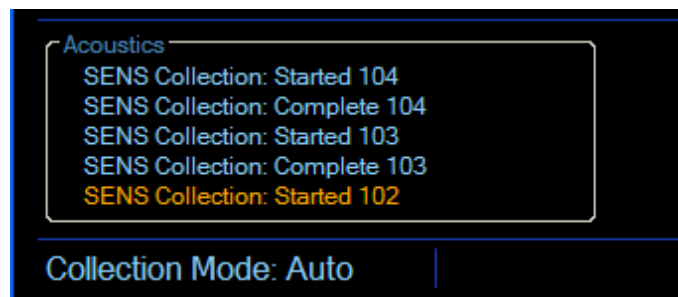
When collection is complete the status shows **Manual Collection Complete**, for example:



Note that the current collection mode is always displayed in the status bar.

10.5.2 Automatic Collection Mode

If you configured the RPS for Automatic Collection, the RPS periodically triggers a collection of all riser beacon data at the intervals specified in the RPS configuration. When collection occurs, the **Acoustics** status window shows current activity, for example:

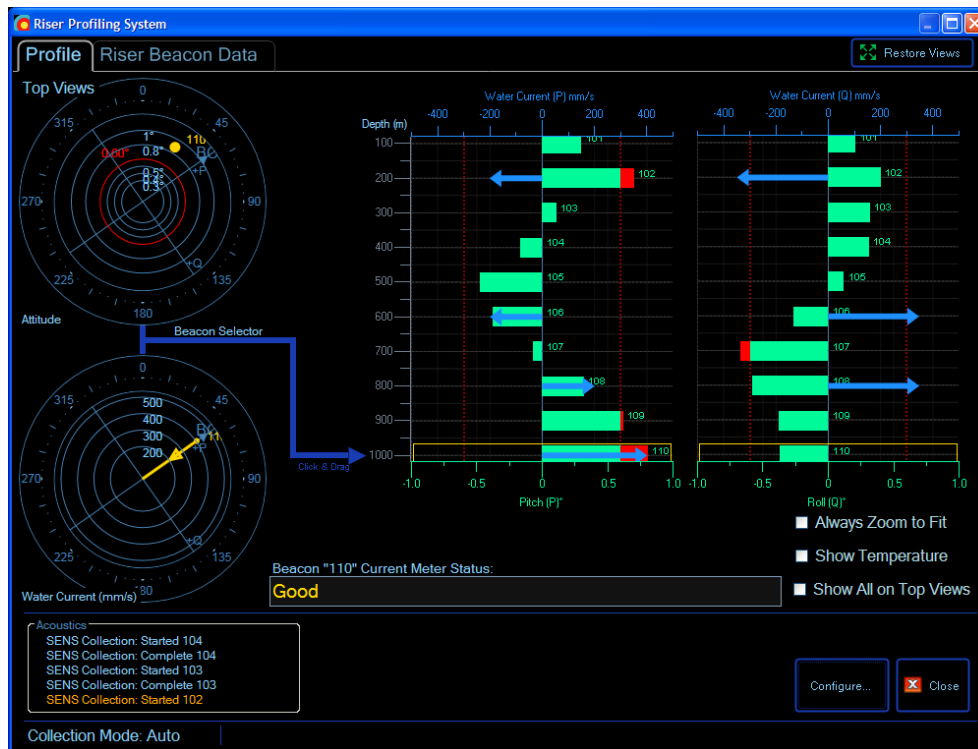


10.6 Riser Profiling System Displays

The RPS main display has two tabs. The **Profile** tab shows a graphical representation of the riser beacon data; the **Riser Beacon Data** tab shows a tabular view containing the actual values retrieved for each beacon.

10.6.1 Profile Tab

During collection the graphical display updates.



Side Views

The main centre and right regions of this window show side-view graphs of Inclination/Water Current against Depth.

Each green bar represents the Pitch and Roll for the named beacon at that depth along the P and Q axes respectively.

Note that the P axis is in the direction of the BOP Heading. The Q axis is at 90 degrees clockwise to it (looking down from above).

The bottom green axes show the roll and pitch scales in degrees.

The alarm thresholds (if enabled) are shown as red vertical dotted lines on the graph. If the roll or pitch for a given beacon exceeds the alarm threshold then the bar indicates the excessive roll or pitch by a red colour (see the examples shown above).

The light blue arrows on the same graph indicate the water current magnitudes along the P and Q axes for each beacon that has a current meter fitted. Note that in the example above, AquaDopp™ water current meters have been fitted only to the even-numbered beacons, hence there are only five beacons providing water current measurements.

The blue axes at the top of the graph show the water current scale in mm/s.

Modifying the View or Scales

All Water Current and Pitch/Roll scales support user interaction. Left click on a scale and drag to pan the scale and its data. Right click and drag on a scale to change the scaling (zoom factor) for that scale and its data.

You can also zoom in to a specific area of the graph by left clicking and dragging a rectangle around the area you wish to zoom.

To show all side view data fully zoomed to fit, select the **Always Zoom** to Fit check box.

To restore these graphs to their original state, click the **Restore Views** button at top right of the display.

Top Views

The left of the display shows two circular top-down views of the riser. Pitch and Roll is shown at top left; Water Current is shown at bottom left. The perimeter scale of each view shows heading ($^{\circ}$), with North topmost at 0. The P and Q axes (mentioned earlier) are shown with the BOP heading aligned to +P.

The riser inclination alarm threshold (if enabled) is shown on the Pitch/Roll view as a red dotted circle.

Both top views auto-scale to fit the data that they display. There is no manual way of changing these scales.

By default only the data for a selected beacon on the side view is shown. On the Pitch/Roll view the beacon's attitude is shown as a single yellow point (labelled with the beacon name). On the Water Current view the current is shown as a yellow arrowed line indicating the direction and speed of the current.

Beacon Selection

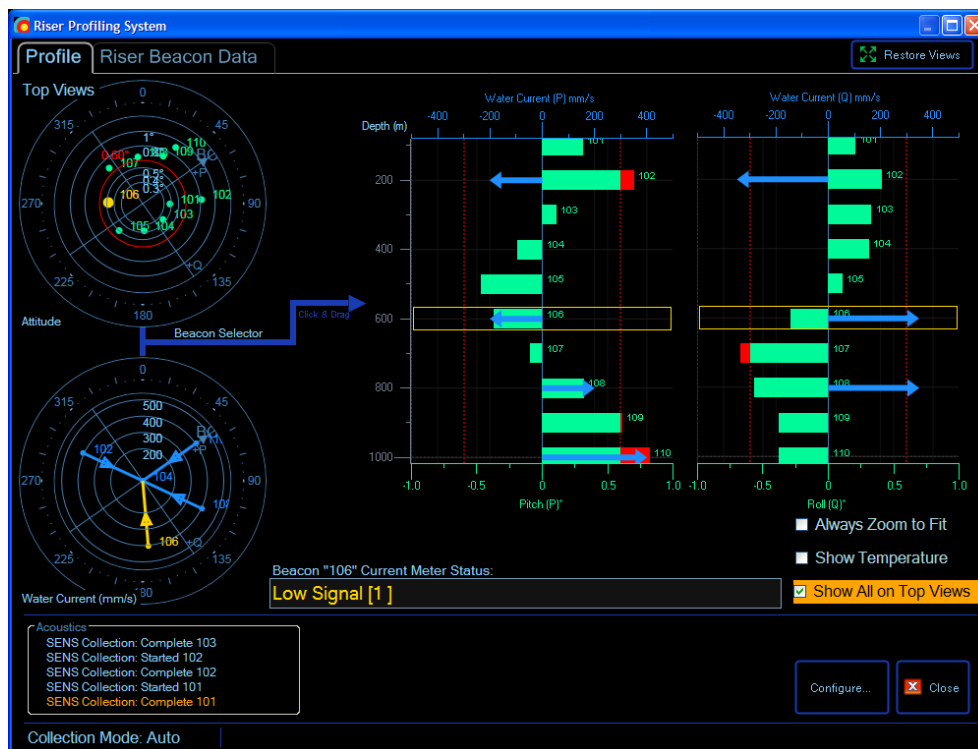
To show different beacon data on the top views, the selected beacon must be changed.

Beacon selection is performed by clicking and dragging the blue **Beacon Selector** arrow up or down beside the **Depth** axis. As the selector is moved, the nearest beacon to the selector arrow is selected (indicated by two yellow rectangles). Both top views update with the selected beacon's data. The selected beacon's Current Meter Status (if available) is also updated (at the bottom centre of the display).

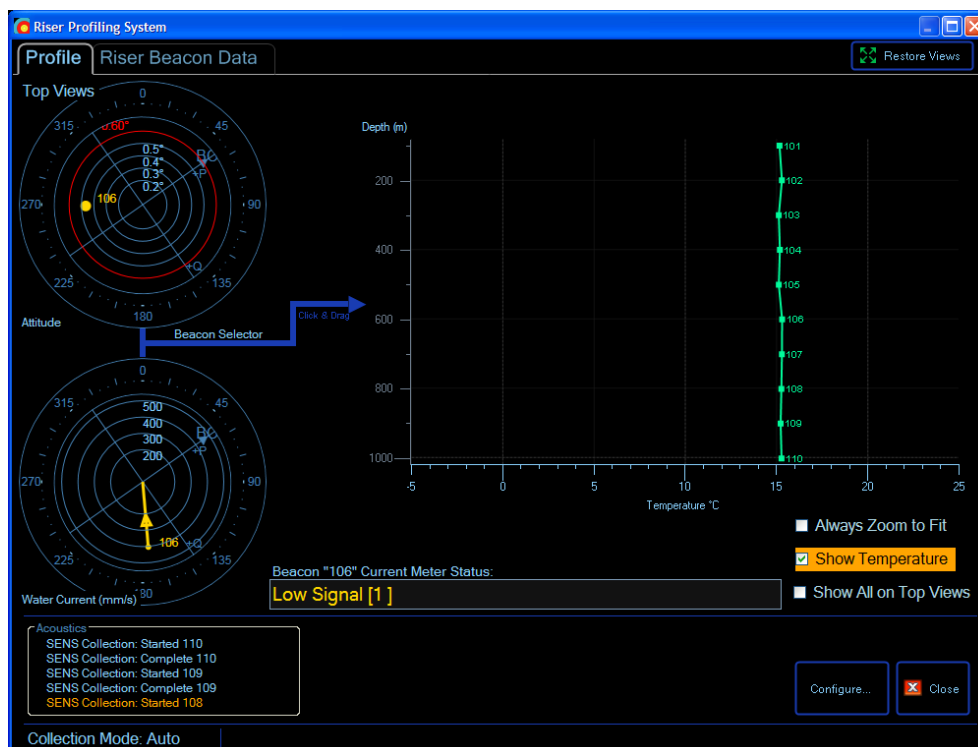
Note that all selected beacon data is indicated in yellow.

Other Display Options

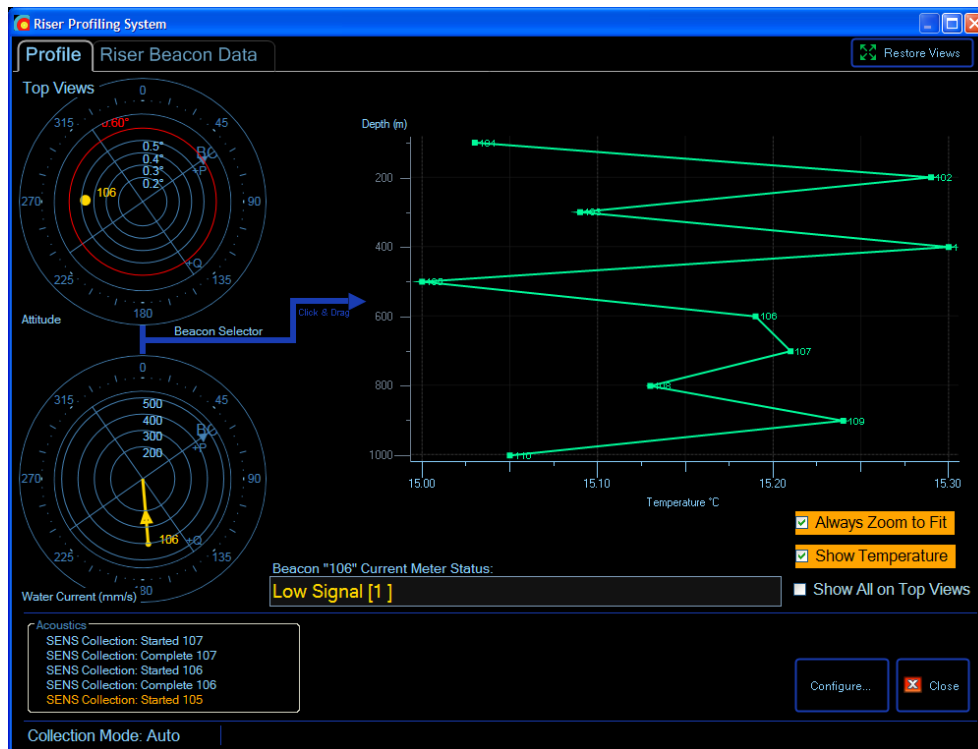
To show all beacon data on the top views, select the **Show All on Top Views** check box at the bottom right. This may be useful, depending on whether there is much overlap between the beacon data. An example is shown below.



To show a graph of Temperature against Depth, click the **Show Temperature** check box. An example is shown below.



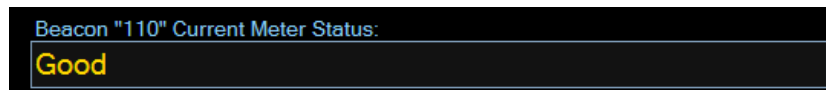
Clicking the **Always Zoom to Fit** check box automatically expands this to show more detail.



To restore, either deselect the **Always Zoom to Fit** check box or click the **Restore Views** button at the top right.

Beacon Current Meter Status Field

As mentioned earlier the **Selected Beacon's Current Meter Status** is always indicated in the status window, for example:



The full range of status texts and their meaning are as follows:

- **Not Installed** – An AquaDopp current meter is not fitted to this riser beacon.
- **Bad Turbulence** – The water current values could not be determined because of severe turbulence around the beacon.
- **Low Signal** – One or more of the sensors on the current meter experienced a low return signal, which may reduce reliability of the result.
- **Velocity Outlier** – One or more of the sensors on the current meter detected a water velocity that was outside the expected range.
- **High SD** – One or more of the sensors on the current meter experienced a high standard deviation of velocity readings.
- **Minor Turbulence** – The water current values were calculated using a reduced set of sensor data, resulting in lower confidence in the result.
- **Good** – The current meter produced a very reliable result with no detected turbulence.

10.6.2 Riser Beacon Data Tab

Select the **Riser Beacon Data** tab. A table of all beacon data values is shown.

This display is useful for inspecting individual values or the age of the retrieved data. None of the fields can be edited.

The screenshot shows the 'Riser Profiling System' window with the 'Riser Beacon Data' tab selected. The table displays data for 10 beacons, sorted by depth. The columns are: Beacon, Depth (m), * Heading Offset*, Pitch (P)°, Roll (Q)°, Tilt°, Temp. °C, Current (mm/s), Current Hdg°, and Age (hh:mm:ss). Below the table, there is a status bar indicating 'Collection Mode: Manual' and a list of acoustic collection events.

Beacon	Depth m	* Heading Offset*	Pitch (P)°	Roll (Q)°	Tilt°	Temp. °C	Current mm/s	Current Hdg°	Age hh:mm:ss
101	100.2	0.0	0.31	0.22	0.38	15.2			00:06:34
102	200.1	0.0	0.71	0.43	0.83	15.2	404.0	240.0	00:06:22
103	300.0	0.0	0.11	0.30	0.32	15.2			00:06:38
104	400.1	0.0	-0.17	0.31	0.35	15.2	401.3	300.0	00:06:24
105	500.1	0.0	-0.47	0.11	0.48	15.1			00:06:42
106	600.1	0.0	-0.37	-0.29	0.47	15.2	401.0	120.1	00:06:26
107	700.3	0.0	-0.09	-0.67	0.68	15.2			00:06:46
108	800.2	0.0	0.32	-0.57	0.65	15.2	401.0	60.1	00:06:29
109	900.1	0.0	0.60	-0.36	0.70	15.2			00:06:51
110	1000.2	0.0	0.81	-0.39	0.90	15.1	401.0	359.9	00:06:31

* Relative to Riser Heading

Acoustics:
 ADOP Collection: Retrieving Data 104
 ADOP Collection: Complete 104
 ADOP Collection: Retrieving Data 102
 ADOP Collection: Complete 102
 Manual Collection Complete

Collection Mode: Manual

The columns are as follows:

- **Beacon** – Shows the beacon name.
- **Depth** – Shows the last retrieved depth in metres of each beacon. If the RPS Configuration window specified any Manual Depths, then those manual depths are shown here as well.
- **Heading Offset** – Shows the Heading Offset specified in the RPS Configuration as a read-only field.
- **Pitch (P) °** and **Roll (Q) °** – Show the latest inclinometer values of each beacon, rotated to the P and Q axis frame.
- **Tilt°** – This shows the maximum inclination due to Pitch(P) and Roll(Q) experienced by the beacon. This is typically along an axis between P and Q.
- **Temp °C** – Shows the last retrieved temperature of each beacon.
- **Current mm/s** – Shows the latest water current speed in mm/s flowing past the AquaDopp attached to the beacon. This field is blank if no current meter is fitted.
- **Current Hdg°** – Shows the latest water current heading (relative to north). This field is blank if no current meter is fitted.
- **Age** – Shows the age of the data obtained for each beacon. Format is: Hours:Minutes:Seconds.

10.7 Automatic Logging of Processed Data

All raw Riser Profiling System sensor data from all deployed riser beacons is automatically logged to the Marksman database. This raw data is processed before being shown on the Riser Profiling System displays.

In addition to the raw data, Marksman also automatically logs the processed version of the data to a separate set of CSV files (which are not connected with the main database).

10.7.1 RPS Log File Management

All data from the RPS system is logged to a long-running rolling set of CSV files.

- One RPS log file will contain up to seven days' worth of logged records.
- After seven days of logging, a new log file will be created to capture data for the next seven days, and so on.
- Log files will accumulate like this until 365 days have elapsed since the first log file was created.
- After 52 files have been logged, the oldest log file (containing data from the first seven days of data) will be deleted, before a new one is created. Therefore, only the most recent 365 days' worth of data is kept.
- Log files are named using the following format:

RPS_YYYYMMDD_HHMMSS.csv

Where:

- YYMMDD is the date
- HHMMSS is the time that the log file was CREATED (not last saved).

Example: RPS_20120709_133917.csv

- Log files are stored in the following folder:

C:\Documents and Settings\All Users\Documents\Sonardyne\
Marksman\Jobs\ <JobName> \RPSLogs

10.7.2 RPS Log File Format

Each record in the log file consists of either a **BeaconSensor** record or a **WaterCurrent** record using the comma-separated values described below.

BeaconSensor

BeaconSensor Record format (field numbers 1... 15).

1. Date/Time of Sensor measurement (UTC) [= Sonardyne QPC time].
2. Record Type = **BeaconSensor**
3. Beacon Name and Address from which the measurement originated.
4. Beacon Depth (metres) – as measured by the beacon, including any depth offset.
5. Raw Pitch (P)° – as seen by the beacon inclinometer. It is used to calculate a corrected value of pitch.
6. Raw Roll (Q)° – as seen by the beacon inclinometer. It is used to calculate a corrected value of roll
7. Corrected Pitch (P)° – computed pitch as seen on the P axis (see the RPS specification).
8. Corrected Roll (Q)° – computed roll as seen on the Q axis (see the RPS specification).
9. Tilt° – computed from corrected pitch and roll.
10. Temperature ° – as measured on the beacon.
11. Pitch Correction° – used to calculate corrected values.

12. Roll Correction° – used to calculate corrected values.
13. BOP Absolute Heading° – used to calculate corrected values.
14. Riser to BOP Heading Offset° – used to calculate corrected values.
15. Heading Offset relative to Riser° – used to calculate corrected values.

WaterCurrent

WaterCurrent Record format (field numbers 1... 19).

1. Date/Time of Sensor measurement (UTC) [= Sonardyne QPC time]
2. Record Type = **WaterCurrent**.
3. Beacon Name and Address from which the measurement originated.
4. Beacon Depth (metres) – as measured by the beacon, including any depth offset.
5. Raw Beam 1 Velocity (mm/s).
6. Raw Beam 1 Velocity Standard Deviation (mm/s).
7. Raw Beam 1 Amplitude (0..255).
8. Raw Beam 2 Velocity (mm/s).
9. Raw Beam 2 Velocity Standard Deviation (mm/s).
10. Raw Beam 2 Amplitude (0..255).
11. Raw Beam 3 Velocity (mm/s).
12. Raw Beam 3 Velocity Standard Deviation (mm/s).
13. Raw Beam 3 Amplitude (0..255).
14. Computed Water Current Speed (mm/s).
15. Computed Water Current Heading ° relative to BOP.
16. Water Current Measurement Status value (enumerated).
17. BOP Absolute Heading° – used to calculate corrected values.
18. Riser to BOP Heading Offset° – used to calculate corrected values.
19. Heading Offset relative to Riser° – used to calculate corrected values.

Example output

2012/07/09 13:39:52,**BeaconSensor**,1703,199.2,0.40,-0.30,-0.26,
0.43,0.50,4.0,0.00, 0.00,45.0,22.0,180.0

2012/07/09 13:39:54,**BeaconSensor**,1702,99.2,0.20,0.10,0.22,0.02,0.22,4.0,0.00,
0.00,45.0,22.0,0.0

2012/07/09 13:40:00,**WaterCurrent**,1704,299.2,-401.0,100.0,128,-201.0,
100.0,128, -200.0,100.0,128,401.0,21.9,Good,45.0,22.0,0.0

2012/07/09 13:40:03,**WaterCurrent**,1703,199.2,-345.0,100.0,128,-346.0,
100.0,128, 1.0,100.0,128,399.0,171.9,Good,45.0,22.0,180.0

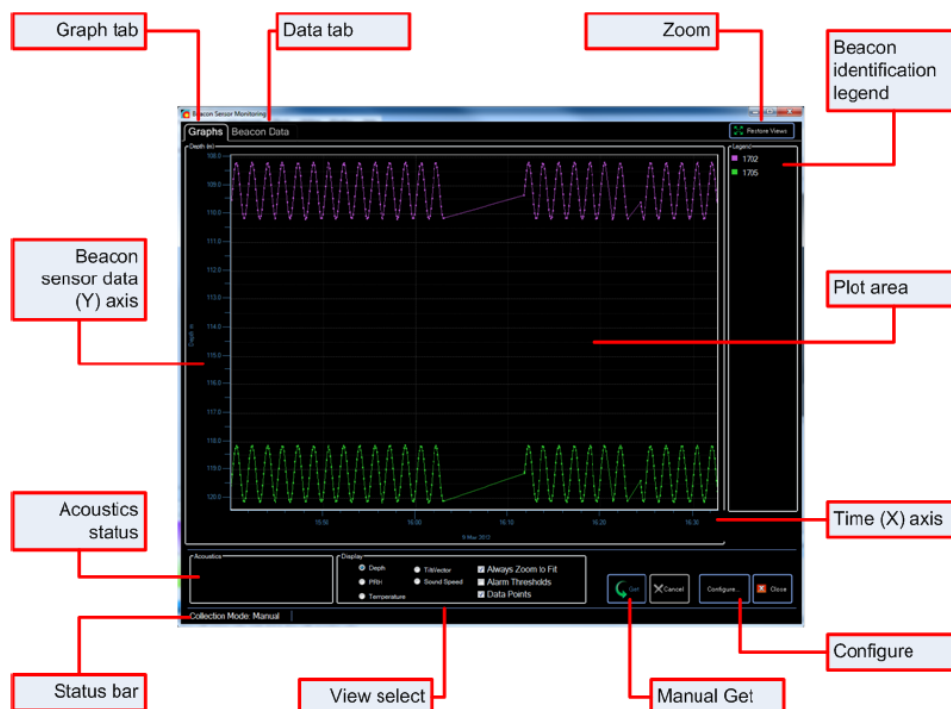
Section 11 – Beacon Sensor Monitoring Tool

11.1 Introduction

This section describes the Beacon Sensor Monitoring tool that is integrated into the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP system.

11.2 Overview

The Beacon Sensor Monitoring Tool allows automatic or manual sensor data collection from one or more Compatts, together with historic and real-time visualisation. Optionally, alarms can be raised if sensor values move outside preset limits.



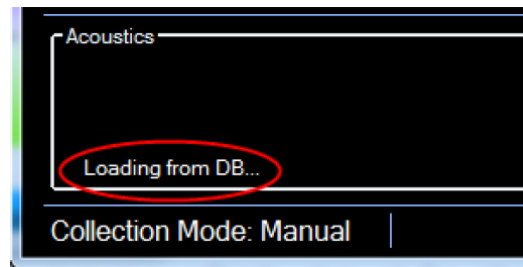
The Beacon Sensor Monitoring tool can gather and display the following sensor data from each Compatt, depending on which sensors are fitted:

- Depth
- Pitch/Roll/Heading
- Temperature
- Tilt/Vector
- Sound Speed

All data is collected by using acoustic telemetry.

The Beacons Sensor Monitoring tool also displays historical data for each beacon. Note, however, that it might take the tool a few moments to retrieve this data.

While historic data is being retrieved, the message **Loading from DB** is displayed in the acoustics status window in the bottom left hand corner of the main window:



After the data retrieval completes, the historical data is plotted and the **Loading from DB** message disappears.

11.3 Assumptions

The Beacon Sensor Monitoring tool assumes that a job has already been created and this matches all the equipment in use. The job must contain:

- HPT or GDT Transceiver attached to the surface vessel and configured for use.
- Compatt 6 and/or Compatt 5 beacons added to the job as Mobile Beacons. These must correspond to the beacons that are physically deployed.

Note

 When each beacon is initialised, its sensor capabilities (Depth, Inclination, Heading, Temperature and Sound Speed) are automatically detected for use by the Beacon Sensor Monitoring tool.

11.4 Configuration

To use the Beacon Sensor Monitoring display, choose **Tools > Beacon Sensor Monitoring** from the main menu. At this point the Graphical display might or might not be empty, depending on whether or not there is historical data to be retrieved.

Note that the Collection Mode in the status bar is initially OFF.

Click **Configure** on the Beacon Sensor Monitoring main window to display the Configuration window. The **General** tab of this window is shown below.



11.5 Setting the Collection Mode

The collection mode determines when to collect sensor data from all the beacons.

- **OFF:** The Beacon Sensor Monitoring tool does not perform any data collection.
- **Manual:** The Beacon Sensor Monitoring tool collects data from the configured beacons (that is, where **Monitor** is checked on the **Beacons** tab) only when the **Get** button (on the main window) is clicked.
- Note that the **Get** button is visible only when manual mode is selected. In this mode, the data collection proceeds as quickly as possible with no delay between each beacon.
- **Auto:** The Beacon Sensor Monitoring tool automatically collects data from all configured beacons (that is, where **Monitor** is checked on the **Beacons** tab). Collection cycles occur periodically using the time periods and spacing specified below:
 - **Automatic Repeat Period** – This is the time period for a full collection cycle. All beacon data is collected and updated at this rate.
 - **Use Inter-Beacon Spacing** check box – When selected, this feature helps minimise the impact of the acoustic telemetry on any acoustic tracking that might be occurring at the same time.
 - If this check box is not selected, the Beacon Sensor Monitoring tool collects all beacon data as quickly as possible, with no delay between each beacon.
 - If this check box is selected then the Inter-Beacon Spacing numeric boxes are visible. Enter the delay between each beacon command during the data collection cycle.

If the system is not required to perform any acoustic tracking, leave this check box deselected.

Note



In auto mode, beacon sensor monitoring runs even when the Beacon Sensor Monitoring Tool window is not open.

Set the **Telemetry Attempt Limit**. If a beacon fails to respond to acoustic telemetry requests, then the Beacon Sensor Monitoring tool retries a number of times set by this limit before abandoning it for the current measurement cycle. The default value of 3 should be satisfactory for most circumstances.

Set the **Alarm Thresholds** for depth, tilt, sound speed and temperature delta. If an alarm is required when any beacon's depth, tilt, sound speed or temperature change by more than a pre-set delta threshold, select the **Raise Alarm When** check box and set the delta value.

11.6 Setting the Beacons to be Monitored

Click on the **Beacons** tab on the configuration window.

Beacon	Monitor	Cal. Depth m	Cal. Temp.°	Cal. Tilt°	Cal. S.S. m/s	Last Depth m	Last Temp.°	Last Tilt°	Last S.S. m/s	Manual Heading°	Calibrate
1702	Yes ☒	0.0	0.00	0.00	0.0	108.2	4.00	7.07		0.00	Calibrate
1705	Yes ☒	0.0	0.00	0.00	0.0	118.2	4.00	7.07	1490.0	45.00	Calibrate

The **Beacons** tab shows all Compatt 6 and Compatt 5 type beacons that are available for use in Beacon Sensor Monitoring. Set the **Monitor** check box to 'yes' to monitor a beacon.

Click on **Calibrate** to set the reference depth, temperature, tilt and sound speed values for each beacon. This calibrated value is then used with the delta alarm threshold set on the **General** tab to set the alarm boundary values. For example, if the calibrated depth is 100 m and the depth alarm threshold is ± 2.00 m, then an alarm is displayed if the beacons depth is less than 98 m or greater than 102 m.

Note that the software only retrieves the data from the sensors fitted to the beacon

The **Manual Heading** column is used to set a heading offset. This is used to ensure the pitch and roll values are rotated correctly if the beacon is to be installed at a specific heading offset. This is set to a default of 0 degrees.

Note

 It is not possible to set a Manual Heading if the beacon has a Pitch Roll Heading device attached, for example a GyroCompatt, because its heading value is read from the device and there is no need to rotate the pitch and roll values.

Click **Apply** to accept changes in the configuration.

Click **OK** to close the window.

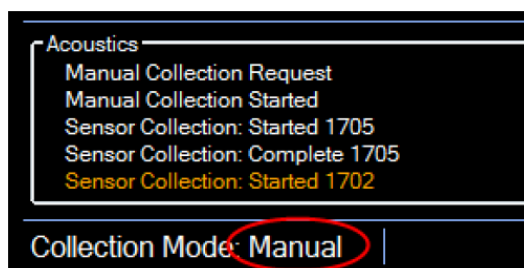
The Beacon Sensor Monitoring tool is now configured to use.

11.7 Operation

11.7.1 Manual Data Collection Mode

The current collection mode is always displayed in the status bar.

If the Beacon Sensor Monitoring tool is configured for Manual Collection, the **Get** button is displayed on the main window. Click the **Get** button to retrieve the latest data from all riser beacons. In this case, data is retrieved as quickly as possible. The current state of collection is shown on the small Acoustics status window, for example:



You can click the **Cancel** button at any time to abort the operation.

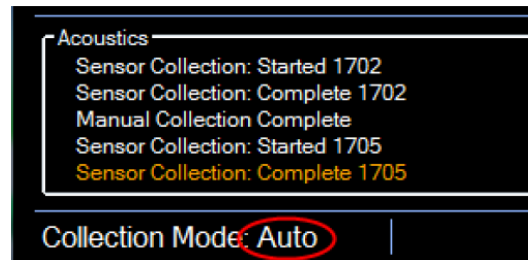
When the collection cycle is complete the status shows **Manual Collection Complete**, for example:



11.7.2 Automatic Collection mode

The current collection mode is always displayed in the status bar.

If the Beacon Sensor Monitoring tool is configured for Automatic Collection, the tool periodically triggers a collection of all the beacon data at the intervals specified in the configuration settings. As the collection cycle progresses, the Acoustics status window shows current activity, for example:



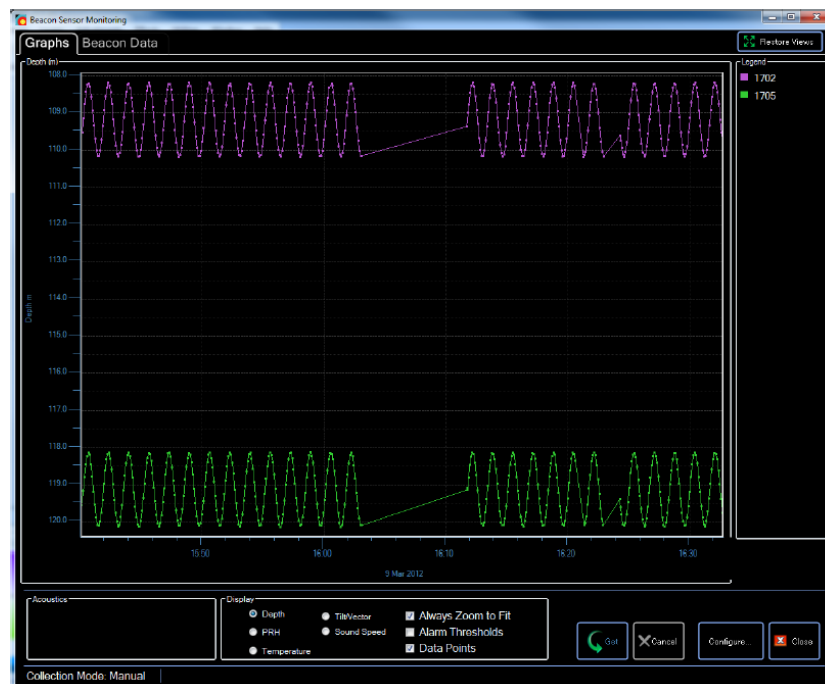
11.8 Beacon Sensor Monitoring Tool Displays

The Beacon Sensor Monitoring tool's main display has two tabs:

- The **Graphs** tab shows graphical time-series plots of the beacon sensor data.
- The **Beacon Data** tab shows a tabular view containing the last values retrieved for each beacon.

11.8.1 Graphs tab

During data collection, the graphical display updates.



View Selection

There are five different graphical views that can be selected using the buttons below the graph. The available choice is among the following:

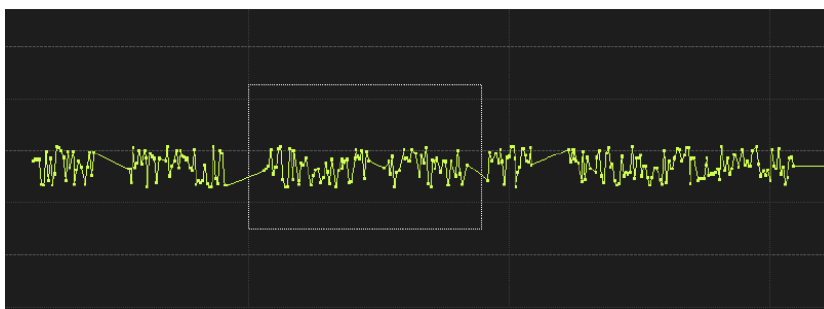
- Depth
- Pitch/Roll/Heading
- Temperature

- Tilt/Vector
- Sound Speed.

The legend on the right-hand side allows identification of the data by a unique colour for each beacon.

Pan and Zoom Controls

Both the X and the Y axes support user interaction. Left-click on an axis and drag it to pan the view. Right-click on an axis and drag it to change the view scaling (zoom factor).



You can zoom a specific area of the graph by left-clicking and dragging a rectangle around the area to zoom.

Select the **Always Zoom to Fit** check box to automatically zoom the view to fit all the data. This option is checked by default. If this check box is not selected, the graph snaps to the latest point that has been plotted.

Other Controls

Alarm Thresholds is used to switch on a visual representation of the alarm levels for each beacon. These are shown as broken red lines above and below the calibrated value. If you need to see the alarm threshold for an individual beacon, hold down the Ctrl key and left-click on the graph to cycle through for each beacon.

Data Points simply turns on and off the data point markers on the graph.

Click the **Restore Views** button at the top right of the display to restore the graph view to its original state.

11.8.2 Beacon Data Tab

Select the **Beacon Data** tab to see a table of the latest beacon data values. None of the fields can be edited.

Beacon	Depth m	Pitch (P)°	Roll (Q)°	Tilt°	Heading°	Temp °C	S.S. m/s	Sensor Age hh:mm:ss
1702	108.2	-5.00	-5.00	7.07	45.90	4.00		00:13:45
1705	116.2	-7.07	-0.01	7.07		4.00	1490.0	00:13:48

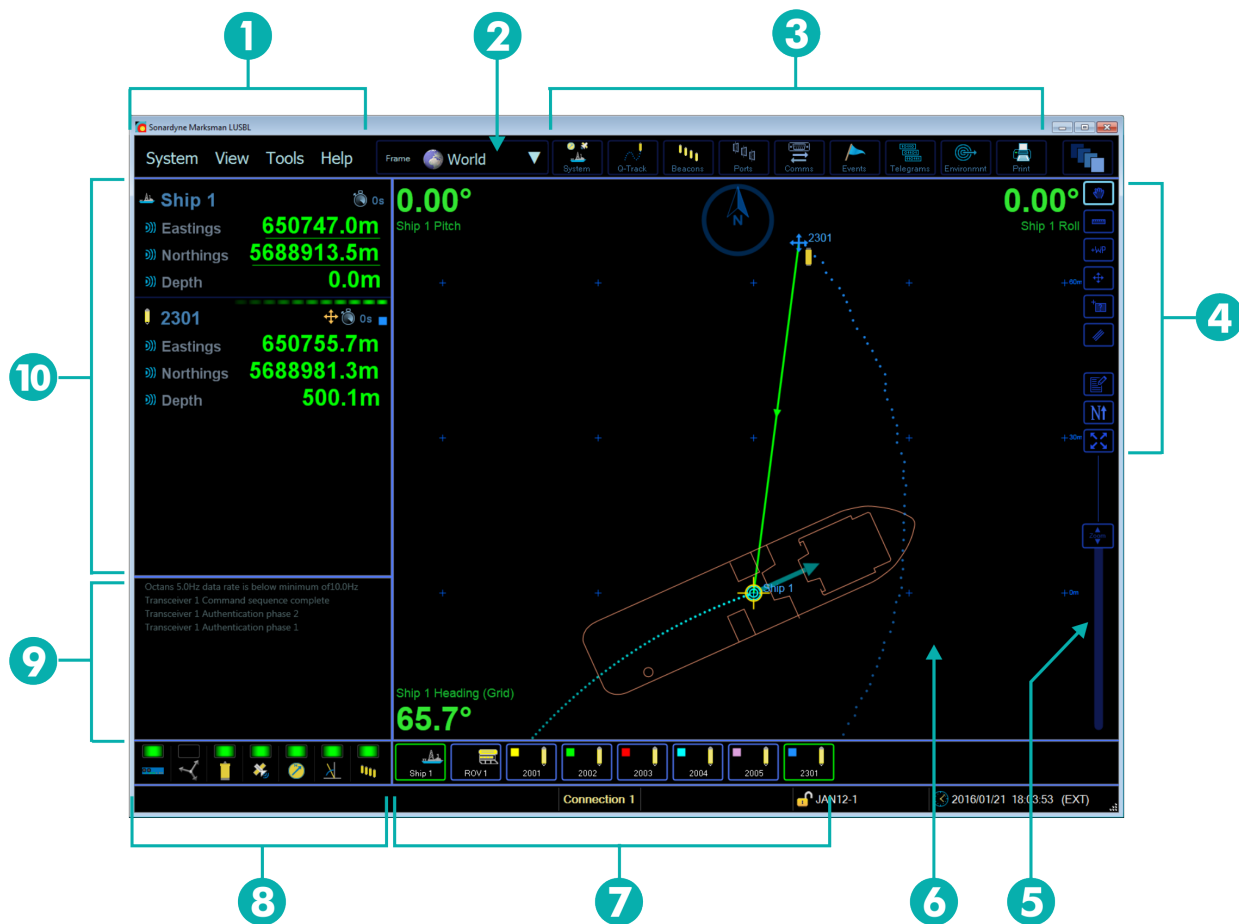
The **Beacon Data** table has the following columns:

- **Beacon**: Shows each beacon name.
- **Depth**: Shows the last retrieved depth in metres.
- **Pitch (P) °** and **Roll (Q) °**: Shows the latest inclinometer values.
- **Tilt°**: This shows the combined pitch and roll calculated using the formula: $Tilt = \sqrt{Pitch^2 + Roll^2}$.
- **Heading°**: This shows the last retrieved heading.
- **Temp°**: This shows the last retrieved temperature.
- **Sound Speed m/s**: This shows the last retrieved sound speed.
- **Age**: Shows the age of the data obtained for each beacon, in Hours:Minutes:Seconds format.

Appendix A – User Interface Description

A.1 Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP Main Window

This appendix references and gives a functional description of the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP user interface.



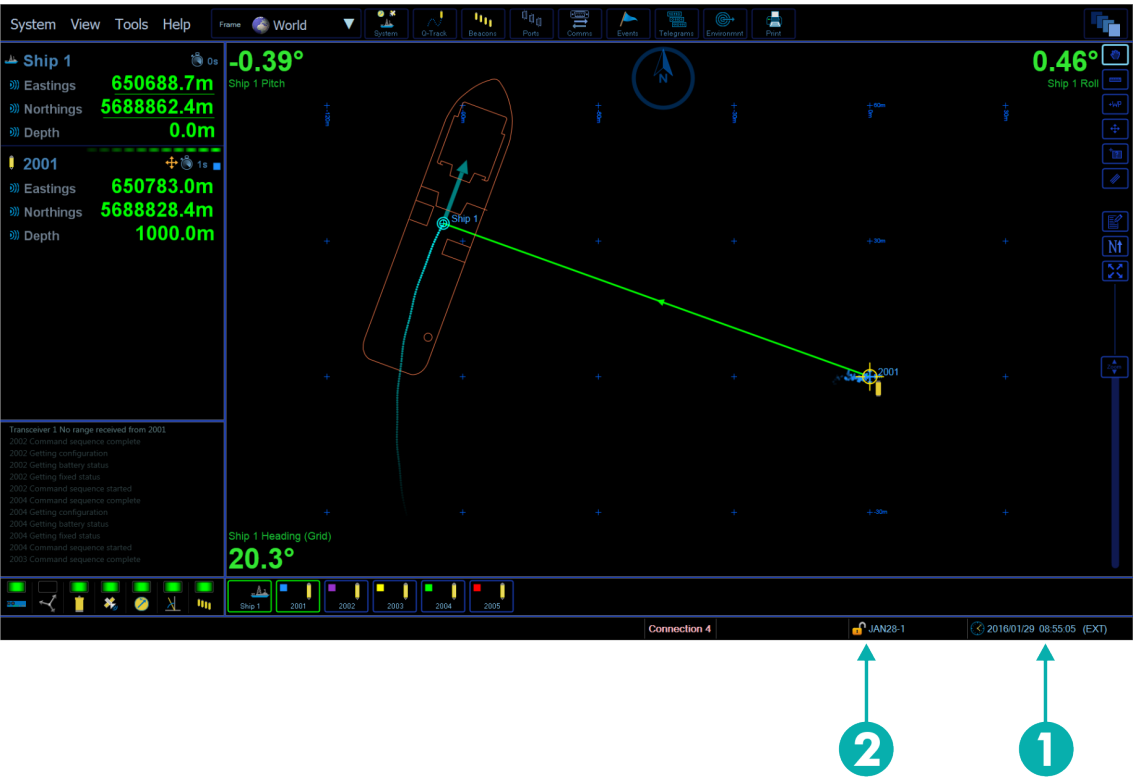
Item	Description
1	Menu Bar
2	Frame Selector
3	Shortcut Buttons
4	Button Controls
5	Zoom Control
6	Plan View Area
7	Target Selection Buttons

Item	Description
8	Instrument Status LEDs:  Green: All sensors are operating correctly  Blue: At least one sensor is not being used in tracking  Amber: At least one sensor is non-operational  Red: All sensors are non-operational Note: Double-click an LED to jump to the setup for that sensor.
9	Information Messages
10	Tracking Pane

The status bar at the bottom of the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP main window shows the name of the current setup, and the current time and its source (either UTC or PC). Refer to *Section A.9.4 "Alarms"* for information about timekeeping.

The status bar also shows information about the most recent alarm condition, with the alarm icon flashing. Refer to *Section A.9.4 "Alarms"* for a detailed description of the alarm window.

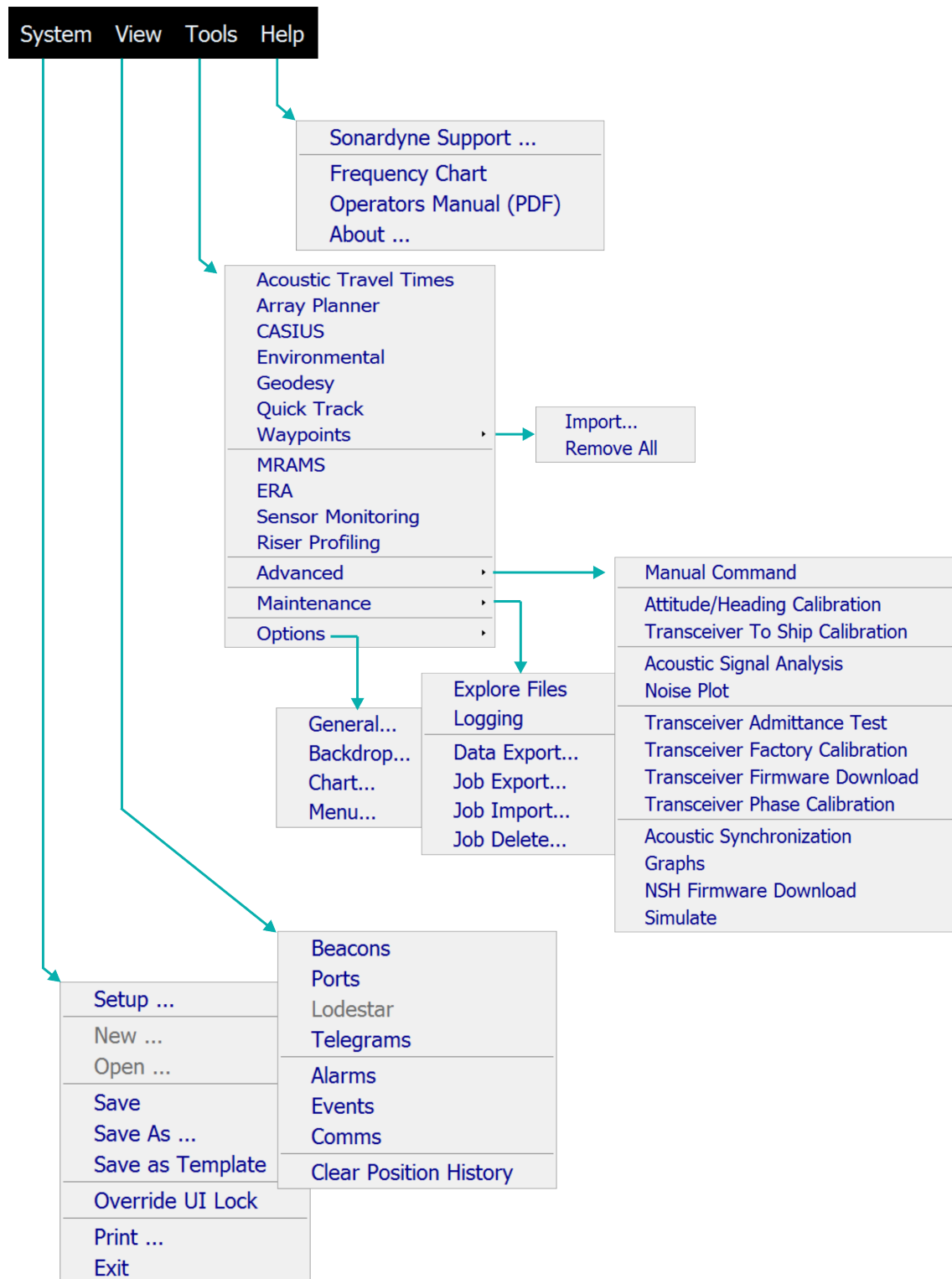
There is an option to display the main window of the software in full-screen mode. Refer to *Section A.10.14 "Options"* for instructions to set this option. The figure below shows an example of the main screen in frameless mode.



Item	Description
1	Current Time
2	Name of Current Setup

The menu system (shown below) provides access to all the features needed to use the software.

Figure A–1 Menu System



Note

 For clarity, all the menu entries are shown. During Operation, some menu entries will not be available and will be greyed out.

A.2 Frame Selector

The frame selector allows you to set the reference frame used to display positions on the main window.



The options available depend on the mobile targets, waypoints and arrays in the setup. To view coordinates with respect to a seated feature such as wellhead, add a waypoint and select it as the frame of reference.

Note



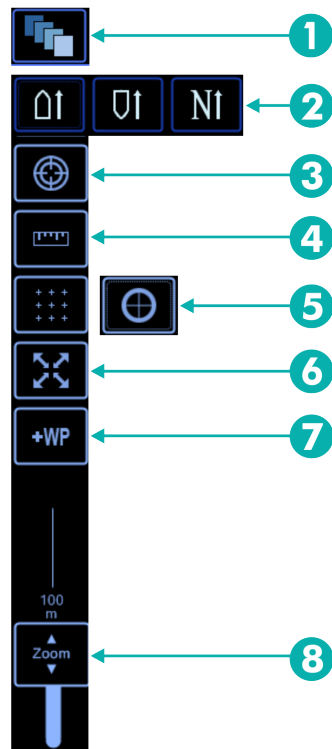
The chart grid control is purely a cartesian view and always shows grid coordinates when World frame is selected - it does not show latitude/longitude. Target positions can be viewed in latitude and longitude or UTM grid in the Tracking Pane.

A.3 Button Controls

The User Interface style and user controls for the main plan view chart vary depending on the version of Windows operating system in use.

A.3.1 Windows XP

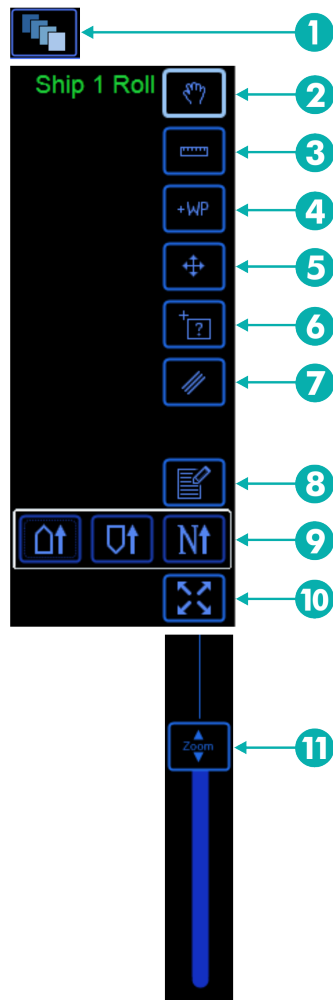
The button controls on the main window set how the main window displays navigation information. They change their appearance when selected, as shown in the examples below:



Item	Description
1	Cycle the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP UI display through four levels of brightness.
2	Select north-up, ship's head up or ship's head down mode for the main display.
3	Centre the display on a target. Click on the target to set it at the centre of the main display.
4	Measure distance tool. Click a starting point and move the mouse to a second point. A circle is drawn on the screen showing the horizontal and slant range and bearing to the second point.
5	Toggle the main display between a radar-style view or a Cartesian grid view.
6	Click to set the chart scale automatically to include all active targets.
7	Click to add a waypoint to the chart at the current location.
8	Click and drag the slider control to set the zoom level of the main display.

A.3.2 Windows 7

The button controls on the main screen set how the main screen displays navigation information. They change their appearance when selected, as shown in the examples below:



Item	Description
1	Cycle the Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP UI display through four levels of brightness.
2	Chart pan mode - drag the chart with the mouse.
3	Measure distance tool. Click a starting point and move the mouse to a second point. A circle is drawn on the screen showing the horizontal and slant range and bearing to the second point.
4	Click to add a waypoint to the chart at the current location.
5	Move waypoint – click and drag with the mouse.
6	Show mouse position coordinates.
7	Create run lines – click and drag from a beacon or waypoint to position (see the information about Chart Options in <i>Section A.5 "Plan View Pane"</i> for run-line choices.
8	View navigation chart options.
9	Select north-up, ship's head up, or ship's head down mode for the main display.
10	Click to set the chart scale automatically to include all active targets.
11	Click and drag the slider control to set the zoom level of the main display.

A.4 Target Selection Buttons

The target selection buttons allow you to select the targets to be tracked and displayed. The buttons available depend on the targets in the current setup.



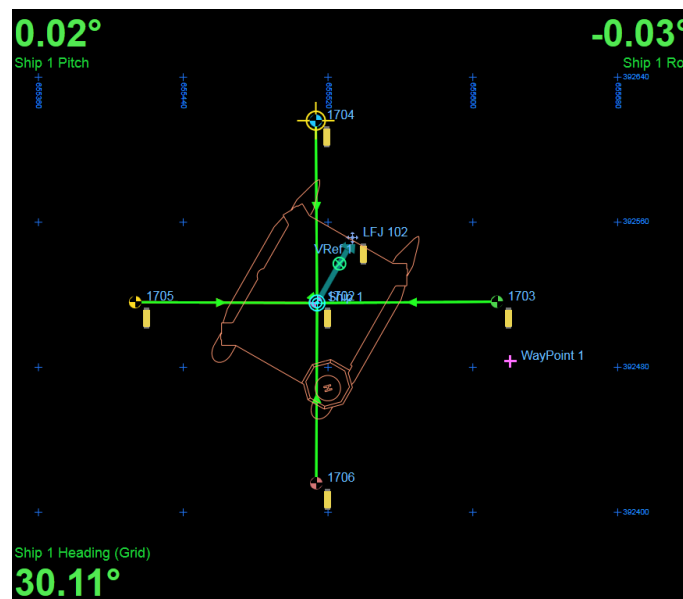
The buttons have green borders for targets that are being tracked, or blue borders if the target is not being tracked. Click the button to toggle the tracking status.

Note

 Buttons and positions are not shown for LUSBL Array Beacons because these are 'owned' by the vessel using them for positioning and should not be interfered with. Beacon positions and tracking status are available through the System Setup and Beacons Table if required.

A.5 Plan View Pane

The plan view pane displays a graphical representation of the relative positions of all items in the setup.



You can use the Chart Controls and the Chart Options to:

- toggle the display between the Cartesian grid (shown here) and the Radar view.
- zoom the display.
- pan the display.
- pin a particular target.
- measure distances between items.
- add Run-lines.
- add Waypoints.

'Range' lines indicate each active acoustic ranging to each tracked target. Range lines are green when tracking is successful.

The current ship's Pitch, Roll and Heading are displayed in the corners of the pane.
Mobile, calibrating and fixed beacons are shown using different icons:



Mobile



Calibrating (rotating symbol)



Fixed

A.6 Tracking Pane

The tracking pane lists all the tracked targets and shows information about their status and position. As the position data ages, the display colour fades from green through to brown or red. The icons used are:



Mobile beacon



Calibrating beacon

Depending on the **Position Display Format** setting defined in **Tools > Options**, positions of the tracking pane can be show using any of the following formats:

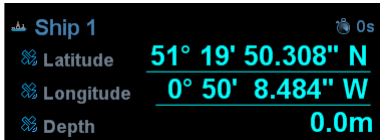
- UTM grid with 1 decimal point precision.
- Latitude/longitude degrees to 7 decimal points.
- Latitude/longitude minutes to 5 decimal points.
- Latitude/longitude seconds to 3 decimal points.

Ship 1 1s Eastings 650779.0m Northings 5688818.4m Depth 0.0m	Ship 1 0s Latitude 51° 19' 50.308" N Longitude 0° 50' 8.484" W Depth 0.0m
2001 2s Eastings 650778.3m Northings 5688817.7m Depth 1000.0m	2001 1s Latitude 51° 19' 50.296" N Longitude 0° 50' 8.541" W Depth 1000.0m
2002 2s Eastings 650781.9m Northings 5688918.4m Depth 1000.0m	2002 1s Latitude 51° 19' 53.328" N Longitude 0° 50' 8.422" W Depth 1000.6m

Positions shown are relative to the transceiver if there is no GNSS data available to the software. If the software receives GNSS information, positions shown can be in real-world co-ordinates.

For each entry in the tracking pane, there is a target selection button that allows you to toggle tracking on or off for the associated target.

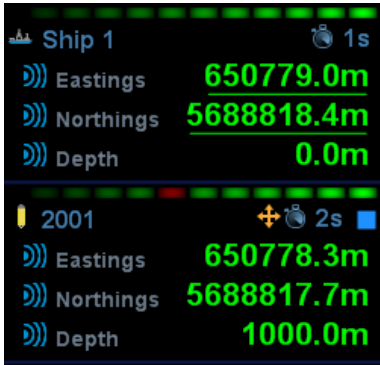
Note that tracking is disabled in the software unless there is a valid security dongle fitted.
INS positions or GNSS-based positions are shown in blue cyan colour to distinguish them from acoustically-derived positions.



Note
Vessel GNSS position is automatically displayed when acoustic tracking is stopped, assuming GNSS is available.

When a position is 'aided' by GNSS or depth sensor, it is displayed with an underscore. In this example, the Ship Easting and Northing were calculated using GNSS input, and the beacon 2001 depth was calculated using the beacon's depth sensor.

A series of moving dashes above the position indicates the status of the acoustic cycle.



A.7 Message Pane

The Message Pane displays information about what the system is doing. Each message fades out over time.



Double-click anywhere on the Message Pane to launch the Events Viewer, which shows a more detailed view of the message system.

When a command sequence starts, **Retry**, **Ignore** and **Cancel** buttons are overlaid on the Message Pane. These buttons allow you to interact with the command sequence:

- Click **Retry** to retry a failed command.
- Click **Ignore** to ignore a failed command.
- Click **Cancel** to cancel a failed or running command.

Note

Cancelling a running command might leave a part of the system in an unknown state. For example, a transponder might not be set up ready for use.

A.8 System Menu

The **System** menu gives access to all the system-related functions of the software.

Setup ...
New ...
Open ...
Save
Save As ...
Save as Template
Override UI Lock
Print ...
Exit

A.8.1 Setup

Launches the **System Setup** window so that you can edit the settings for the current setup.

A.8.2 New

You can create a new setup either from:

- a blank template, or
- a template that you create and save.

A.8.3 Open

You can open a setup file that already exists.

The ability to save and open setup files means that you can break and then continue an operation without the need to re-enter all the setup details.

Setup files use a version of the XML file format, which can be read by any text editor program.

A.8.4 Save options

The three **Save** options are:

- **Save** — Saves the current setup under its current name. If you have not already supplied a name for the setup, you are prompted for one.

- **Save As** — Saves the current setup under a different name. This allows you to create a new setup based on the current setup.

This is a useful option to use if you want to create only a single new setup from the current one.

- **Save as Template** — Saves the current setup as an XML template file so that you can use it as the basis for future new setups.

A.8.5 Override UI Lock

Allows temporary override of job protection, see *Section B.1 "UI Lock"*.

A.8.6 Print

Prints the screen or saves the screenshot to a file.

A.9 View Menu

The dialog boxes that are accessible through the View menu display important information about the system and its operating parameters.



A.9.1 Beacons

For a detailed description of the Beacons options, refer to *Section 5 "Beacons"*.

A.9.2 Ports

The **Communications Port Table** lists all comms ports currently in use, allows editing of the port settings and gives a quick view of the live comms.

Select	View	Port	Baud	Device Name	Protocol	Location	Data
☐		NSH\3A	38400	Transceiver 1	6G Protocol	Ship 1	<U001240, BR: EVT1, SQ0, U0
☐		NSH\4A	9600	GNSS 1	\$GPGGA	Ship 1	\$GPGGA, 162511.216, 5119.83840, N, 00050.14140, W, 5.07, 1
☐		NSH\5B	115200	PitchRoll 1	:SON2	Ship 1	:162511240 000254 000482 046690 000g
☐		NSH\7A	9600	Heading 1	\$HEHDT	Ship 1	\$HEHDT, 46.7, 1*30

Buttons: + Add, - Delete, Data Legend (Receive: green, Transmit: red), Apply Changes, Undo Changes, Print, Close

- Click **Add** to add a new device; see the **Add Device** dialog box below.
- Clicking **Print** launches the Windows Print dialog box. This allows the capture and print out the Communications Port Table.
- Clicking **Close** closes the Communications Port Table.

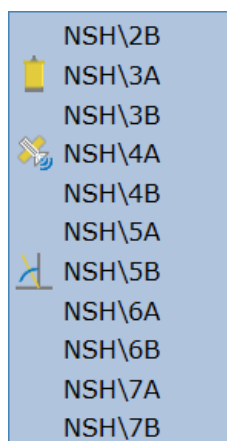
The columns within the Communications Port Table are described in the following table.

Description	Function	UI Control Type
Select	Selects a beacon row for a subsequent operation	
View Comms	Open the Comms Viewer with the tab for this device. If tab doesn't exist, open a new tab	
Edit	Opens the appropriate editor for the device. Responder Beacons open the Beacons Table, Reports open Output Telegram editor, all other devices open the System Editor	
Port	Serial port assigned to this device/ output telegram. Populated with NSH\xxx and/or COMxxx	 Drop-down list
Baud	Baud Rate of port (110 to 115200)	 Drop-down list
Device Name	Name of device/output telegram	Static label field with device type icon on LHS
Protocol	Serial Comms Protocol used for device/output telegram. Responder Beacons shall show "Responder Beacon" in this field	Static label field indicating device or telegram protocol
Location	Where the device is located. (Ship, ROV, Structure, System, Mobile). Output Telegrams show "System"	Static label field with location type icon on LHS
Data	Last decoded data to/from the device/output telegram. Outgoing data shown in different colour to incoming	Static label field

Note that the Serial port selection is restricted for the following device types:

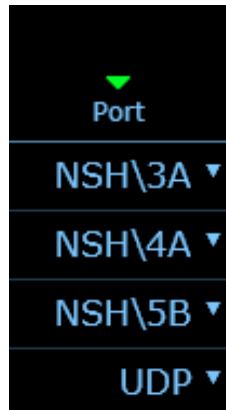
- Responder Beacons – Only dedicated NSH ports can be used for trigger ports, although conventional COM ports CTS line can be used for some system configurations.
- Time of Day – Only dedicated NSH ports can be used for PPS ports
- If UDP is selected as a port for a device type, then the UDP settings are only accessible within the System Setup. The port column (as shown above for the Remote Control device) will simply show "UDP".

The serial port drop-down list shows a device type icon beside each port that is already in use (as shown below):



Sorting the Table

To sort a table column (that contains sortable data), clicking on a column header will toggle the green chevron (as shown below) to sort ascending or descending. Only one column is sortable at a time.



Delete

When at least one table row is selected via its select check box, the Delete button is enabled, except when:

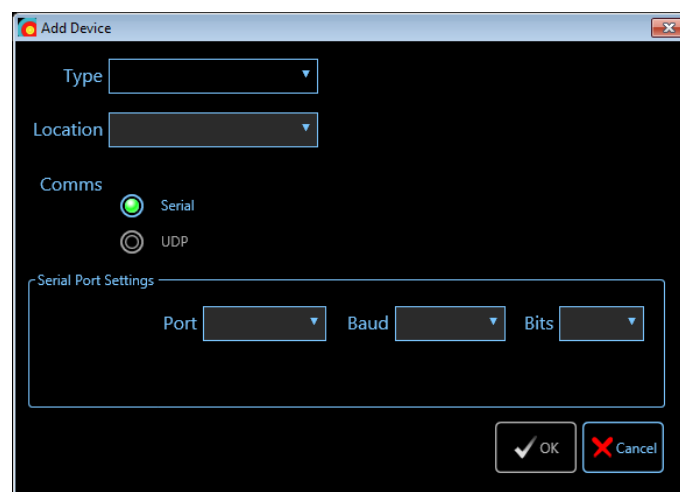
1. One of the selected items is a Responder Beacon. It is only possible to create/edit/delete any beacon via the Beacons Window.
2. One of the selected items is an Output Telegram. It is only possible to create/edit/delete any output telegram via the Output Telegram Editor.

When the Delete button is enabled, clicking on it deletes all selected devices. Confirmation is required when more than one device is being deleted.

Add Device Dialog Box

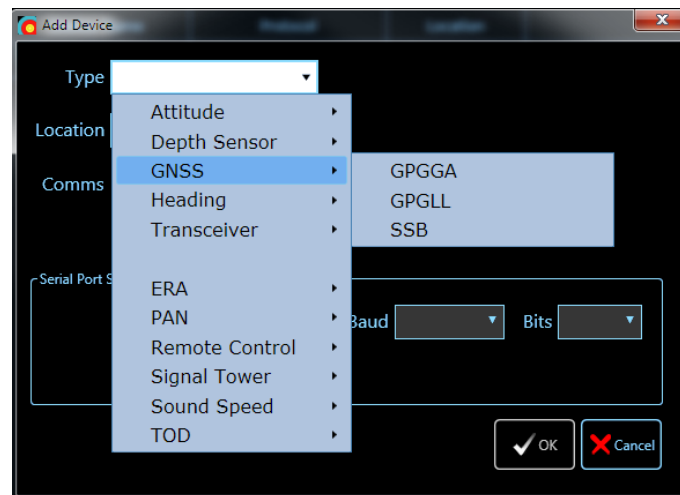
Clicking **Add** opens the **Add Device** dialog box. This dialog box is shown whenever a serial communication device is to be created, excluding the addition of beacons and output telegrams as they have their own more sophisticated editors.

Any device type, location and port can be added, as shown below:

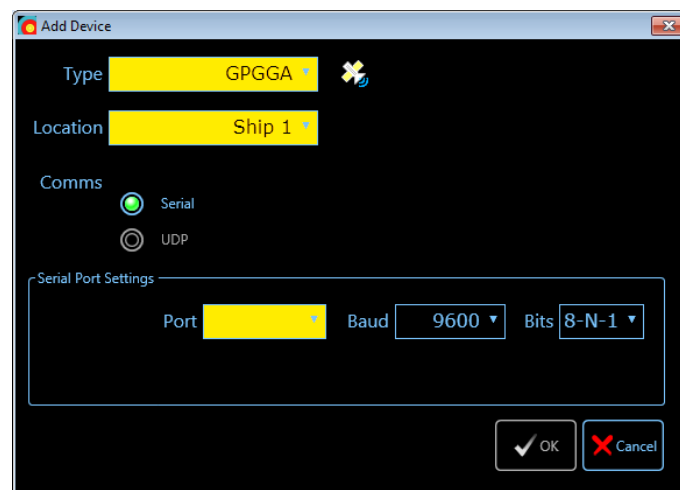


Type

The following devices can be added:



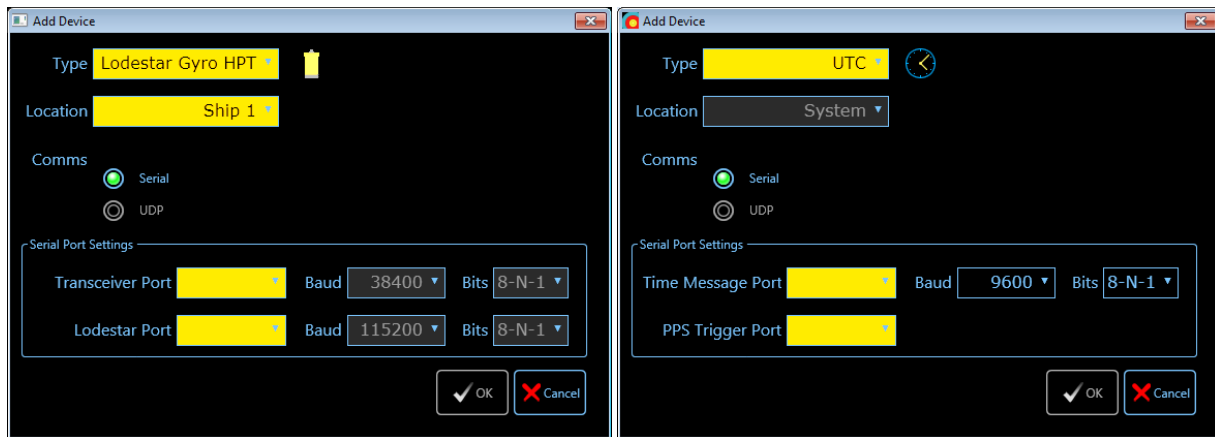
For example, selecting **GNSS > GPGGA** populates the dialog box as follows:



If the selected **Type** is any of:

- Lodestar Gyro HPT
- Lodestar Gyro GDT
- TOD device (any subtype)

then the dialog box displays a second set of comms port boxes, as shown in the examples below.



Location

The **Location** drop-down list allows selection of where the device is located.

- If the selected device type is an Attitude, Depth Sensor, GNSS, Heading or Transceiver, then the drop-down list displays all Vehicles in the job.
- If the selected device type is a TOD, PAN, ERA, Remote Control, Signal Tower, Sound Speed then the drop-down list only displays System. No vehicles are offered.

Serial Port Settings

The **Serial Port Settings** consists of primary (and optional secondary) serial port controls, consisting of:

- **Port** – A drop-down list that allows selection of the serial communications port to which the device is connected.
- **Baud** – A drop-down list that allows selection of the port baud rate. In the case of devices that only use CTS or Trigger functionality, this will be disabled.
- **Bits** – A drop-down list that allows selection of Data-Parity-Stop bits. In the case of devices that only use CTS or Trigger functionality, this will be disabled.

By default, the following Data-Parity-Stop combinations are enumerated in the drop-down list:

- 8-N-1
- 8-N-2
- 7-O-2

Where:

E = Even parity

N = No parity

O = Odd parity

UDP Settings

Note



This option is currently only available for Remote Control devices.

If the **UDP** radio button is selected, the normal Serial Settings group box is hidden and the **UDP Settings** group box is shown.

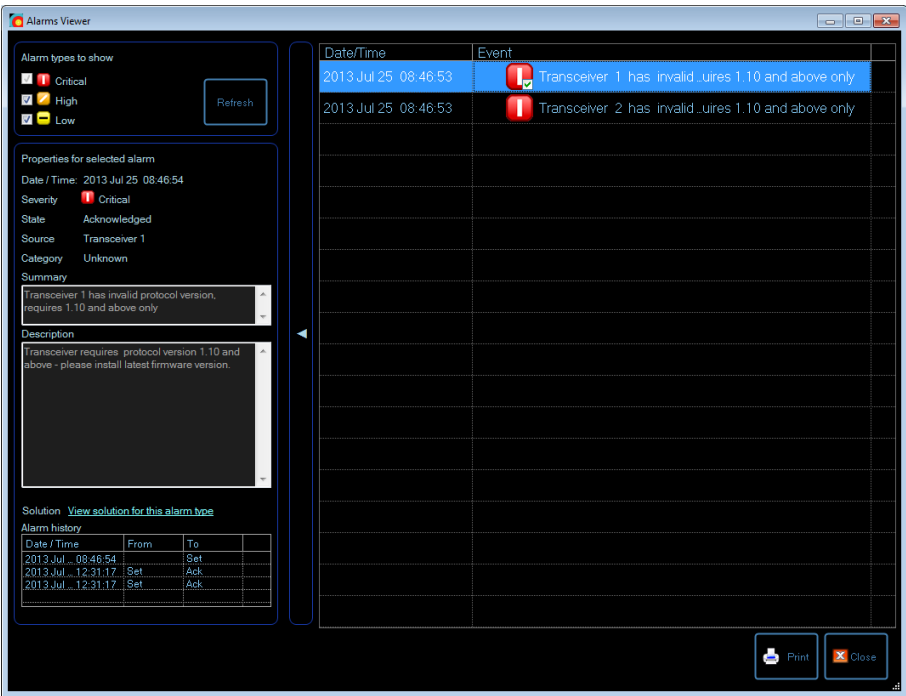
The **UDP Settings** group box contains controls to specify UDP parameters, as follows:

- **Mode** – Set to Unicast, Multicast or Broadcast.
- **IP Address** – Specifies the destination IP address of the UDP comms.
- **Tx Port** – Specifies the destination Port number for UDP Transmit comms.
- **Rx Port** – Specifies the destination Port number for UDP Receive comms.

A.9.3 Telegrams

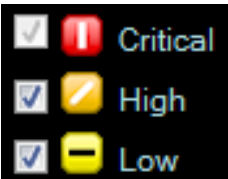
The **Telegram Table** shows the current settings for Telegrams sent to the vessel's DP system or survey system, and allows you to edit and add Telegrams. Refer to *Section 4.20 "Configuring Output Telegrams"* for a description of the **Telegram Table**, and for instructions to use it.

A.9.4 Alarms



There are three main panes of the **Alarms Viewer**:

- **Alarm list** – a list of all the current alarms, showing details of the date and time when each alarm occurred and details of the event that caused the alarm condition. Clicking on an alarm in the list acknowledges the alarm, and temporarily silences the alarm sounder.
- **Alarm properties** – detailed properties about the alarm selected in the alarm list.
This pane includes a **View solution for the alarm type** link, which opens a file containing user guidance in a browser window. These HTML files can be modified locally, if required.
- **Alarm category** – alarm categories (**Low**, **High** and **Critical**) indicate the priority, and are used for sorting the list into priority order.



See *Appendix G "Alarms and Events"* for a list and description of the alarms.

The **Print** button allows you to send the alarm list view to the default printer. You can hide or display the **Alarm properties** and **Alarm category** panes by clicking a control, which provides more space to display the alarm list.

System alarms can be in one of the following states:

Clear (no alarm)



Set, unacknowledged (a fault exists, the user has not acknowledged)



Set, acknowledged (a fault exists, the user has acknowledged)

When an alarm is set, a Summary of the alarm condition is displayed at the bottom-left of the main screen, a flashing red Alarm button is displayed at the bottom-right of the main screen, and a siren audio output starts.

When the user acknowledges an alarm, the audio (siren) output is silenced for a short period, but this will resume if the fault is not cleared.

An alarm can be cleared only by clearing the cause of the fault. See the alarm description and solution for help on this. When an alarm is cleared, the audio output is silenced, and the alarm text and red button are removed.

Alarm suppression – repeated nuisance alarms can be suppressed if absolutely necessary by making a system configuration change. An example of where this may be permissible is for a GNSS HDOP alarm triggered whenever the GNSS antenna’s view of the sky is obscured. Please contact Sonardyne Support for guidance.

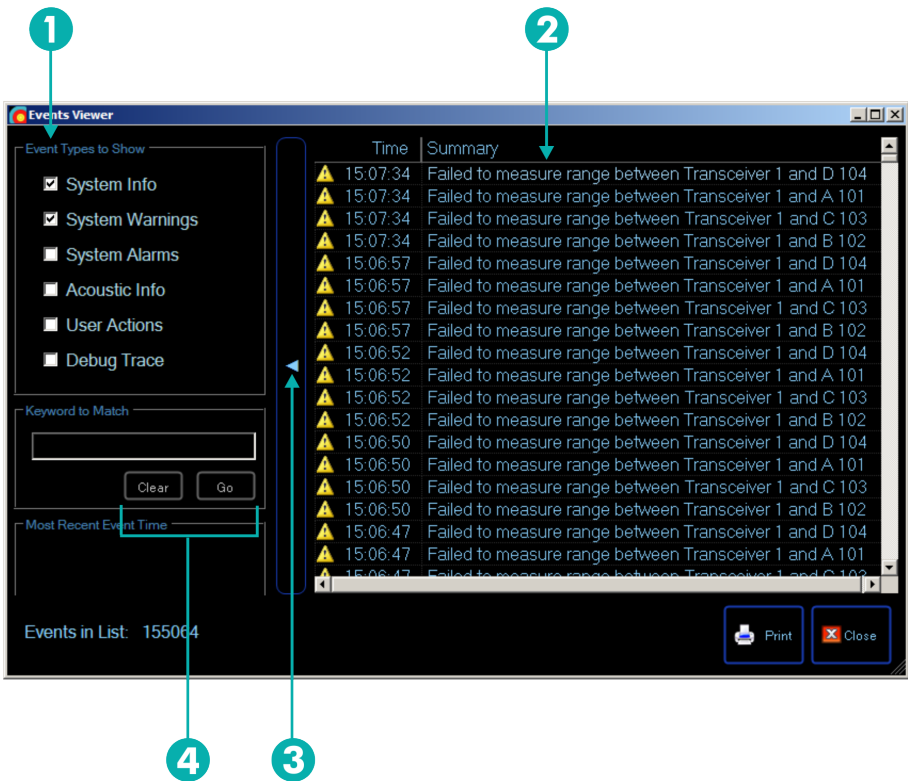
Note



Do not ignore a system alarm as this can lead to incorrect operation.

All alarm state changes and user actions are logged to the system event log for later review.

A.9.5 Events



Item	Description
1	Event Catagory Filter
2	Event List

Item	Description
3	Display/Hide Pane
4	Event Search Buttons

The main features of the **Events Viewer** are:

- **Event list** – a list of all events, showing details of the date and time when each event occurred and details of the event.
- **Event category** – select the event categories to display in the event list, and you can filter the list to include only events that occurred during a defined interval.

The **Events Viewer** also allows you to search for particular events, print the event list, and close the **Events Viewer**.

You can hide or display the **Event category** panes by clicking a control, which provides more space to display the event list.

See *Appendix G "Alarms and Events"* for a list and description of the events.

Note



The system event log should be periodically reviewed (particularly the Warnings and Alarms categories). Unexplained events, particularly repeated warnings, should be investigated, and the cause understood and corrected.

A.9.6 Lodestar Statistics

This menu option is greyed out unless the system is receiving data from a Sonardyne Lodestar INS.

The statistics displayed include all current inertial measurements, and an indication of their quality and age.

Lodestar Statistics - Lodestar INS 1

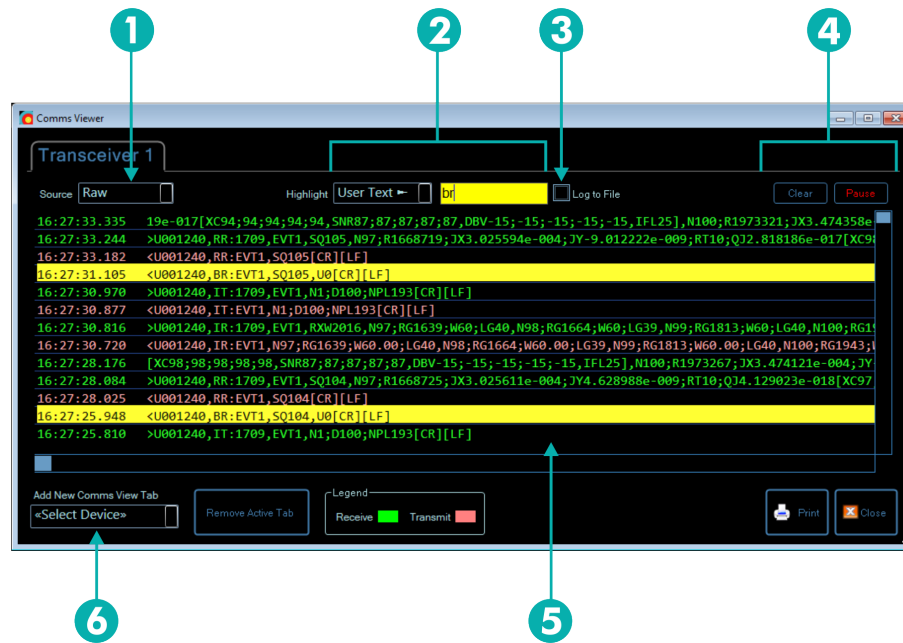
Position	Velocity	Orientation
INS Latitude: 51° 19' 49.3331" N Longitude: 0° 50' 10.4444" W Depth: 0.1 m	INS East: 0.00 m/s North: 0.00 m/s Down: 0.01 m/s	INS Heading: 279.93° Pitch: 0.035° Roll: -0.142°
Quality 1DRMS: 0.022 m Semi Maj: 0.016 m Maj. Axis: 319.9°	Quality RMS: 0.003 m/s Down: 0.005 m/s	INS Heading: 279.96° Pitch: 0.038° Roll: -0.143°
INS - GPS Horizontal Difference: 151.273 m		Quality Heading: 0.113° Roll/Pitch: 0.006°
Biases Gyro: X: -0.00520°/hr, Y: -0.00272°/hr, Z: 0.00464°/hr Accelerometer: X: 3.1 uG, Y: -4.3 uG, Z: 319.7 uG	Acoustic Aiding Time since last aiding: 4 secs Processed: 5 out of 5 acoustic observations in last minute	Difference: INS - AHRS Heading: 0.026° Pitch: 0.003° Roll: -0.001°
Time Since Last Lat/Long Update: 0 secs	Observation Status 10-08-02 08:44:07.862 Bcn=408 Code=0x0000 10-08-02 08:44:10.137 Bcn=408 Code=0x0000 10-08-02 08:44:12.039 Bcn=408 Code=0x0000 10-08-02 08:44:14.323 Bcn=408 Code=0x0000 10-08-02 08:44:16.341 Bcn=408 Code=0x0000	

Print Close

A.9.7 Comms

The **Comms Viewer** shows communications between the system and the various Instruments in the setup. You can select any device in the current setup and add a tab to display its communications.

- Output strings are shown in pink.
- Input strings are shown in green.



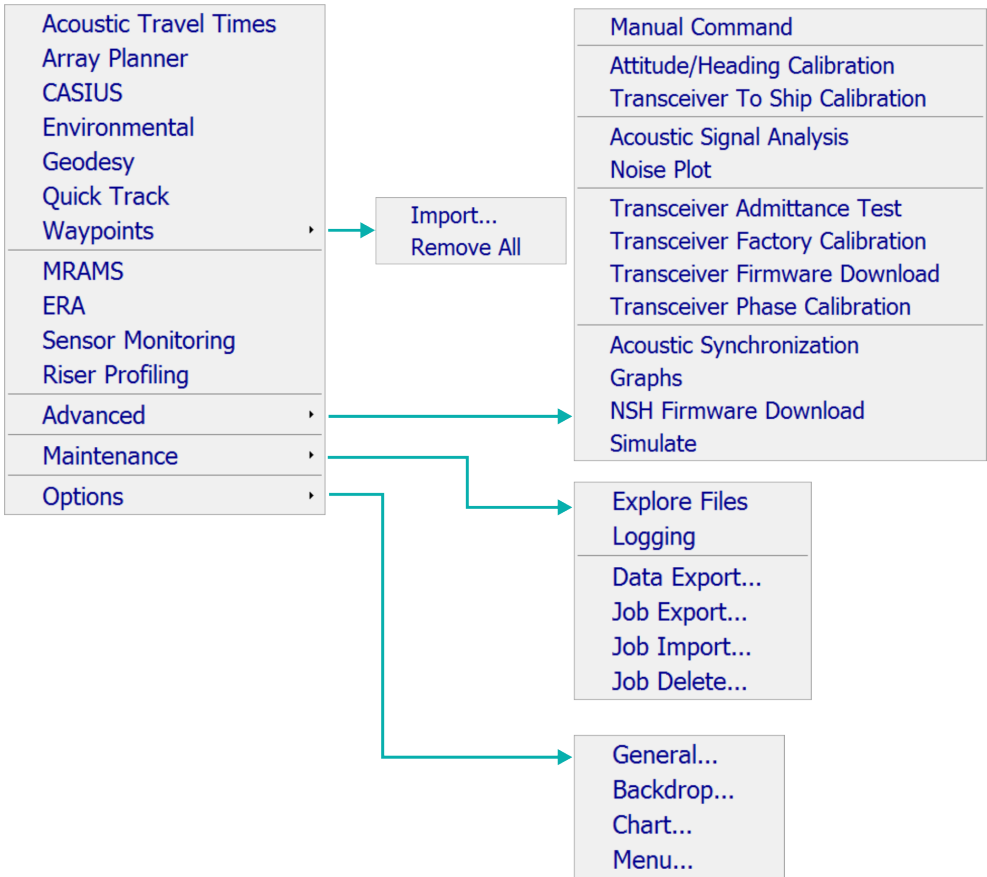
Item	Description
1	If necessary, change the communication Source to display: - Raw for text with control characters - Decoded for normal text - Observation for additional diagnostics (where available)
2	If necessary, select Highlight/User Text and enter text in the adjacent box. The system identifies any string in the communications that includes this text and highlights the string in yellow.
3	If necessary select the Log to File check box and identify the location and name of a file on the computer where the software can store the communications as a text file.
4	Use the Clear and Pause buttons to control the flow of data strings.
5	Review the communications.
6	Select a device in the current setup. A tab is added for the device you select. If necessary, click Remove Active Tab to remove a selected tab from the Comms Viewer.

A.9.8 Clear Position History

Clears the Position History Trails from the chart.

A.10 Tools Menu

The **Tools** menu includes a set of software tools that help you to optimise the performance of the system. The following sections describe the dialog boxes accessible through this menu.



The image above shows the **Tools** menu, with the **Advanced**, **Maintenance** and **Options** sub-menus detailed.

Some options on the Advanced sub-menu may be greyed out, depending on the system's tracking status.

A.10.1 Acoustic Travel Times

The Acoustic Travel Times tool display shows the two-way acoustic travel times for each beacon in the setup plotted against time. Overlapping travel times can make it difficult for the transceiver to separate the responses from individual beacons, leading to longer intervals between updates.

This tool ensures reply signals from beacons on the same interrogation signal do not overlap. If they do, you should adjust the beacon turnaround time (TAT) to separate the travel times.

Note

 Pulse-position mode beacons supply a double pulse reply (for depth) or triple pulse reply (for pitch and roll).

The following acoustic diagnostic types can be displayed by clicking on the buttons listed below:

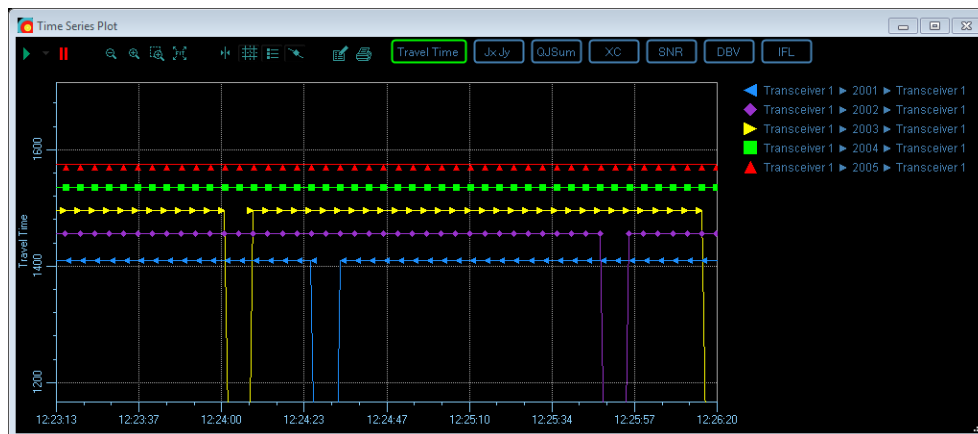
- Travel Time
- Jx Jy
- QJSum

- XC
- SNR
- DBV
- IFL

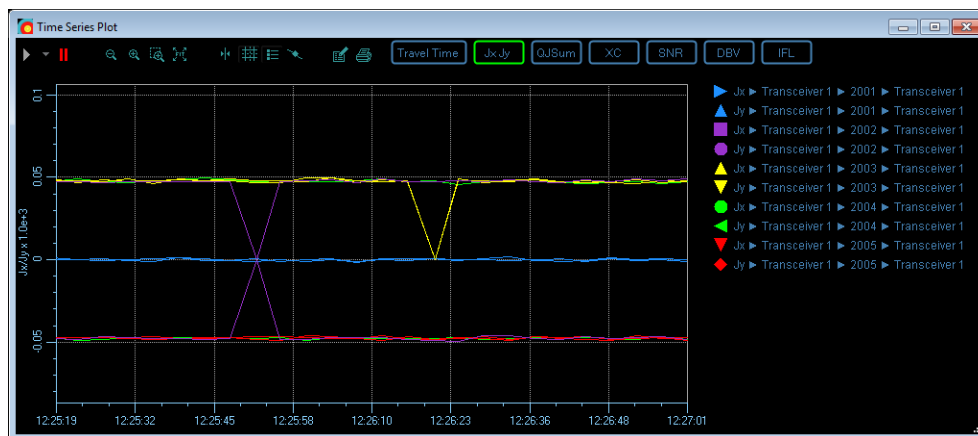
An example of each graph type is shown below.

Travel Time

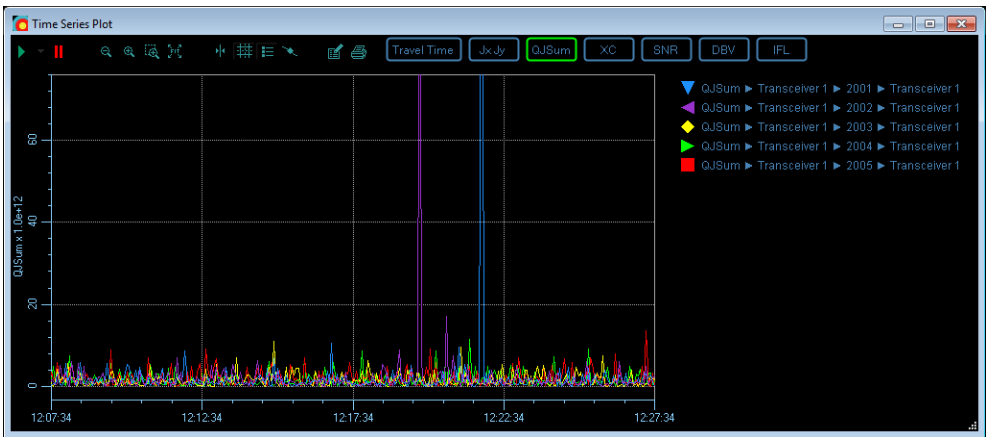
The Travel Time graph below shows an example of an acoustic travel times display. In this example, the travel times for 2003 (yellow) and 2004 (green) are too close together, so one of the beacon TAT values requires adjustment.



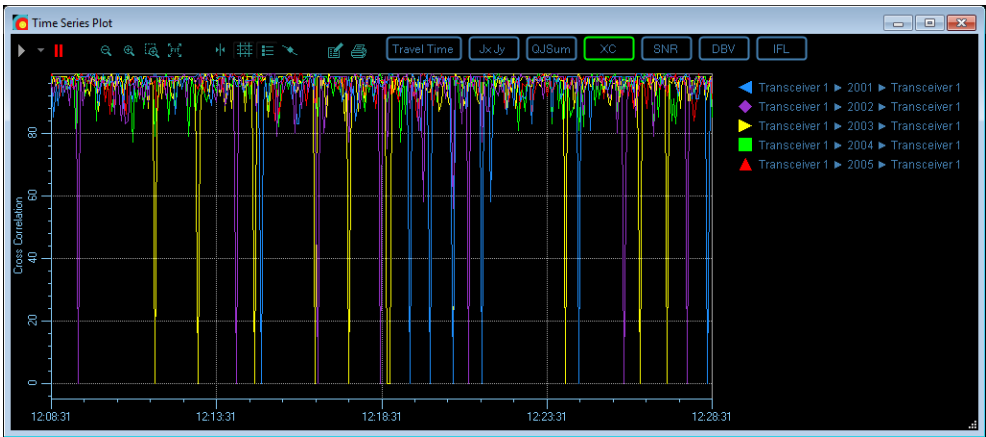
Jx Jy



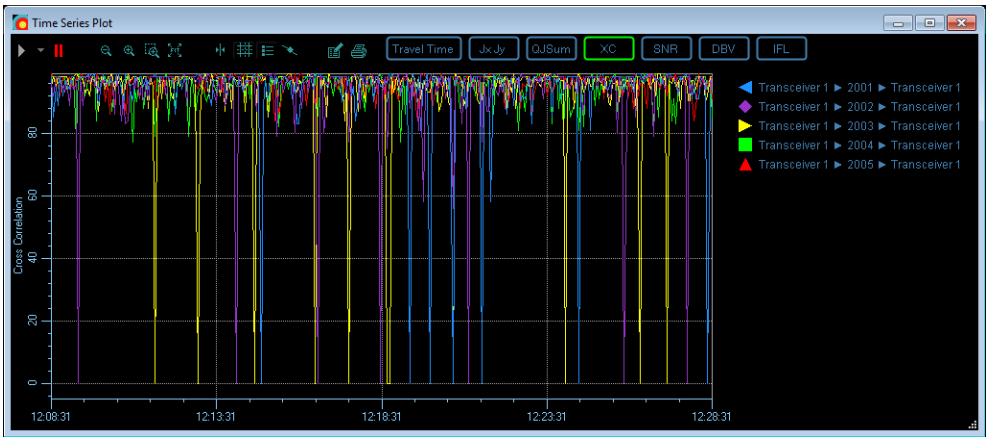
QJSum



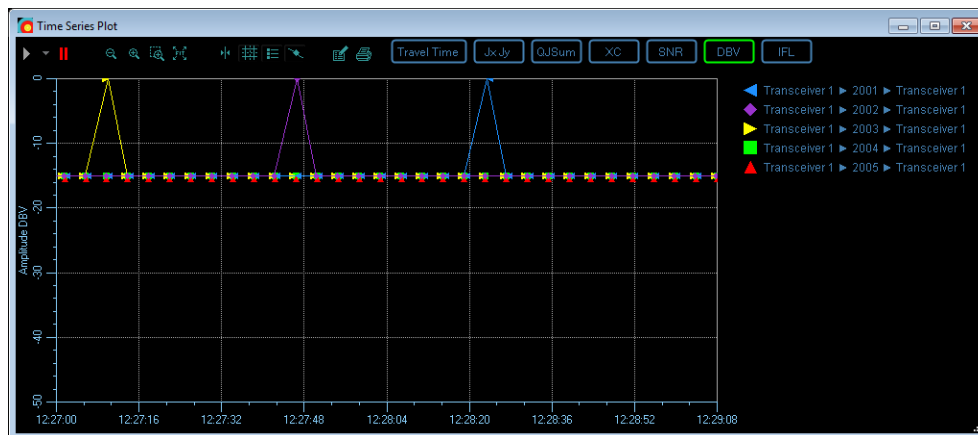
XC



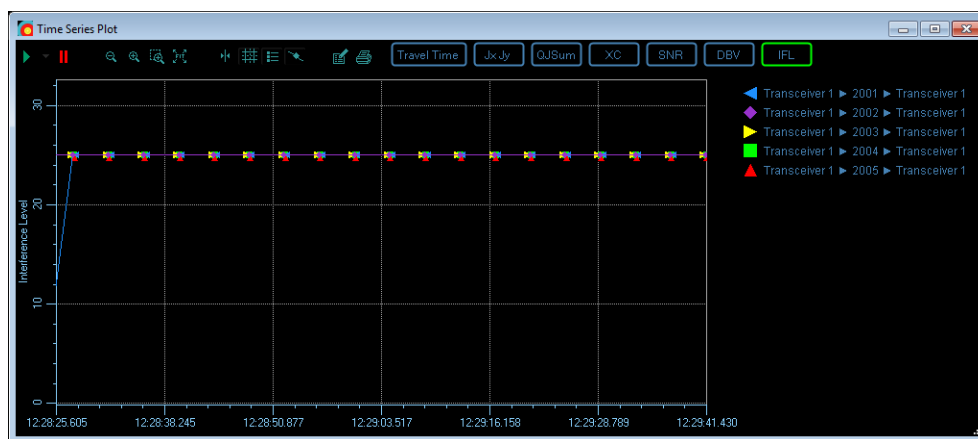
SNR



DBV



IFL



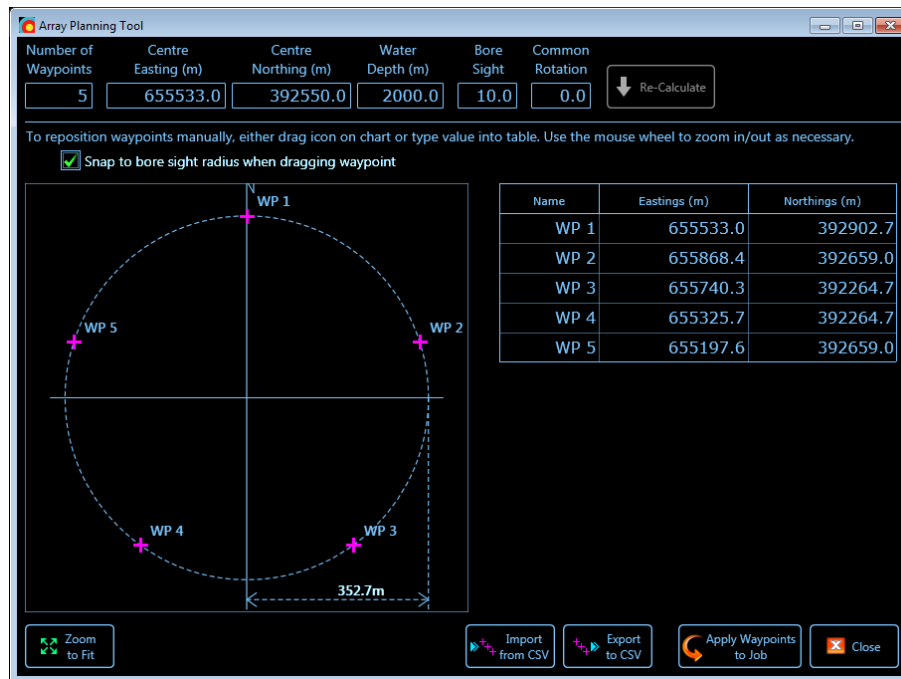
A.10.2 Array Planner

The **Array Planning Tool** is launched from the **Tools/Array Planner** menu.

Note

 **World Frame** must be selected in the **Frame** selector at the top of the main window. This means you should either have **GNSS** enabled or calibrated array reference beacons in world frame.

The **Array Planning Tool** is designed to allow you to define a pattern of seabed waypoints where array beacons will be deployed - typically using a tracked ROV.



The tool shows a 2D graphical view centred on the transceiver, a waypoint position table and some edit boxes to control how waypoints are deployed.

The deployment pattern is circular, with the radius defined by the editable **Water Depth** and the **Bore Sight** angle of the transceiver. The centre of the circle is defined by the editable **Easting** and **Northings** values.

The user can define the **Number of Waypoints** (equally spaced) to be distributed around the circle, and an overall **Common rotation** angle to be applied to all waypoints relative to the centre.

After any of these parameters are adjusted the user must click the **Re-Calculate** button to update the chart and the waypoint/position table.

You may also manually adjust the position of any waypoint by:

1. Dragging a waypoint on the graphical view.

Note that if the **Snap to bore sight radius** check box is checked, the waypoint will tend to follow the circle. Otherwise it can be moved completely freeform. In either case, the table position values will update as the waypoint is dragged. Clicking the **Zoom-to-fit** button will fit all waypoints within the graphical view.

2. Typing exact Easting and Northing values into the table. After the values are entered (carriage return), the graphical view will update to show the new position.

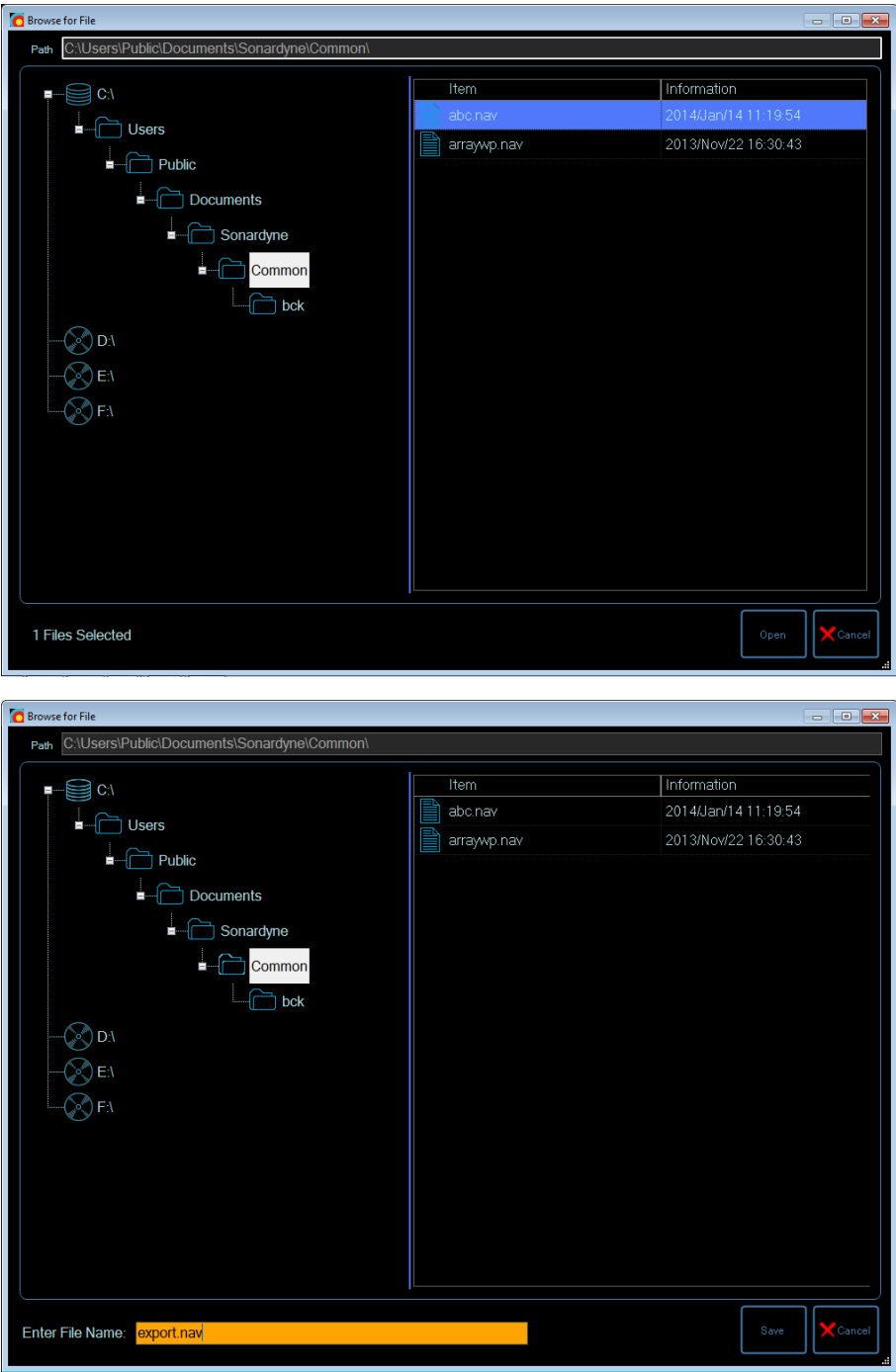
After the waypoint plan completes, clicking **Apply Waypoints to Job** will create the waypoints on the main chart (and in the job). Any pre-existing waypoints in the job with the same name will be overwritten with the new waypoint positions. The new waypoints will appear on the chart at the specified locations.

Import and Export

The waypoint pattern information can be **Imported** or **Exported** from/to a NAV file using the corresponding buttons, followed by **Save** or **Open**.

Note

 A maximum of 10 waypoints can be imported using this method. To import a larger number of waypoints, see *Section A.10.7 "Waypoints"*



The file format used is CSV, but the file extension is NAV. The NAV file format is the same used by Fusion LBL 6G. The following is an example NAV file defining the position of three waypoints:

```
// Fusion 6G Navigation File - version 1.00
//
WP1,WAYPOINT,500010,6000010,0.000,,0,50.000,0.000,Waypoint,16711935,50.000,50.000,
WP2,WAYPOINT,500020,6000020,0.000,,0,50.000,0.000,Waypoint,16711935,50.000,50.000,
```

WP2,WAYPOINT,500000,6000010,0.000,,0,50.000,0.000,Waypoint,16711935,50.000,50.000,

A.10.3 CASIUS

The CASIUS tool menu displays the CASIUS Control Panel, which has two tabs:

- CASIUS Data Collection tab
- CASIUS Data Export tab

CASIUS is an acronym that stands for Calibration of Attitude Sensors In the USBL System manufactured by Sonardyne International Limited.

By manoeuvring near a stationary beacon deployed on the seabed and recording DGPS positions and acoustic positions relative to the beacon, you can use CASIUS to compute:

- The precise position and depth of the beacon.
- The mean sound speed through the water column.
- USBL transceiver offsets from the GNSS antenna.
- Pitch, roll and alignment corrections to correct for the misalignment of the attitude and heading sensor (AHRS) and gyrocompass with respect to the USBL transceiver.

In general, pitch and roll alignment errors have a greater effect on beacons directly under a vessel (especially in deep water), and heading errors will have a greater effect at horizontal offsets from a beacon.

The correction values for pitch, roll and heading that you obtain by performing a CASIUS calibration help you to achieve significantly better results when you are positioning acoustic beacons. You should perform such a calibration regularly during each operation, so that you can detect any long-term drift in gyrocompass and AHRS sensors, and apply appropriate corrections.

Refer to *Appendix J "CASIUS Data Collection Methods"* for instructions to perform a CASIUS calibration using this tool.

Before starting a CASIUS data collection run:

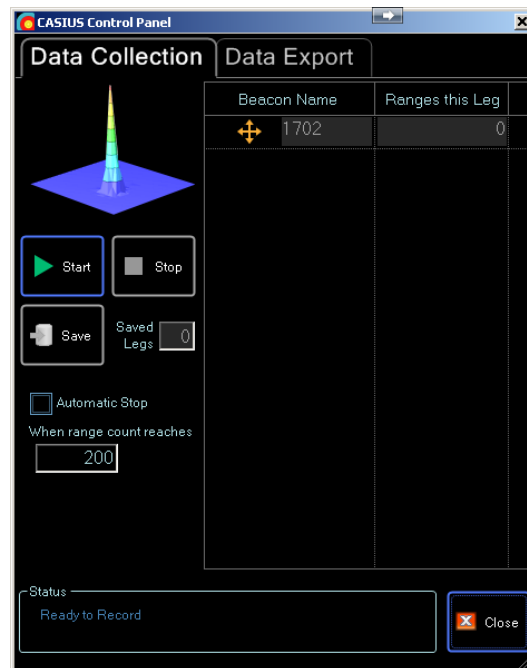
- Ensure that tracking of the CASIUS beacon is reliable and stable.
- Ensure the sound speed has been set correctly.
- Ensure a high quality GNSS position is available and enabled. The status field should say **Ready to record**.

Select the **CASIUS Data Collection** tab. If you prefer to use auto mode, click **Automatic stop** and set the number of ranges required. Otherwise, data collection will continue until stopped manually.

Procedure:

1. Click the **Start** button to begin data collection.
2. Click **Stop** when the required number of ranges has been acquired if in manual mode.
3. Click **Save** to store the collected data set.

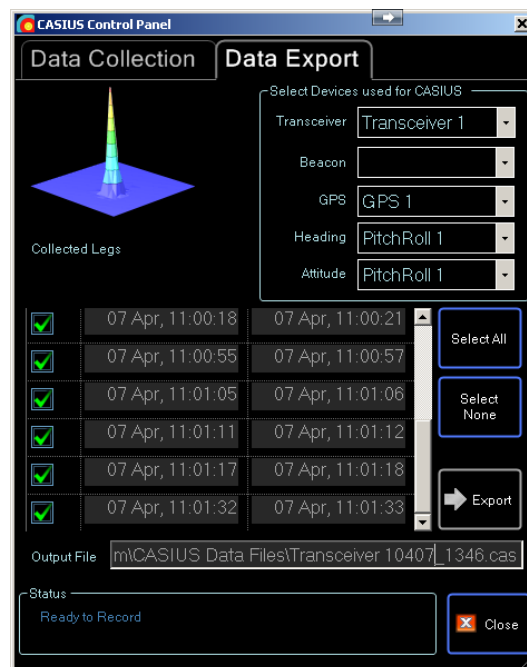
Repeat steps 1 to 3 for each leg of the CASIUS data collection.



When data has been successfully collected for all CASIUS legs, select the **Data Export** tab.

Select the transceiver, beacon, GNSS, heading and attitude sensor to be used for the CASIUS calibration from the drop-down lists, then select the data sets for CASIUS processing by clicking on the **Use** check boxes.

Click **Export** to process the CASIUS data.



A.10.4 Environmental

The Environmental Settings dialog box allows you to set the default sound speed, and to import a sound speed profile, if one is available for the operating area. This is one of the system's common operating procedures and is described fully in *Section 4.19 "Configuring the Sound Speed"*

A.10.5 Geodesy

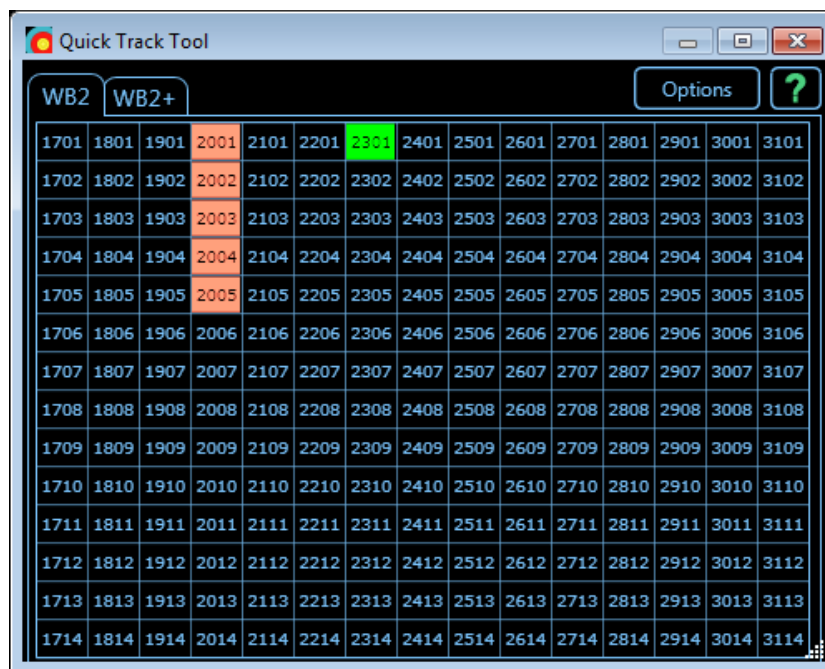
See Section 4.11 "Geodesy Tool"

A.10.6 Quick Track

The Quick Track tool is used for simple jobs requiring a small number of 6G or PGT beacons. Quick Track tool. Quick Track uses the unique IIS interrogate signal for a 6G beacon.

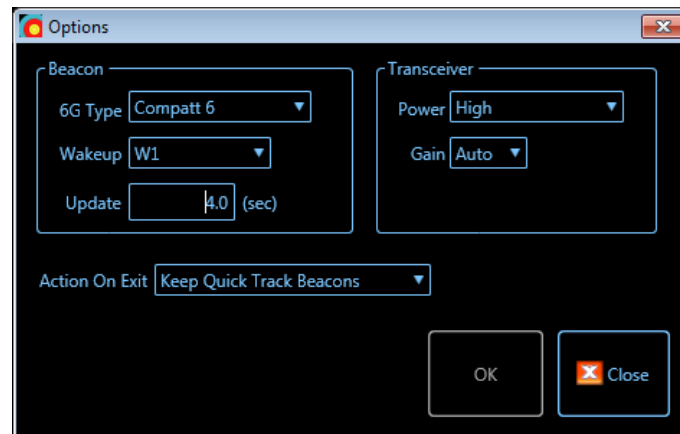
Clicking on the beacon address in the Quick Track tool :

- Adds a 6G beacon with that address to the setup.
- Starts the beacon tracking.
- Enables a beacon output telegram (if there is a telegram setup).
- Clicking the address again stops that beacon tracking and removes it from the setup.
- An active Quick Track beacon is shown in green. Other beacon addresses already allocated are shown in pink.

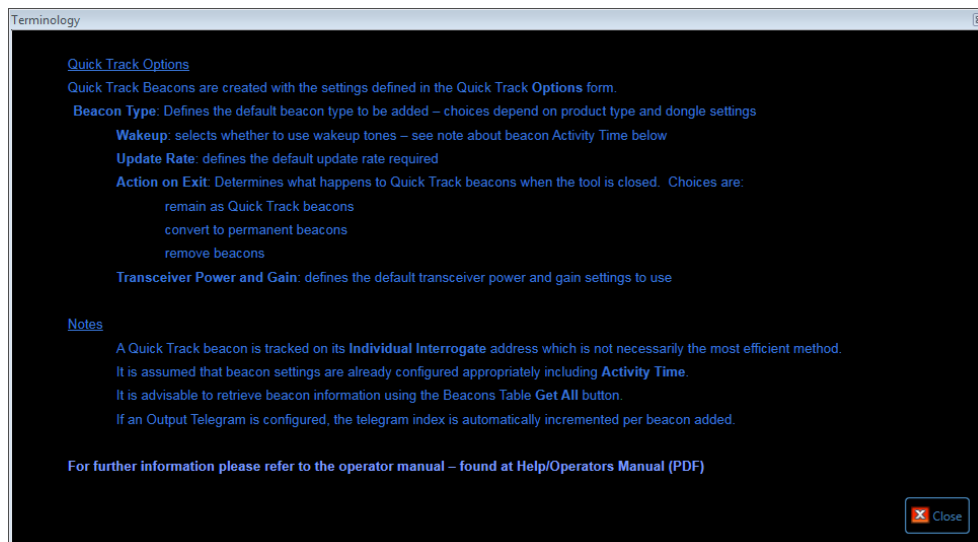


The Quick Track defaults can be configured by clicking the **Options** button.

- **6G Type** – Defines the type of beacon to be added to the setup (choices offered depend on the product and security key settings).
- **Wakeup** – Selects whether to use a wakeup tone – this depends on the beacon configuration.
- **Update Rate** – Defines the acoustic update time.
- **Action on Exit** – Determines what happens to Quick Track beacons when the tool is closed.
 - Remain as Quick Track beacons
 - Convert to permanent beacons
 - Remove beacons
- **Transceiver Power and Gain** – Defines the default transceiver power and gain settings to use



Guidance notes are displayed by clicking

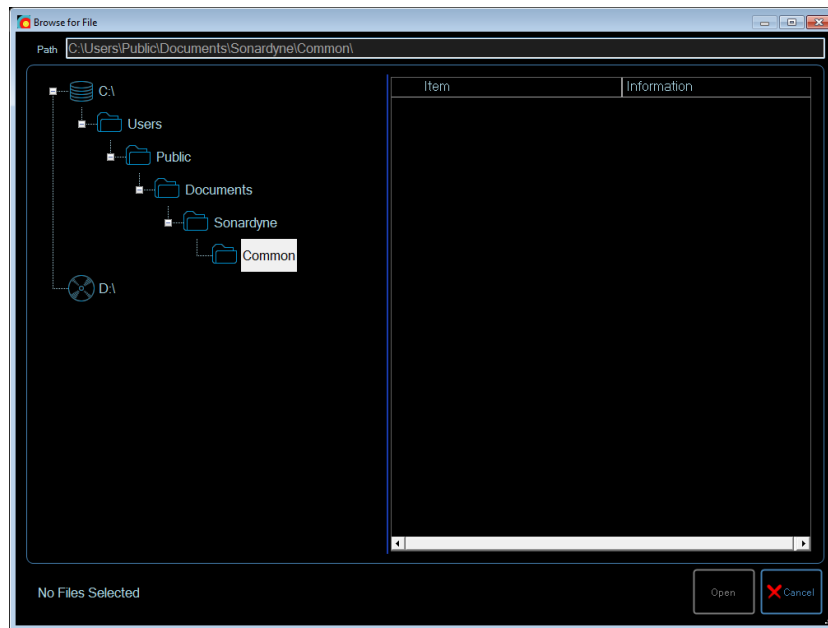


A.10.7 Waypoints

Import

To import a large number of waypoints, select **Tools > Waypoints > Import** to open the waypoints import window. Navigate to and select the NAV file containing the range of waypoints and then click **Open**.

Import supports importing of waypoints from standard .NAV files. See *"Import and Export"* in Section A.10.2 for a description of the .NAV file format.



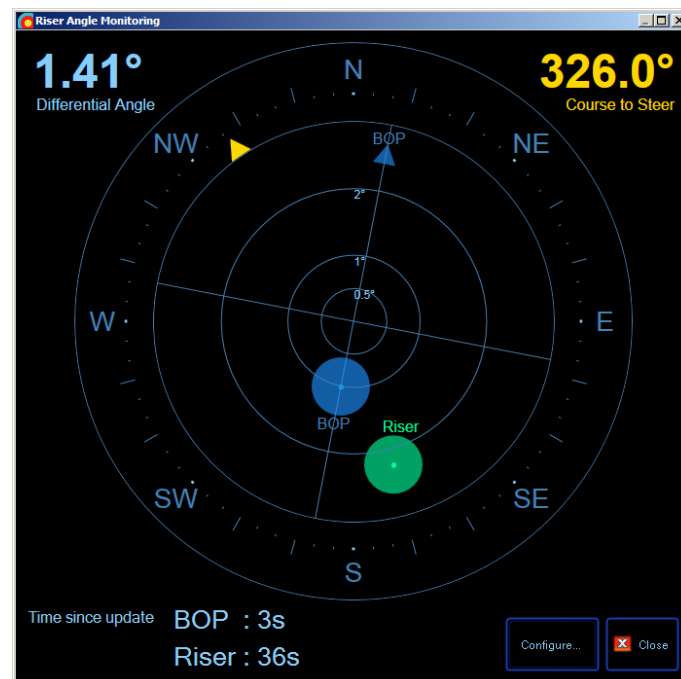
Remove All

Select **Tools > Remove All** to delete all the waypoints in the job. Click **Yes** to confirm .

A.10.8 MRAMS

See Section 9 "Riser Angle Monitoring" for a description of the Riser Angle Monitoring feature.

Select **Tools > MRAMS** to display MRAMS measurements.

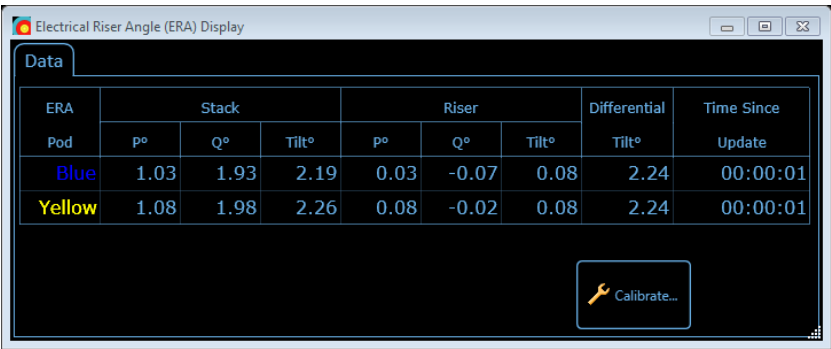


A.10.9 ERA

See Section 9 "Riser Angle Monitoring" for a description of the Riser Angle Monitoring feature.

Select **Tools > ERA** to display ERA measurements.

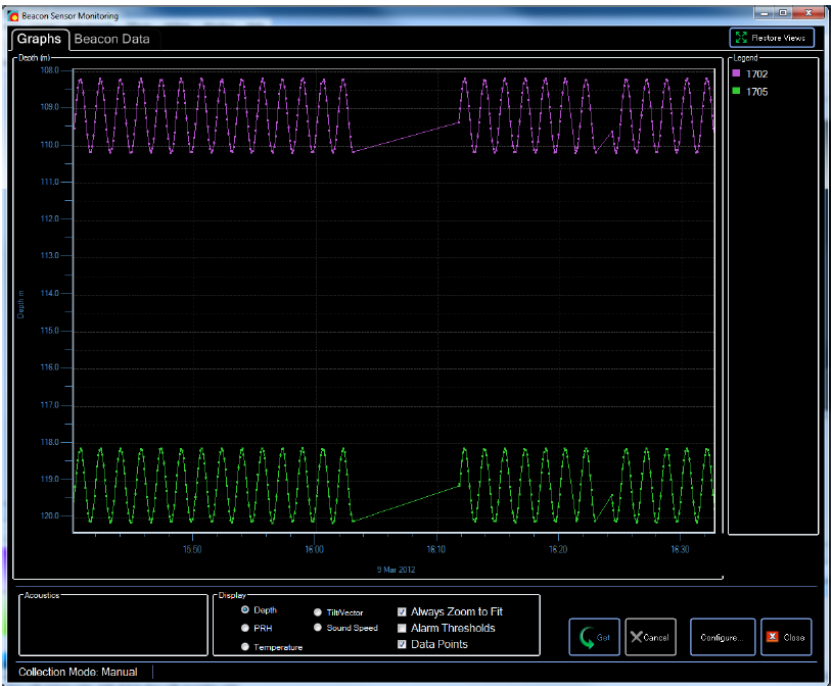
Click **Calibrate** to enter the Stack and Riser offsets.



ERA Pod	Stack			Riser			Differential	Time Since Update
	P°	Q°	Tilt°	p°	Q°	Tilt°	Tilt°	
Blue	1.03	1.93	2.19	0.03	-0.07	0.08	2.24	00:00:01
Yellow	1.08	1.98	2.26	0.08	-0.02	0.08	2.24	00:00:01

A.10.10 Sensor Monitoring

See Section 11 "Beacon Sensor Monitoring Tool "for a description of the Sensor Monitoring feature.
Select **Tools > Sensor Monitoring** to display the Sensor Monitoring window.



A.10.11 Riser Profiling

See Section 10 "Riser Profile System"
Select **Tools > Riser Profiling** to display the Riser Profiling window.



A.10.12 Advanced

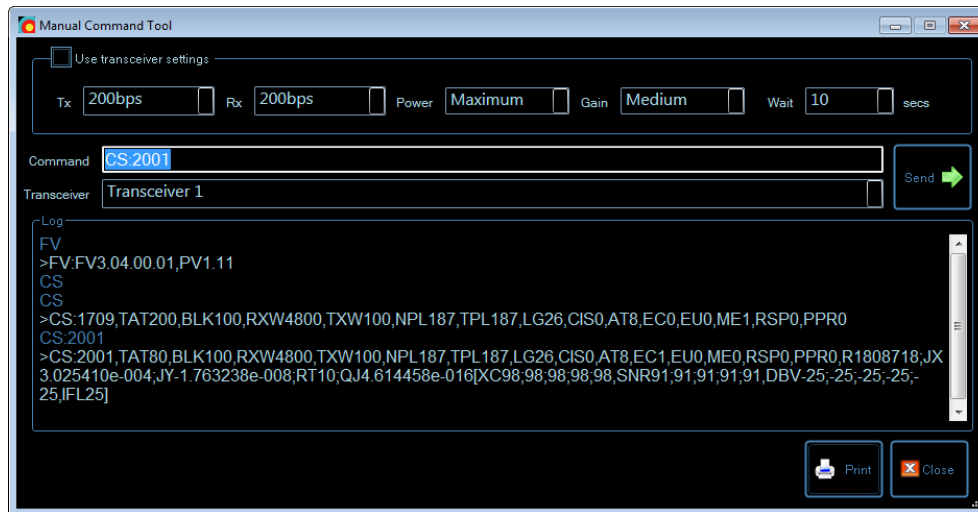
The **Advanced** menu item provides the following features:

- Manual Command
- Attitude and Heading Calibration
- Transceiver To Ship Calibration
- Acoustic Signal Analysis
- Noise Plot
- Transceiver Admittance Test
- Transceiver Factory Calibration
- Transceiver Firmware Download
- Transceiver Phase Calibration
- Acoustic Synchronization
- Graphs
- NSH Firmware Download
- Simulate

Note

 Only the Manual Command, Acoustic Synchronization and the Acoustic Signal Analysis options are available on the Advanced menu if you are tracking.

Manual Command



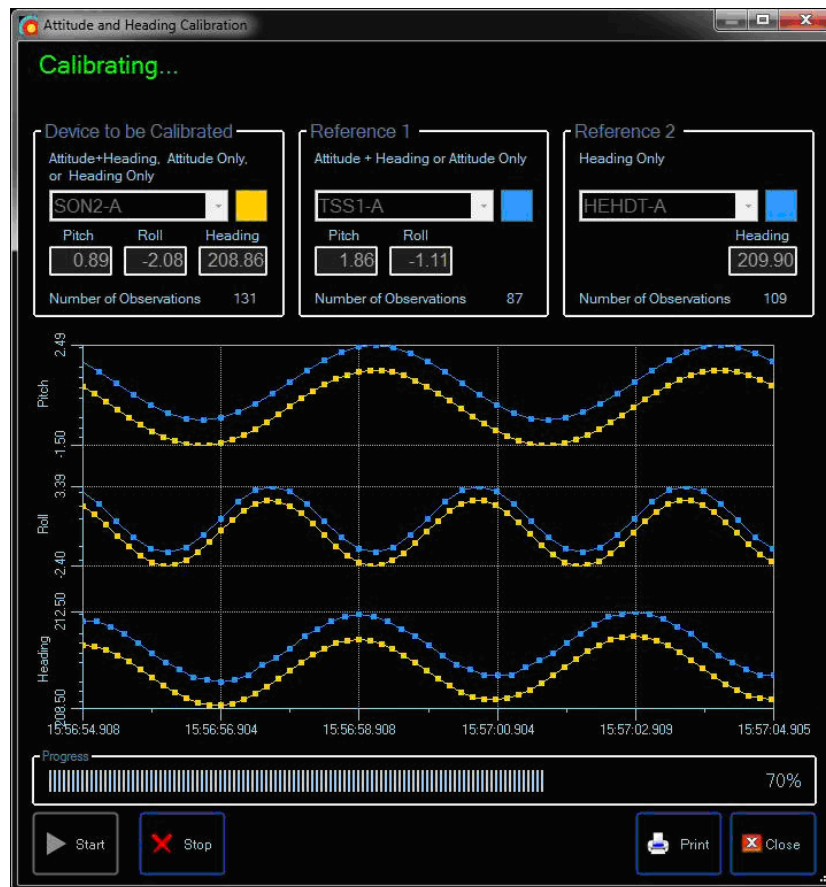
The **Manual Command Tool** allows you to type a command and send it to a selected transceiver. The centre pane shows communications with the selected transceiver as the command is issued and the replies received.

Optionally, you can also set the following parameters for the manual command:

- Tx, Rx telemetry schemes
- Telemetry power
- Receiver gain
- Telemetry wait time

Alternatively, the current default parameters can be used by selecting the **Use transceiver settings** check box.

Attitude and Heading Calibration



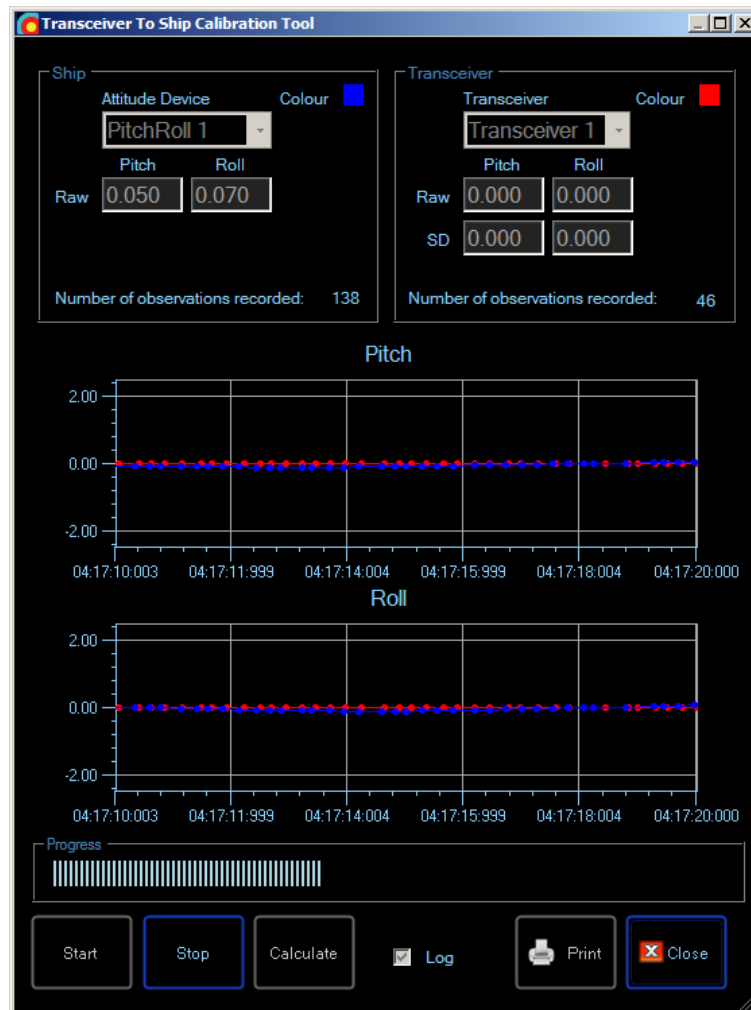
This tool allows you to calibrate an AHRS device against either a single 'reference' AHRS, or two separate Attitude and Heading devices (shown as **Reference 1** and **Reference 2** above). The tool automatically hides the **Reference 2** selection control if **Reference 1** provides all the required data.

The charts show the measurements of Pitch, Roll and Heading for the data sources, using the colours shown in the top control groups to identify them.

Buttons at the bottom of the tool dialog box allow you to start and stop the calibration.

At the end of the calibration you are given the option to apply the calculated offsets to the device.

Transceiver To Ship Calibration



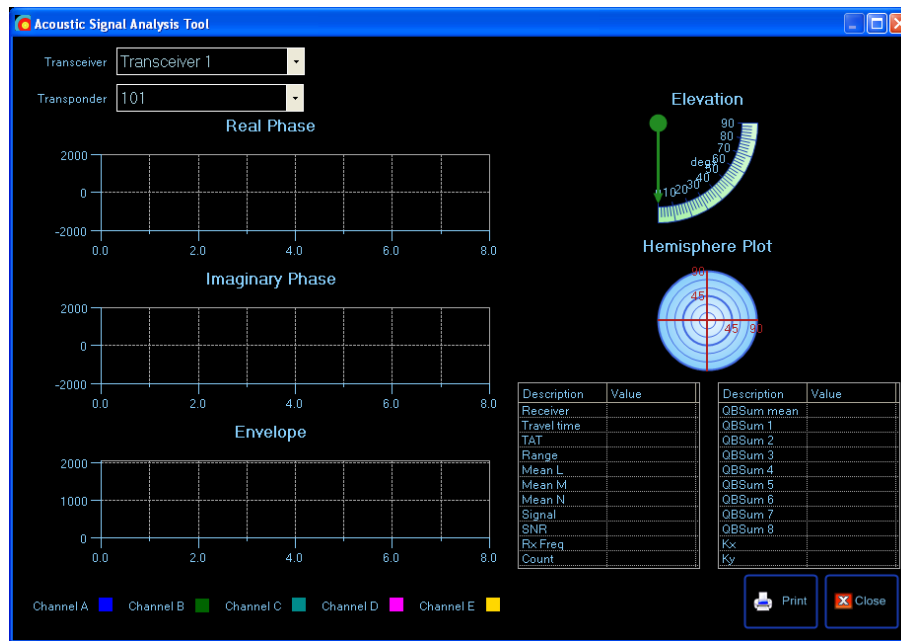
The two control groups **Ship** and **Transceiver** show real-time data for the AHRS Instrument and for the transceiver's internal inclinometer. They also show the correction necessary to align the inclinometer and AHRS measurements, and the standard deviation (SD) error in the inclinometer measurements.

Two charts show the measurements of Pitch and Roll for the two data sources, using the colours set in the top control groups to identify them.

A series of buttons at the bottom of the tool dialog box allow you to control the calibration and to log and print the results.

Acoustic Signal Analysis

The acoustic signal analysis tool allows you to assess the condition of the acoustic signal. This tool provides a large amount of detailed information that you can use to diagnose acoustic problems that may affect system performance.



The **Real Phase** and **Imaginary Phase** graphs show the phase of the signal received on each of the transceiver's receiving transducers relative to a local reference signal generated within the transceiver.

- **Real Phase** represents the component of received signal that is in phase with the reference signal.
- **Imaginary Phase** represents the component of the received signal that is in quadrature with the reference signal.

This is information about the difference in received signal phase between the five transducers, and the graphs show information from each of the transducer channels as a different colour.

Each line in the graph includes eight points, to represent the eight samples taken of the acoustic pulse. They rise in amplitude as the signal strength rises.

The graph's horizontal axis is the time into the received pulse, in milliseconds, over which the eight samples are taken.

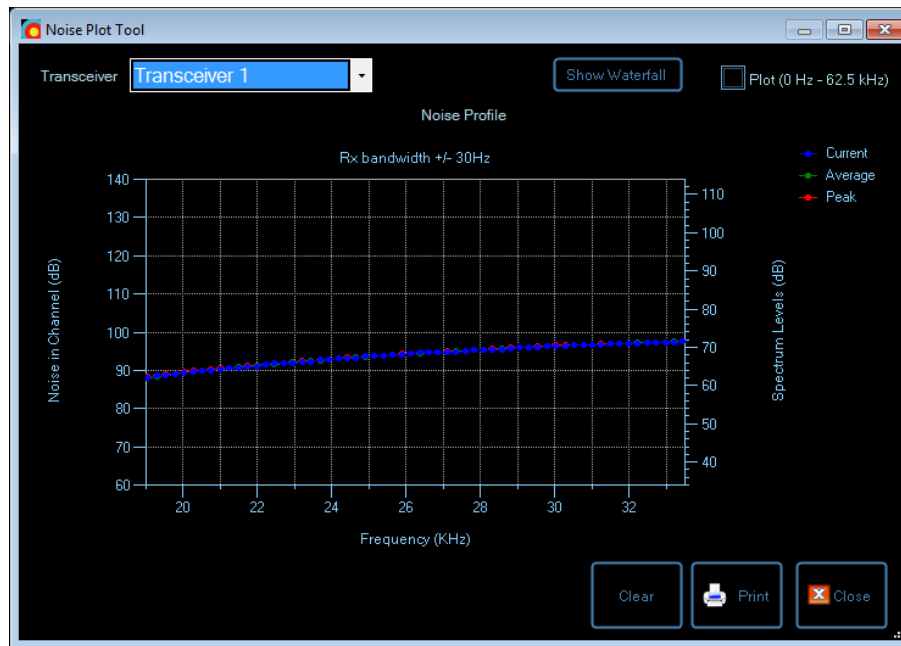
The **Envelope** graph displays the absolute magnitude of the acoustic signal as seen at each of the five transducers. The absolute magnitude is:

$$\text{Magnitude} = \sqrt{(\text{real}^2 + \text{imaginary}^2)}$$

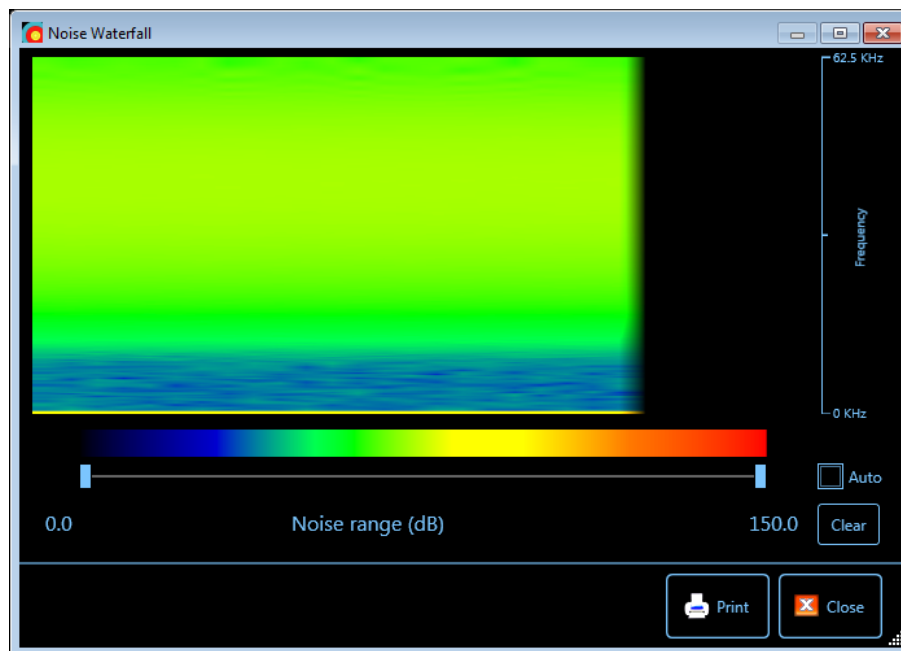
The **Envelope** graph also includes five lines, with one for each transducer. However, because they are all of the same magnitude, the graph shows them superimposed on top of each other. This is normal—the signal magnitude should always be the same at all five transducers.

Noise Plot

The noise plot tool is a fault finding tool that you can use to analyse the amount of background noise to which the transceiver is exposed. You can use it to take various noise profiles of the vessel under different operating configurations — for example with thrusters on and off; with the echo-sounder on and off. These profiles will give you an good idea of the power and gain settings to use; the maximum range you will achieve; and the power setting required in the beacon.



Click **Show Waterfall** to display a waterfall plot.



Transceiver Admittance Test

This procedure performs a transceiver admittance test and health check.

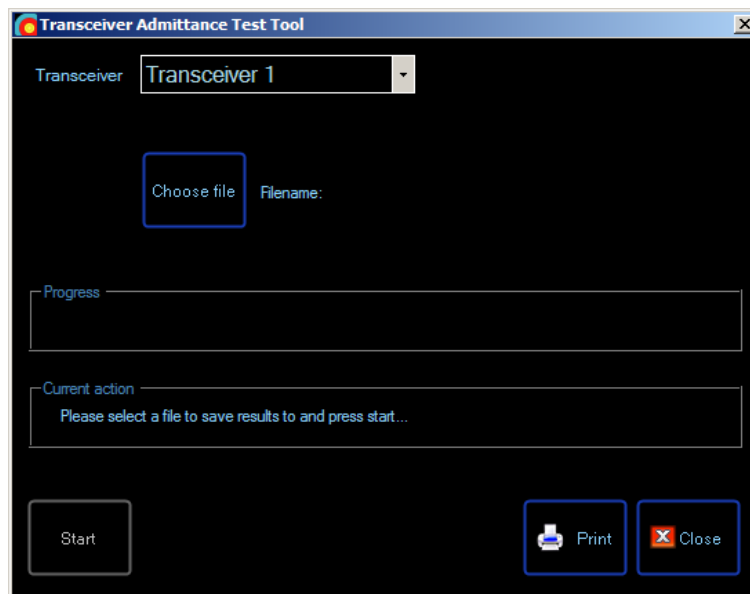
The health check works only on transceivers that have a device serial number that is higher than 1560, because these units were fitted with all the necessary components when shipped as new. It may be possible that older transceivers could have had both an array and a pre-amp upgrade performed at some time, in which case this health check will work.

On completion of the check, a CSV file is created. You should send this file to Sonardyne for analysis.

Note

 You can perform these operations only if tracking is off-line.

1. Make certain the GDT transceiver is connected and is working correctly. Use System Setup to do this.
2. Select **Tools > Advanced > Transceiver Admittance Test** to display the Transceiver Admittance Test Tool.



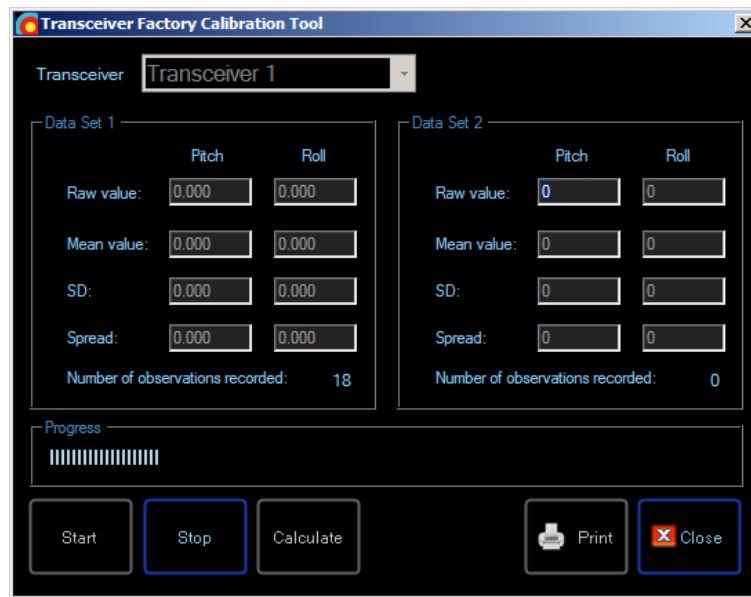
3. Select the correct **Transceiver** and click **Choose file** to select the folder and file name for the output CSV file.
4. Click **Start** to begin the check.
A progress bar shows progress as the test is performed and data collected.
5. When the test finishes, send the CSV file to Sonardyne for analysis (email address: **usbl.support@sonardyne.com**).

Transceiver Factory Calibration

The **Transceiver Factory Calibration Tool** performs a coarse calibration on the internal roll and pitch sensors.

Place the transceiver on a flat and level surface and display the Transceiver Factory Calibration Tool and follow the instructions below.

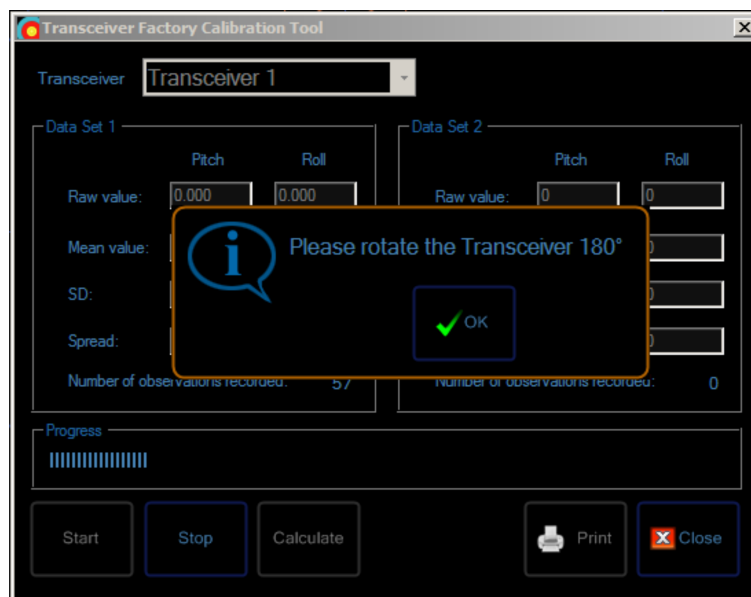
1. Click **Start**.
The transceiver takes and stores a series of measurements from the internal roll and pitch sensors.
2. Turn the transceiver through 180° when prompted.



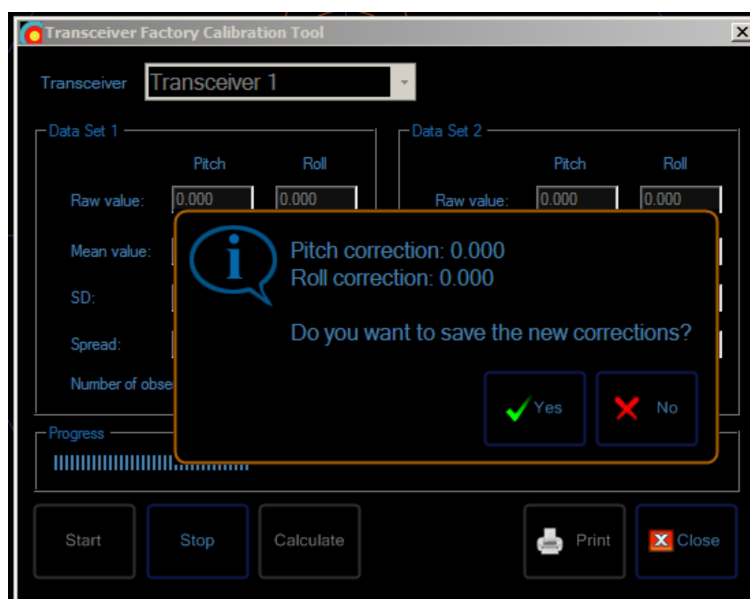
3. Click **OK**.

The transceiver takes another series of measurements from the internal roll and pitch sensors. A progress bar shows progress of the calibration.

On completion of the measurements, the calibration details are displayed.



4. Click **Yes** to save the results of the sensor calibration, or click **No** to discard the results.



Note

 You can choose to export the results of the internal sensor calibration. Refer to the section *"Data Export"*.

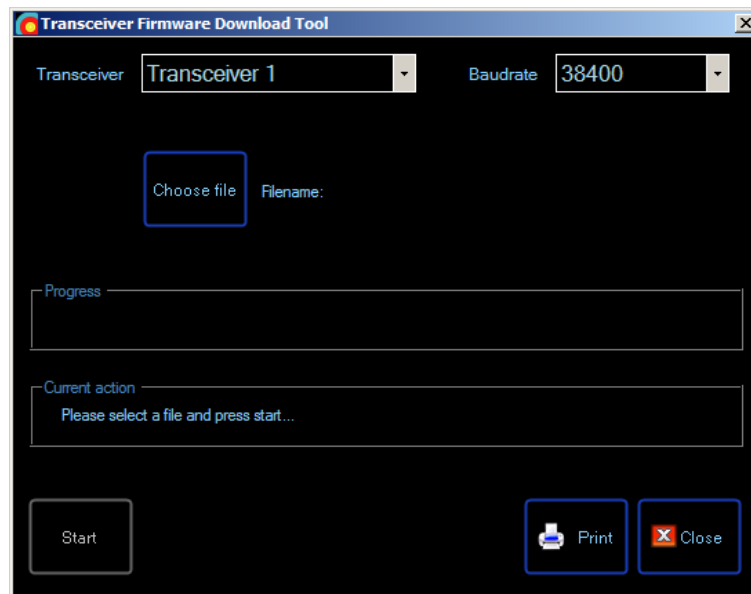
Transceiver Firmware Download

GDT firmware is stored in a ***.gdt** file. Sonardyne recommends that you obtain the latest version of firmware from -Sonardyne International Limited and that you save it to the C: drive of the computer that you use to run the software.

Note

 You can perform these operations only if tracking is off-line.

1. Make certain the transceiver is connected to an NSH transceiver port and the NSH is networked into the Navigation Computer correctly.
2. Add a transceiver device to the system setup of the correct type, and confirm that communications to the transceiver is working correctly
3. Select **Tools > Advanced > Transceiver Firmware Download** to display the Transceiver Firmware Download Tool.



4. Select the correct **Transceiver** and then set the **Baudrate** to use for the firmware download.

Note

 Higher baudrates will allow a faster download. However, you should consider that vessel's wiring can sometimes cause communication errors at higher baudrates.

5. Click **Choose file** and select the file to download.
6. Click **Start** to begin the download.

A progress bar shows the download progress. The download will take approximately 15 minutes at 38400 baud, and proportionately longer at lower baudrates.

Notes

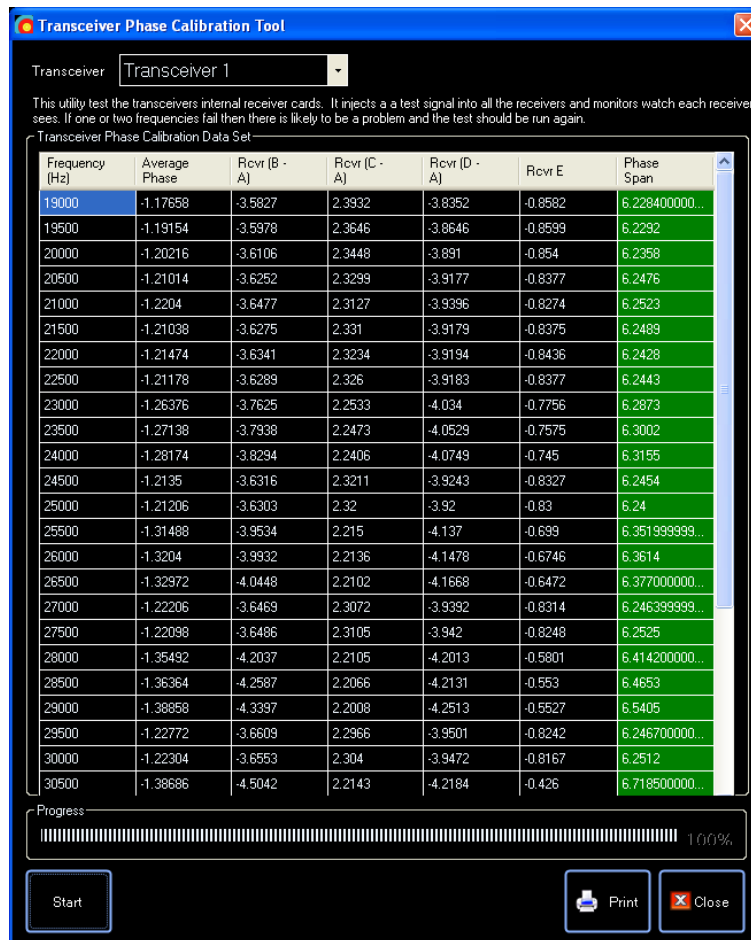
 If the download fails, try again using a lower baudrate. Avoid using the PC for other purposes while the download progresses.

7. Return to the System Setup for the transceiver and click **Set All**.
8. Confirm the firmware version is now set to the new version you have downloaded.

Transceiver Phase Calibration

The Transceiver Phase Calibration test tool is available only when all transponder beacons are offline and set to not tracking.

To perform a transceiver phase calibration test select **Tools > Advanced > Transceiver Phase Calibration** from the menu.



This tool tests the transceiver's internal receivers by injecting a test signal across a range of frequencies, and measuring the differences (using receiver A as the reference). The results are shown with a colour coding:

- red indicates a large difference (typically more than 8 degrees).
- green indicates a small differences.

If only one or two frequencies fail, it is unlikely that there is a problem because the test can be disturbed by external noise. In this case, repeat the test to try to gain a successful result.

The system runs this calibration test automatically at 15 minute intervals, and sends warning messages if a problem is detected. You should use this tool if you suspect there is something wrong with the transceiver.

Acoustic Synchronization

The Acoustic Synchronization tool allows you to synchronize all the acoustic signals transmitted by the system to reduce or avoid interference with other acoustic systems operating on the vessel.

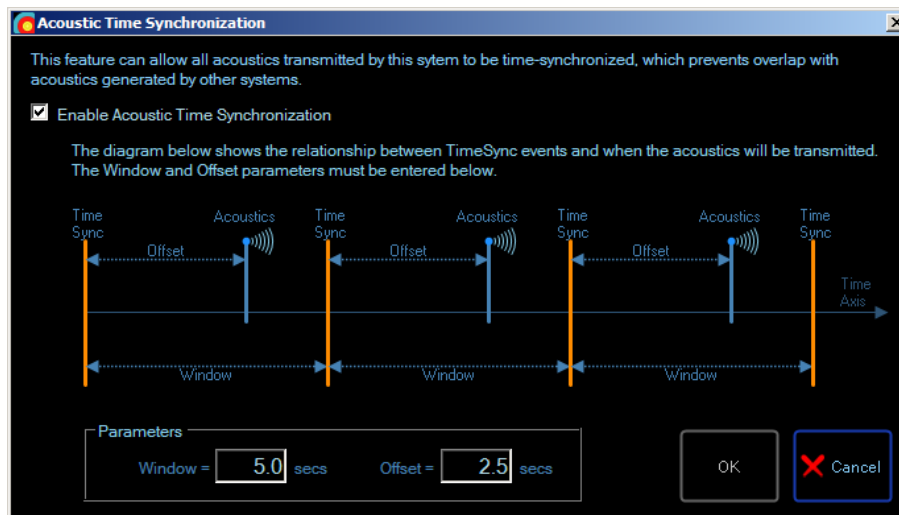
The **Window** parameter sets the interrogation rate to be used on this system. Generally, all synchronised systems should use the same **Window** width. The **Offset** parameter allows control of where one system transmits with respect to the others so that signals do not collide in the water. There are several strategies that can be used to select the most appropriate **Window** and **Offset** times to use. The most appropriate strategy depends on the application, and the requirements of the operator. The three main strategies are:

1. Keep the interrogation signals from all systems close together, leaving a large space until the reply signals arrive. In deep water, setting the **Window** on all systems to 5 s, and staggering the **Offset** by 0.2 s or 0.5 s can work well. This is a straightforward, low risk approach. In some applications it is preferred to have data from the independent systems spread out in time as evenly as possible.
2. Estimate how long an acoustic cycle will take, and set the **Window** to at least twice this time, and the **Offset** equal to half of the chosen **Window** width. In 1500 m of water, signals take approximately 1 s to arrive at the seabed, and 1 s to return. Add to this the longest turn around time, and the estimated cycle time might be around 3 s. Setting the **Window** to 6 s on both systems in a dual independent system, and **Offsetting** the second system by 3 s would ensure reliable performance, and that there is an acoustic position available every 3 s.
3. Use an offline planning tool to tune TATs, and **Offsets** to achieve fast, interleaved updates.

Sonardyne support can provide further guidance on particular tracking scenarios if required.

Select the **Enable Acoustic Time Synchronization** check box to enable this feature.

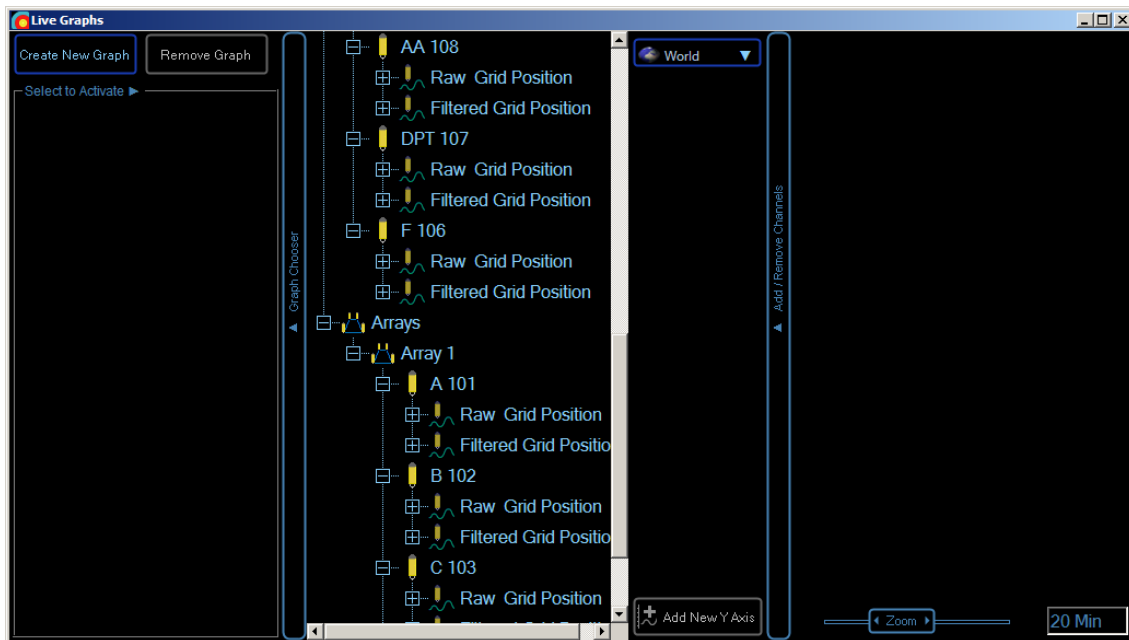
Enter the **Window** time and the **Offset** time to use for synchronization and click **OK**.



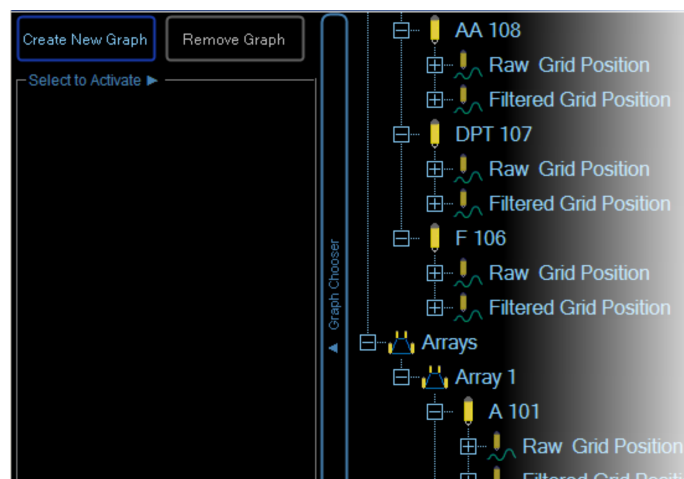
Graphs

The software allows you to create live graphs that show the measurements made by objects in the setup. You can select the instrument to use as the data source for a graph, and then you can select the measurements to use for the graph.

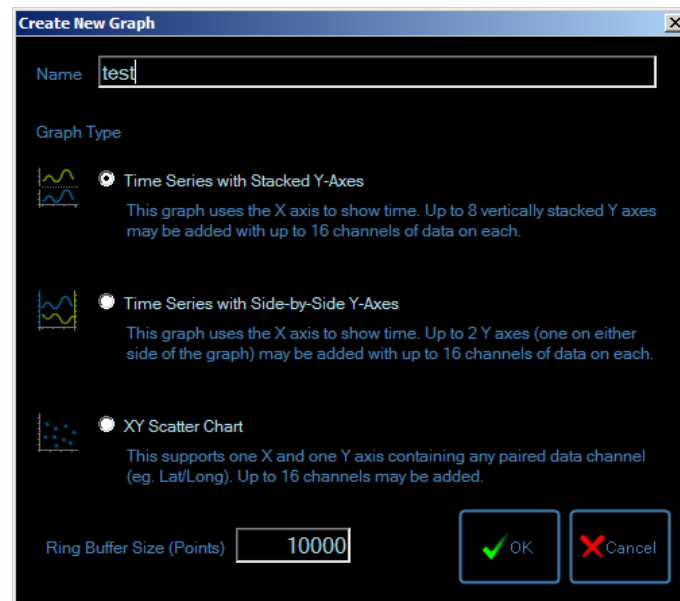
1. Select **Tools >Advanced>Graphs** to display the **Live Graphs** window.



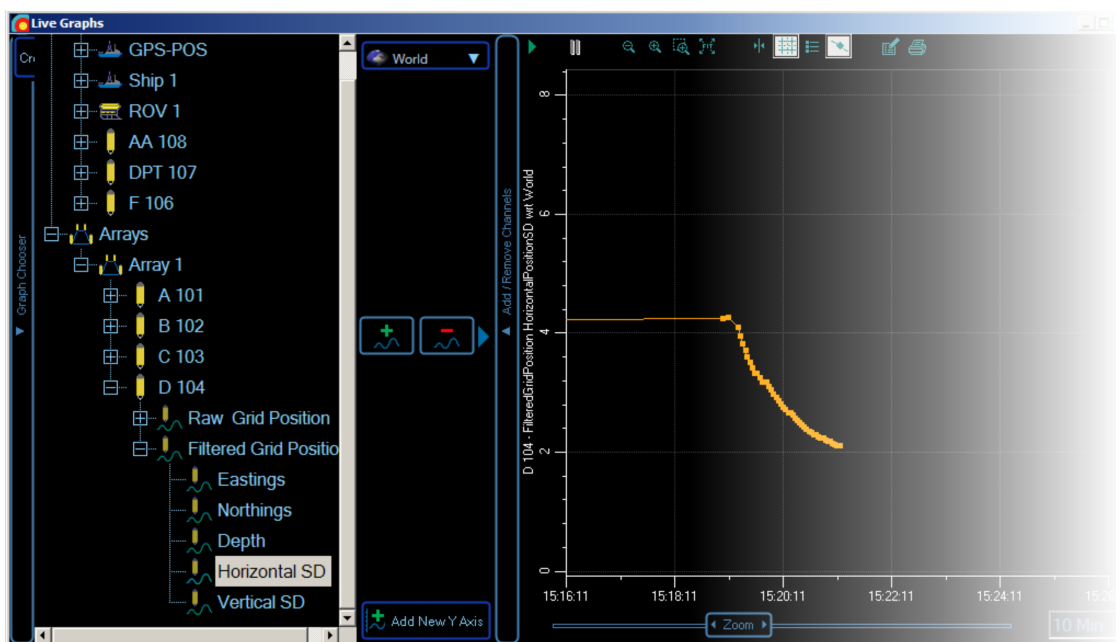
2. Click **Create New Graph**.



3. Enter a name for the new graph.
4. Select the type of graph and click **OK**.



5. Select an instrument in the object tree above whose measurements you want to use for the graph.
6. Either:
 - a. Click **Add New Y Axis**, or
 - b. Click the **+** button to add an existing Y axis.



Graph Controls:



The graph controls, shown above, are from left to right:

- Play/Resume the plot
- Pause the plot
- Zoom Out

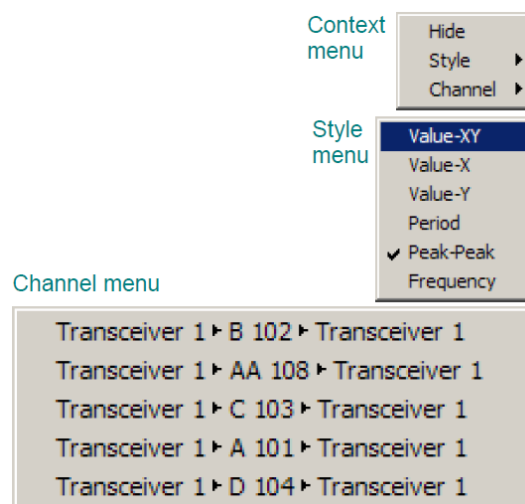
- Zoom In
- Zoom Area
- Zoom to Fit
- Cursor On/Off
- Grid Lines On/Off
- Legend On/Off
- Markers On/Off
- Edit Properties (for advanced users only)
- Print

Cursor:

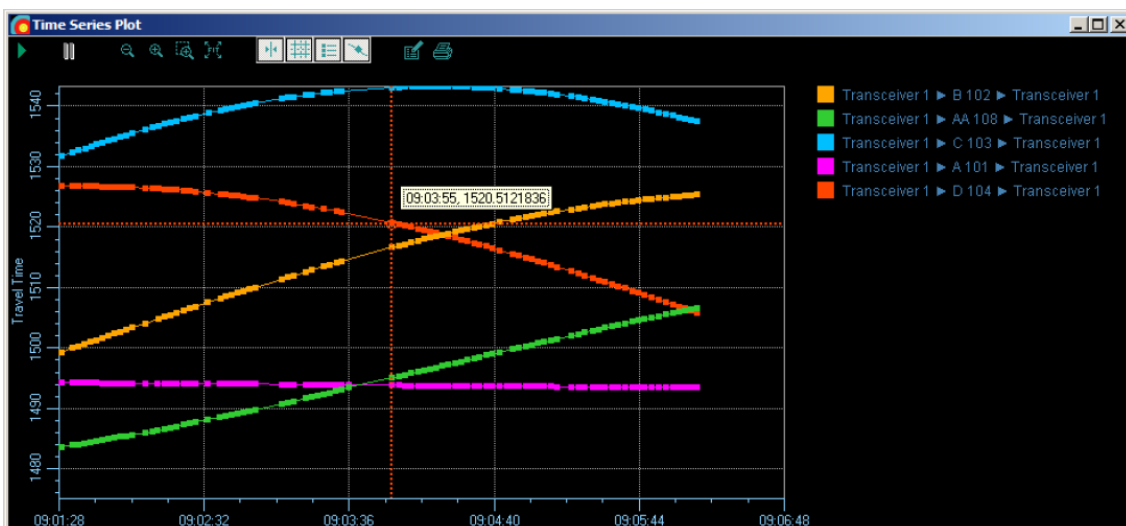
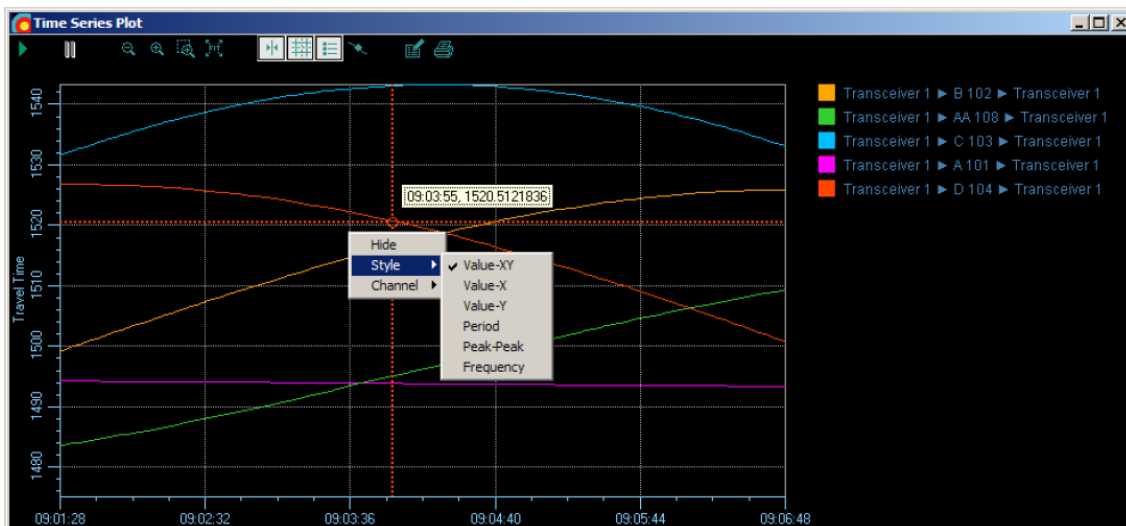
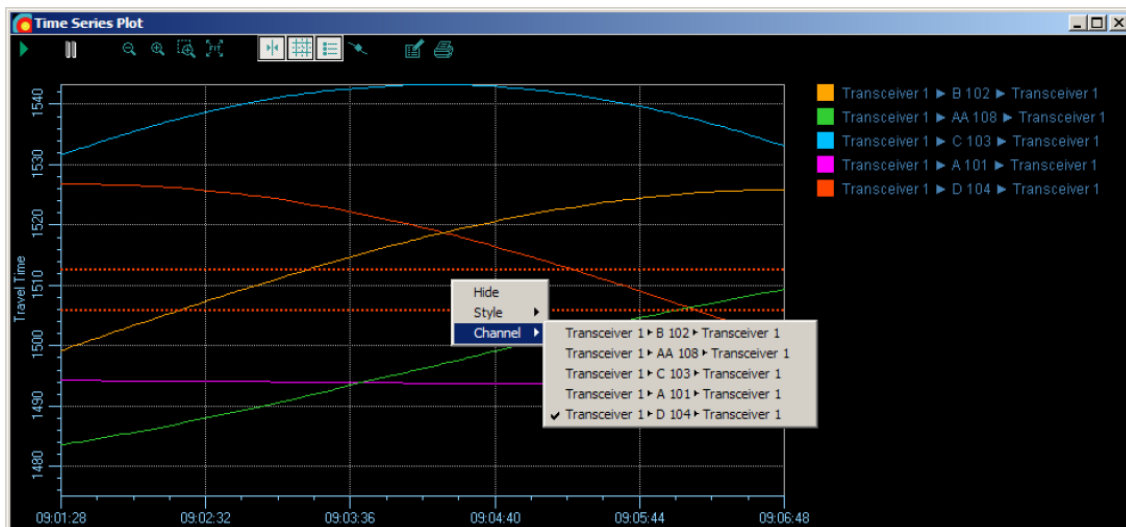
Use the **Cursor On/Off** toolbar button to enable the cursor. Right-click the cursor lines to see the cursor context menu.

The Style menu allows selection of the type of cursor read-out.

The Channel menu allows selection of the channel to associate with the cursor. Note that the cursor's colour changes to match the selected channel.



shows an example where the acoustic travel times display has been set up with the cursor on channel D104, and the display uses the Value-XY style.



NSH Firmware Download

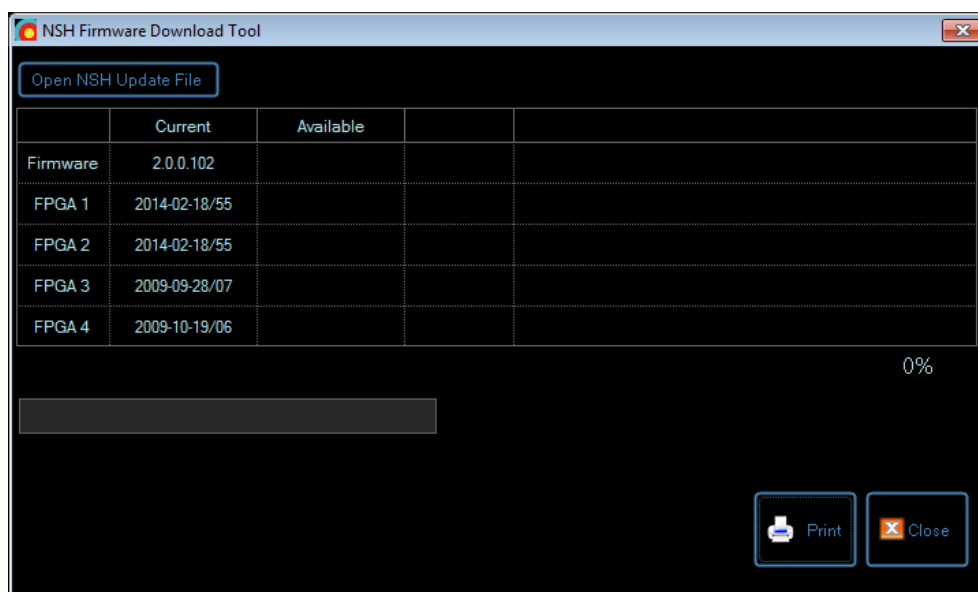
Sonardyne recommends that you use the NSH firmware version appropriate to the system software version; this firmware file is found on the system software release CD/DVD. The NSH firmware is stored in a *.nsh file.

Alternatively, obtain the latest recommended version of firmware from Sonardyne International Limited.

Note

 You can only perform these operations if tracking is off-line.

1. Save the .nsh file to the C: drive of the computer that you use to run the software.
2. Make certain the NSH is networked into the Navigation Computer correctly.
3. Add an NSH device to the system setup, and confirm that communications to the NSH is working correctly.
4. Click **Tools > Advanced > Transceiver Firmware Download** to display the Transceiver Firmware Download Tool.



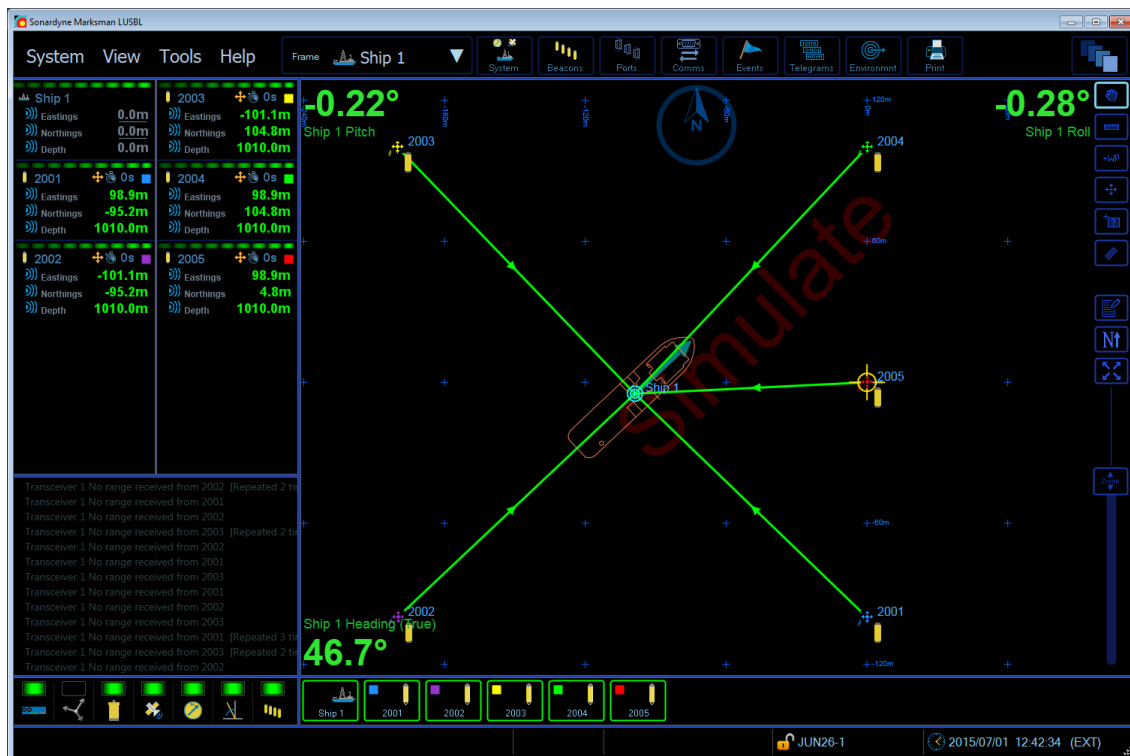
5. Click **Open NSH Update File** and select the file to download (the Current and Available firmware file versions are displayed).
6. Confirm that the Available firmware version is newer than the Current firmware version and then click **Download**.
7. A progress bar indicates the status of the firmware download and **Download Complete** is displayed after the installation has completed.
8. Confirm the new firmware version is now installed.

Simulate

The built-in simulation mode is mainly used for generating DP test telegrams. For a more sophisticated simulation tool, use a product such as SonSim available from Sonardyne.

Guidance notes

- It is necessary for the transceiver to be on and working. The Scheduler is not given transceivers, and therefore cannot simulate positions, unless the transceivers are operational.
- Regardless of the configuration, only the first transceiver is simulated.
- Beacons remain in their simulated positions regardless of pitch, roll and heading changes.
- At least one beacon must be defined, but does not need to be present. Each beacon is given a simulated position.
- Simulated positions are relative to the transceiver, not to the CRP.
- The current simulated positions are:
 - (100, 100, 1000));
 - (100, -100, 1000));
 - (-100, 100, 1000));
 - (-100, -100, 1000));
 - (100, 0, 1000));
 - (0, 100, 1000));
 - (0, -100, 1000));
 - (-100, 0, 1000));
- There is currently no user interface that allows configuration of the simulated positions.
- All beacons are updated at the update rate of the fastest.



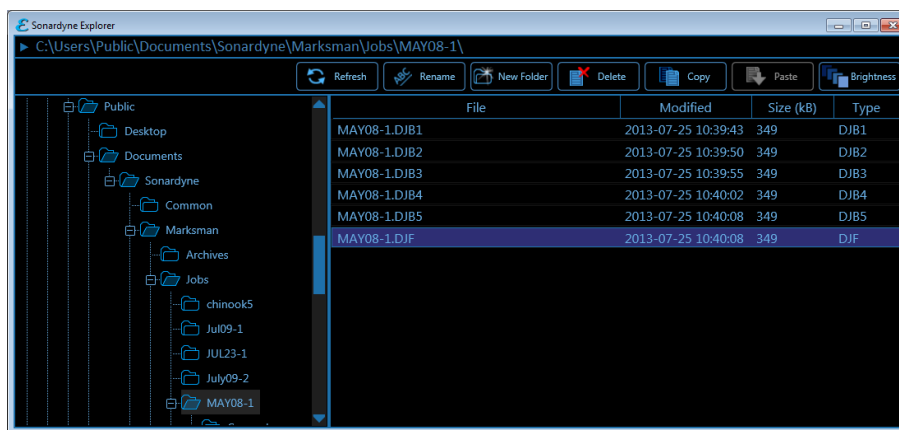
A.10.13 Maintenance

The Maintenance menu allows you to manage data logging, to explore the files, and to import or export set-up files.

Explore Files

The software's file explorer quickly navigates the user to the most commonly used system folders. Using this Explorer, the user can:

- **Copy** and **Paste** files between the system folders and removable backup media, such as USB memory sticks.
- **Rename** file, such as exported data files. Note that this option must not be used to rename Marksman system files otherwise unexpected behaviour might occur.
- **Delete** files.
- Create **New Folders**.
- **Refresh** the file list.
- Change the viewer **Brightness**.



Logging

The log file system is managed automatically by the software, but the **Logging** user interface allows you to make manual changes, if necessary.

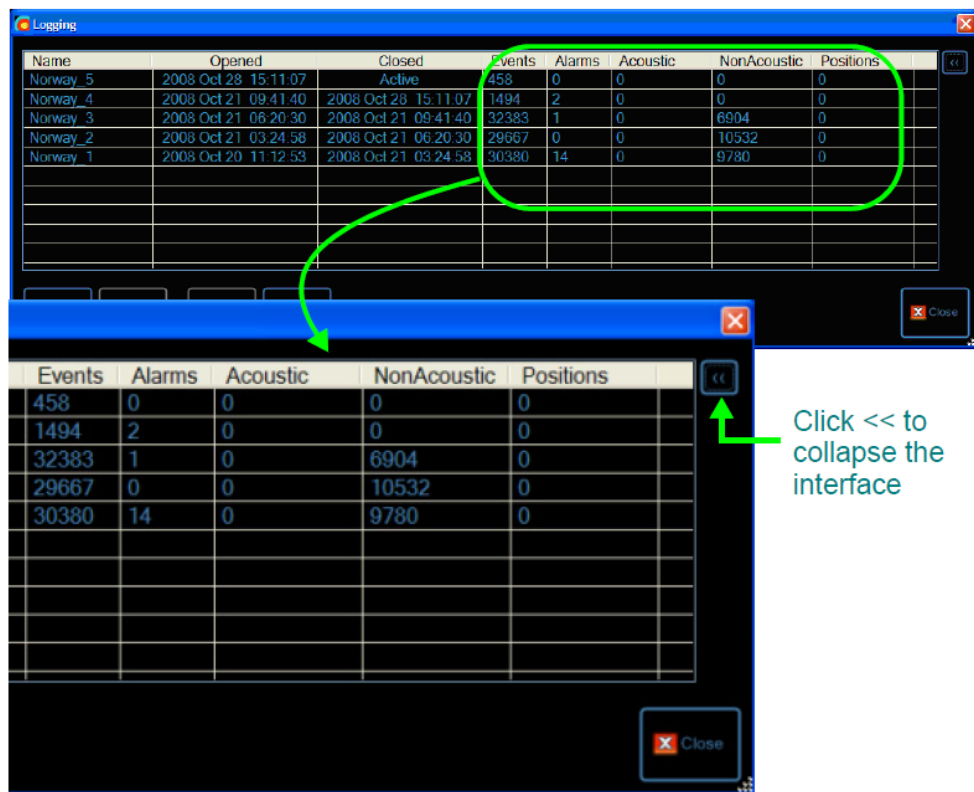
Figure A–2 Logging User Interface



Click >> to expand
the interface

The Logging user interface (UI) is shown in *Figure A–2*. It shows a list of the log files, together with details of the dates and times when the files were opened and closed, or their current status. Normally, log files are created and purged entirely automatically without user intervention. Occasionally, operator assistance may be required, but this should be done under the guidance of Sonardyne Support.

Click the >> button (near the top right-hand corner) to expand the interface to show more information about each file, for example:

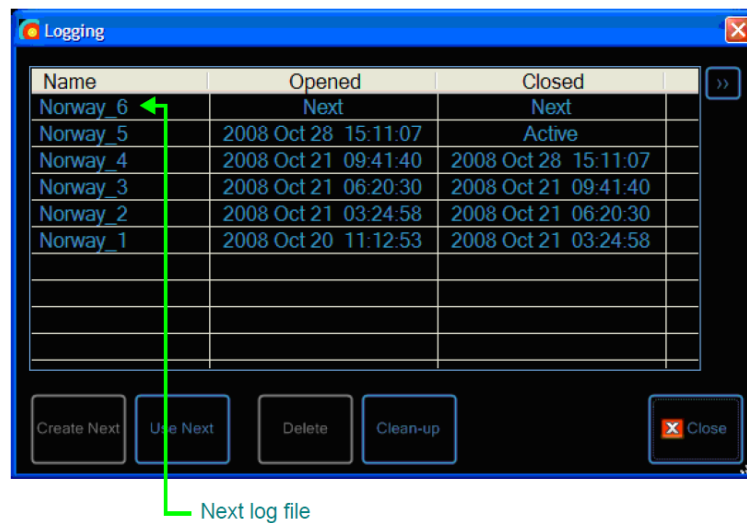


The Logging interface allows the following operations:

- Create Next
- Use Next
- Delete
- Clean-up

Create Next

The **Create Next** button is enabled if there is no 'next' log file already available. Click the **Create Next** button to create the next log file to which the system logs data. The application takes several seconds to create the next log file, after which the display updates, for example:



The status indicator **Next** in the **Opened** and **Closed** columns for the **Norway 6** entry shows that this is the next log file to be ready for use by the system to log data. However, in this example the active file is still **Norway 5**.

After you create the next log file as described, the **Create Next** button is disabled and the **Use Next** button is enabled.

Use Next

The **Use Next** button is enabled only if there is a 'next' log file available for use.

Click the **Use Next** button to stop logging to the log file that is currently active, and start logging to the next log file. The **Opened** and **Closed** fields are updated, for example:



The **Use Next** button is disabled, and the **Create Next** button is enabled, ready for you to create the next log file.

Delete

This option allows you to delete a continuous sequence of one or more log files, always beginning from the oldest log file in the list and ending at the log file you select. The **Delete** button is enabled only when you select a file in the list.

To delete a selection of files, click the most recent file that you want to delete, and click **Delete** to delete the selected file and all log files in the list that are older than the selected file, for example:



The software displays a prompt for confirmation, for example:



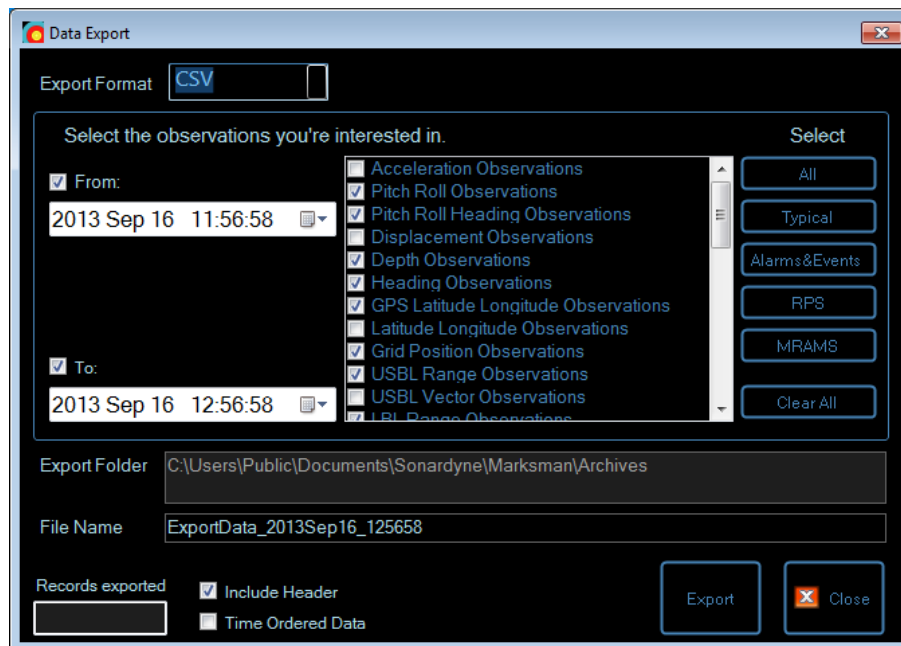
Click **Yes** to confirm the deletion. The interface is then updated to show the new list of log files, and the **Delete** button is disabled, for example:



Clean-up

The Clean-up button starts a house-keeping session that deletes any old log files as specified in the **House Keeping** section of the Options – Logging tab.

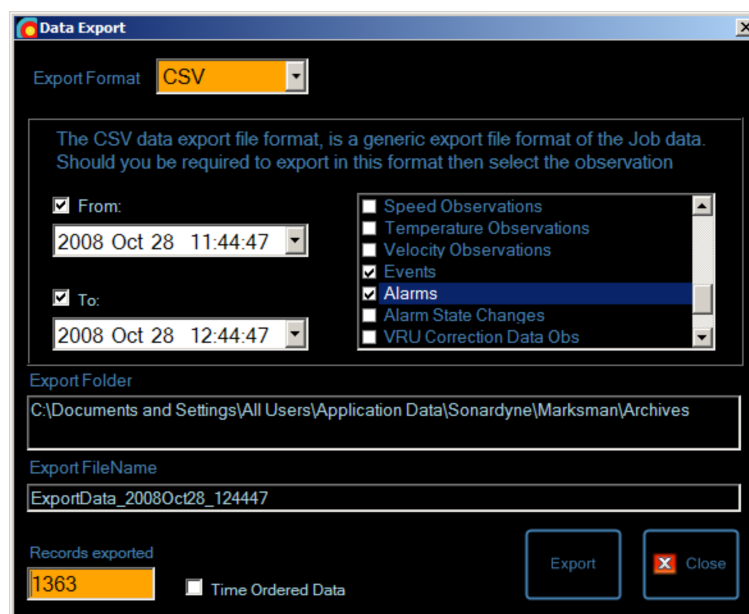
Data Export



The data export mode uses **CSV**, which you select through the **Export Format** control on the dialog box.

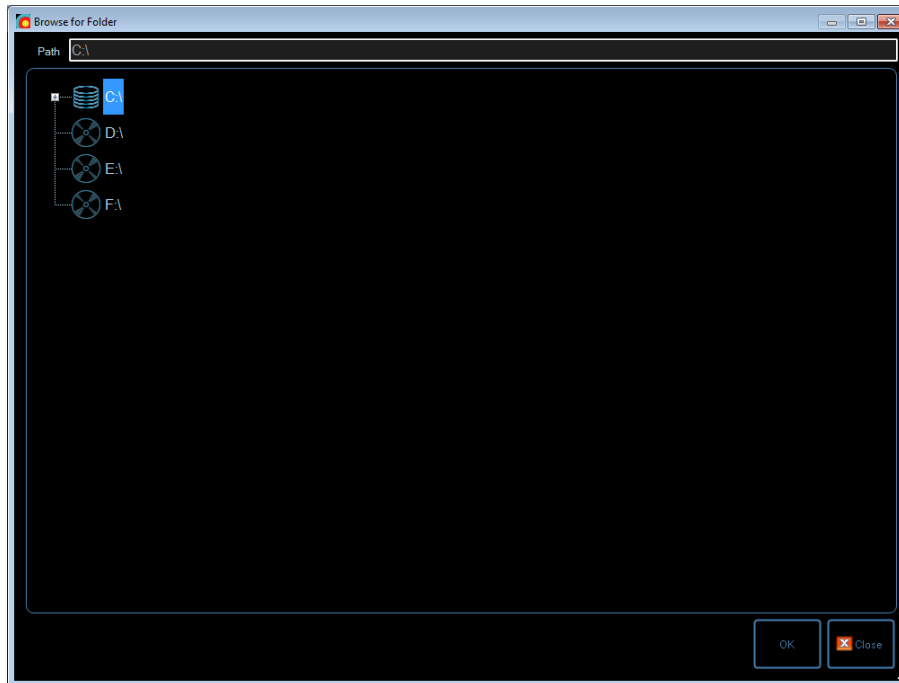
The CSV export mode is a general purpose exporter.

1. Select **CSV** in the **Export Format** control.
2. Set the **From** and the **To** dates between which to export observations.
 - To select all observations after a particular date, set the **From** date and then deselect the check box for the **To** date.
 - To select all observations before a particular date, set the **To** date and then deselect the check box for the **From** date.
3. Select the observations to include in the export.
4. Click **Export**.



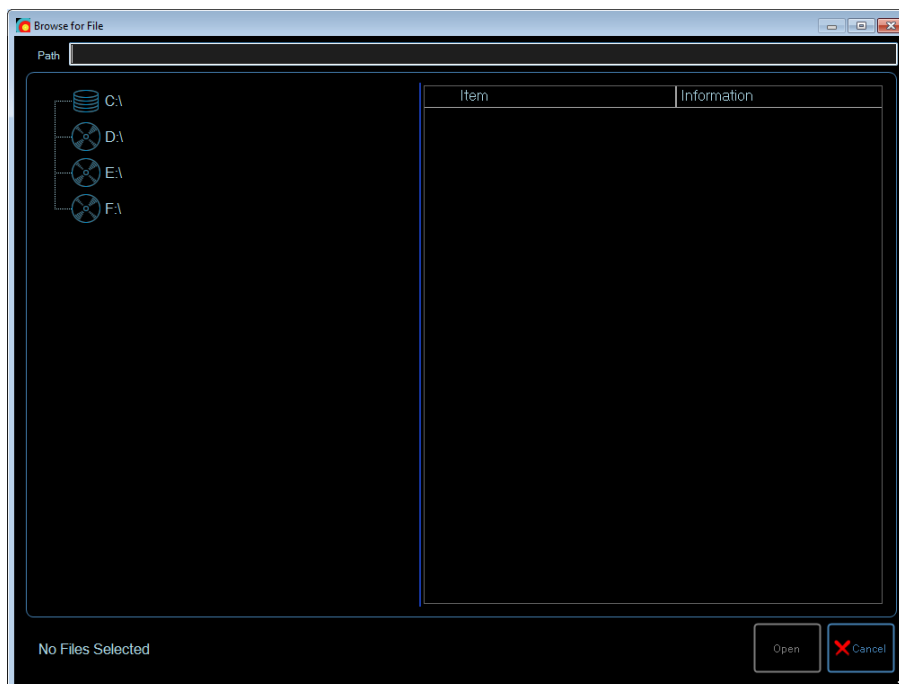
Job Export

This option allows you to export the current setup or a job to another system. Use the export dialog box to select a folder or removable device to receive the copied setup file.



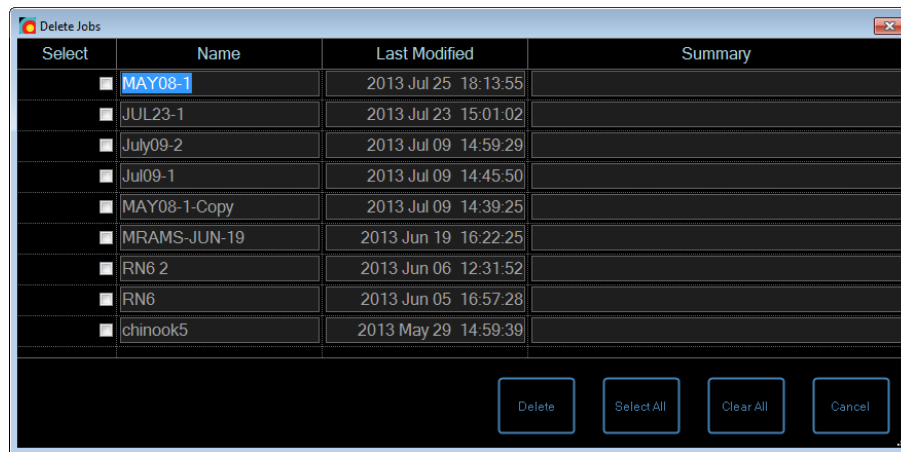
Job Import

This option allows you to import a setup or job from another system. Use the dialog box to navigate to a folder or removable drive containing the setup file (.DJF) to be imported.



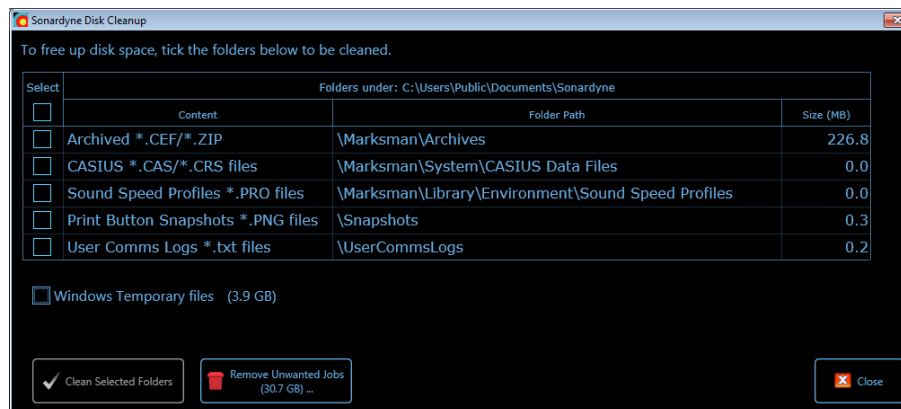
Select the jobs to be deleted, and click **Delete**. A dialog box allows you to confirm the action before the delete occurs.

Select all and **Clear all** allow you to select all the files for deletion, or to select none of the files.



Disk Cleanup

This option allows selected folders to be "cleaned", removing the contents from the hard drive to free up space on your PC.



The following folders and their associated file types can be cleaned:

- \Marksman\Archives (Archived .CEF/.ZIP files)
- \Marksman\System\CASIUS Data Files (.CAS,/.CRS files)
- \Marksman\Library\Environment\Sound Speed Profiles (.PRO files)
- \Snapshots (.PNG files)
- \UserCommsLogs (.txt files)

Select the content you want to delete or select the top check box to select all and then click **Clean Selected Folders**.

Windows temporary files can be "cleaned" by selecting **Windows Temporary files** and then clicking **Clean Selected Folders**.

Deleting Jobs



To delete unwanted saved jobs, click **Remove Unwanted Jobs**, select the job to be deleted and then click **Delete**. A dialog box allows you to confirm the action before the delete occurs.

The Remove Unwanted Jobs button displays the file size of all saved jobs.

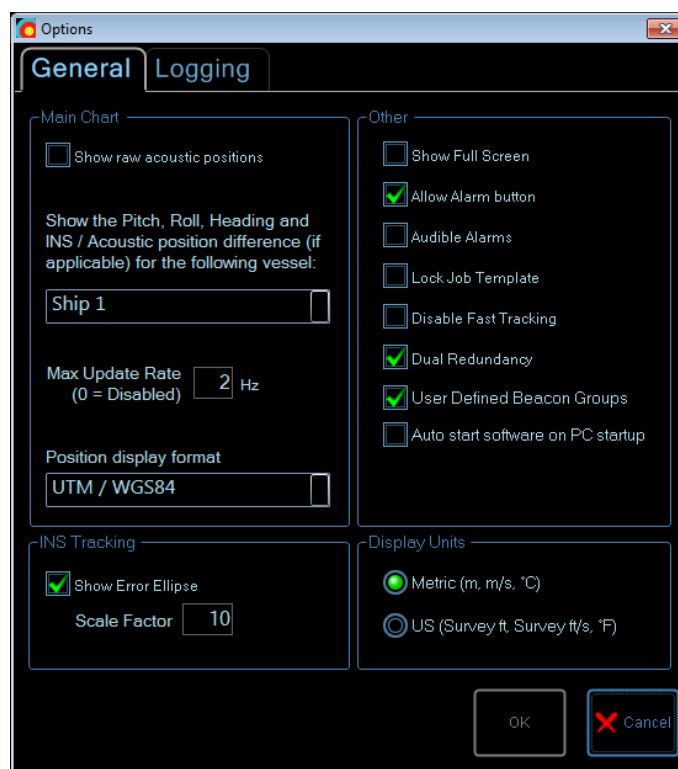
Note

 Take care not to unintentionally select and delete the current job.

A.10.14 Options

Options > General

The **General** dialog box contains the **General** and **Logging** tabs.



Main chart options:

- Select **Show raw acoustic position** to see the unfiltered position points.
- Select **Show...the following vessel** to choose the primary vessel for the display chart.
- Select **Position display format** to choose UTM or latitude/longitude display format.

INS Tracking Options

- Select **INS Show Error Ellipse with Scale Factor** to display an error ellipse with a defined multiplication factor scale.

Other Options

- Select **Show Full Screen** to remove the Windows title bar.
- Select **Allow Alarm Button** to display the on-screen alarm button.
- Select **Audible Alarms** to enable the alarm audio output.
- Select **Lock Job Template** to protect the job template containing the installation data.
- Select **Disable Fast Tracking** to stop interleaved ranging cycles (ping stacking); the system will send a command and wait for a response before sending another.
- Select **Dual Redundancy** to run two systems in a mirrored configuration..

- Select **User Defined Beacon Groups** to enable user-defined groups of beacons in the Beacons Table.
- Select **Auto start software on PC startup** to automatically start the software when the PC starts.

Display Units

Select Metric to display all measurements in SI units.

Select US to display in US survey feet, degrees Fahrenheit, and so on.



Normally, you should leave the data logging options in their default settings. Please refer to Sonardyne for advice before changing settings.

To keep logged data for:

- 1 week – set **Housekeeping Offline** to 168 with **Change Log File** at 1 hour.
- 1 month – set **Housekeeping Offline** to 720 with **Change Log File** at 1 hour.

Options > Backdrop

A chart backdrop may be used to reference the positions of vessels or beacons to seabed assets or topography.

Note

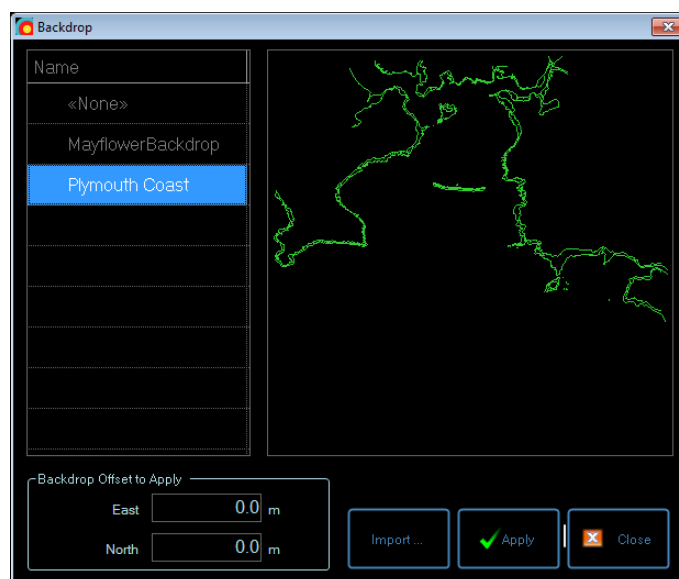


This optional feature is available only on Windows 7 (or later Windows versions).

Backdrop image files must be of type DXF. Select the appropriate backdrop from the named list and click **Apply**. Select **None** to work without a backdrop.

Multiple backdrop files may be **Imported** and stored on the system.

The DXF backdrop should normally have its Easting/Northing origin already defined, but an **Offset** may be applied if necessary.



Options > Chart

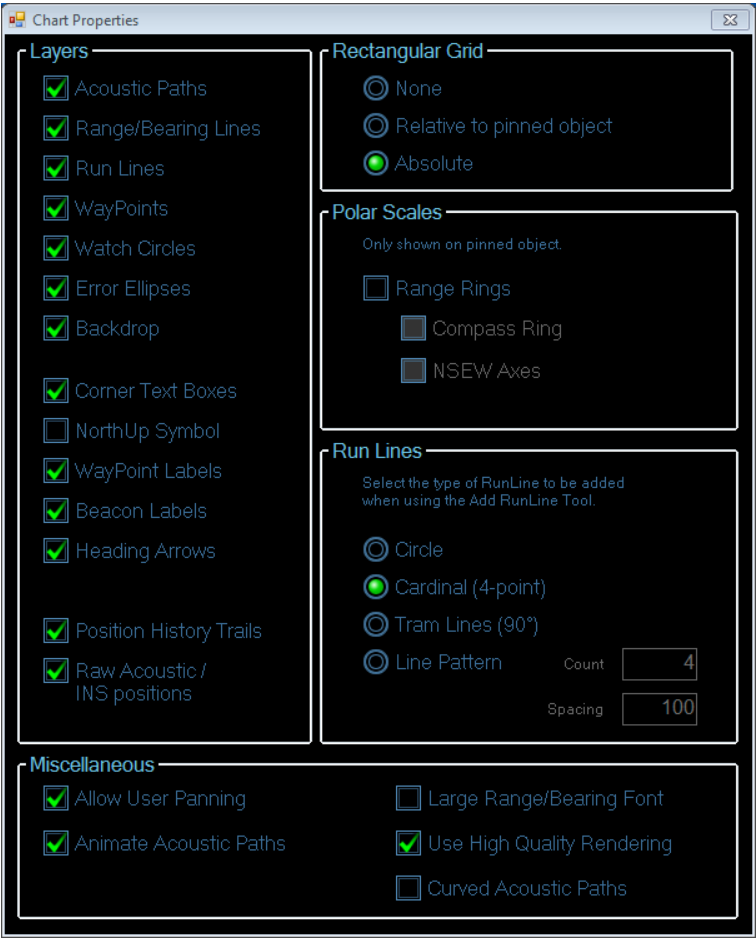
On Windows XP-based systems, there are no chart options, other than those listed in the **General Options** dialog box and the **Button Controls** described above.

On Windows 7-based systems, the navigation chart in the **Plan View Pane** has a flexible set of user options available through the **Chart Options** dialog box.

You can select:

- to view or hide each of the different object layers.
- a rectangular grid.
- a polar display with optional compass ring.
- run-lines settings for several different patterns.
- chart panning (dragging with the mouse).
- animation of acoustic range lines.
- range tool font size.

Selection of any of these properties takes immediate effect and the setting is saved automatically.



Options > Menu

The Menu dialog box allows you to customise the Main UI menu. Clicking a menu item allows you to show or hide that item in the Main UI. If the menu has a corresponding toolbar button then it will also be shown/hidden as appropriate.

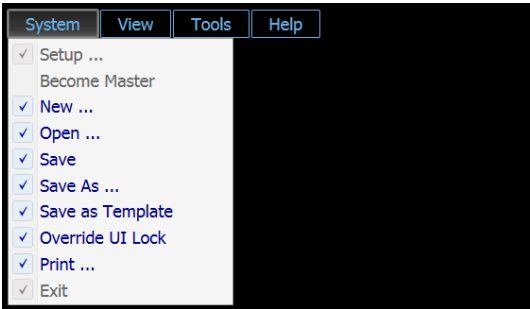


The four menu items are shown expanded below.

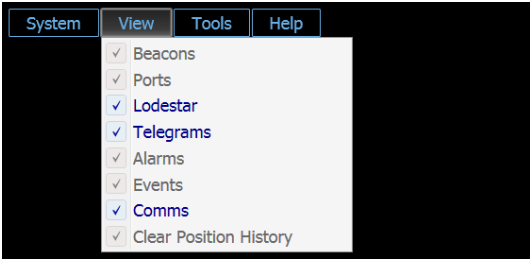
Note

 Menu items displayed below are dependent on the product and options purchased.

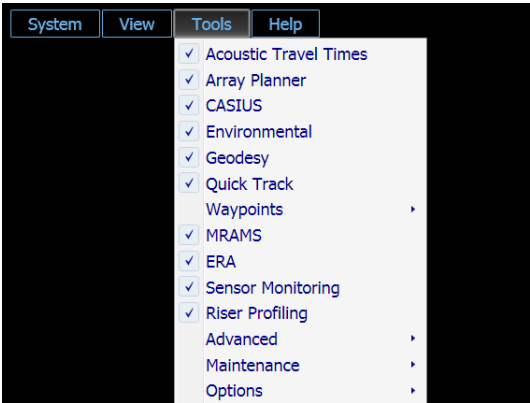
System



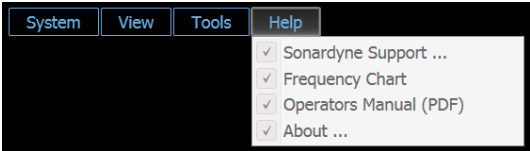
View



Tools



Help



Note

 When a system is upgraded to include new features, the new menu items must first be enabled (selected) in this menu to enable them to appear in the Main UI.

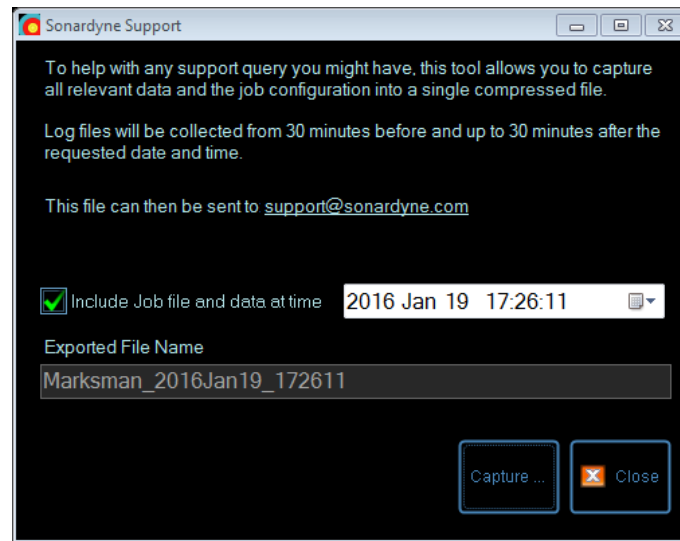
A.11 Help Menu

There are three options under the **Help** menu:

Sonardyne Support

This option allows you to export relevant data and configuration to a compressed file, so that you can send the file (.CEF extension) to Sonardyne as part of a support request.

1. Select the date and time the event occurred and then click **Capture...**
2. Browse to the desired folder for the output file and then click **OK**.
3. A support log file will be created containing logged data from 30 minutes before to 30 minutes after the target time. The support log file can be sent to Sonardyne Support for analysis.



Frequency Chart

The frequency chart can be referred to for guidance on optimising USBL accuracy vs. range and avoidance of other acoustic systems operating in the vicinity (see *Figure 5–1 "Sonardyne Frequency Chart"*).

Operators Manual

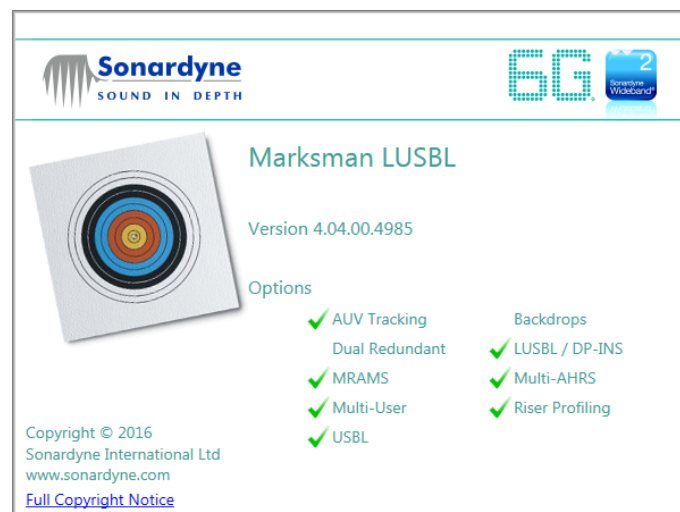
This option opens the User Manual (this manual) so that you can refer to it easily.

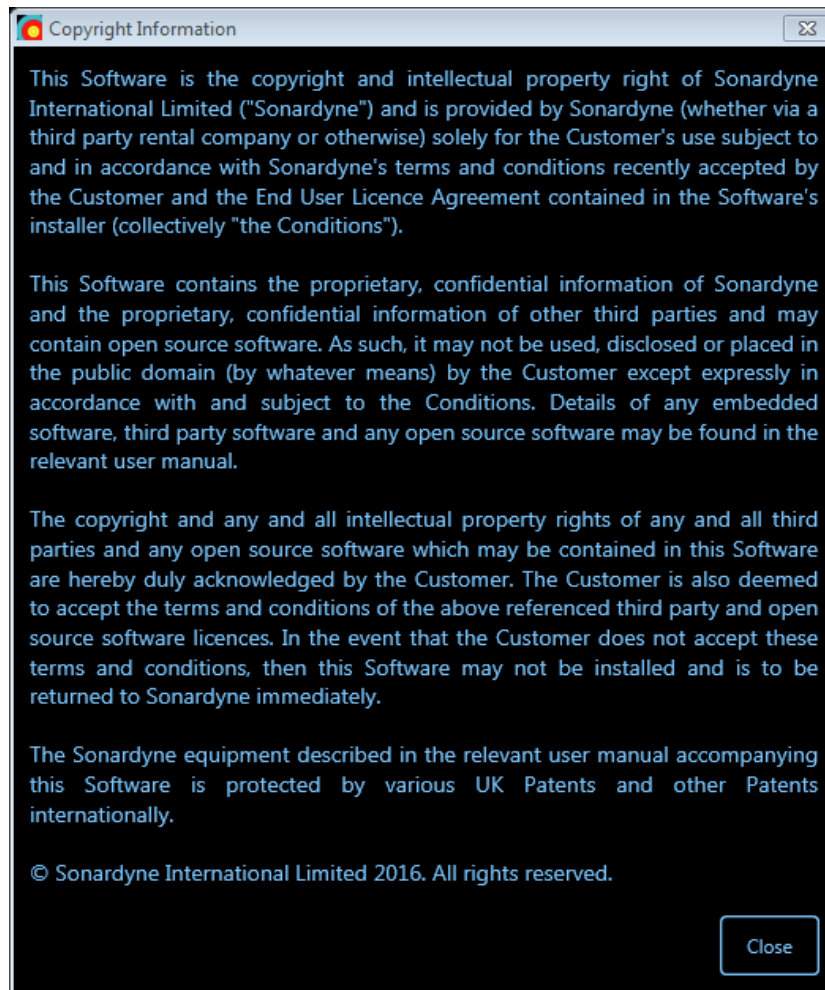
About

This option displays information about the system options which the security key (dongle) has enabled, the primary software version number and the copyright statement. A detailed copyright notice is also provided.

If you experience a problem with the software, make a note of the version number on this dialog and supply this information to Sonardyne International Limited when you report the problem.

Contact Sonardyne International Limited for advice and information about updates to the software.



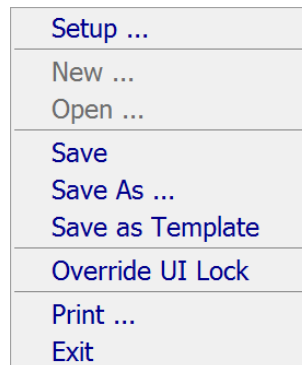


Appendix B – System Integrity

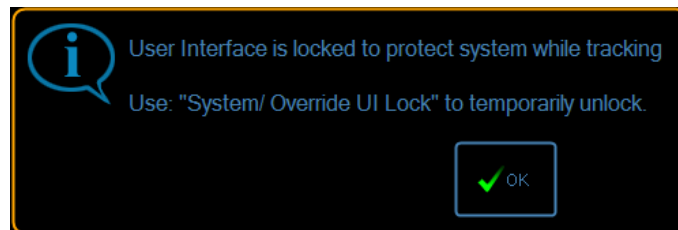
B.1 UI Lock

B.1.1 Overview

A system setup can be locked to prevent accidental changes being applied. Depending on the product and the settings in the Security Key, a User Interface Lock may be provided. If **Override UI Lock** is present in the **System** menu, this feature is enabled as shown below.



When UI lock is enabled, any user changes to the setup while the system is tracking are blocked, and the following warning is displayed:



Note

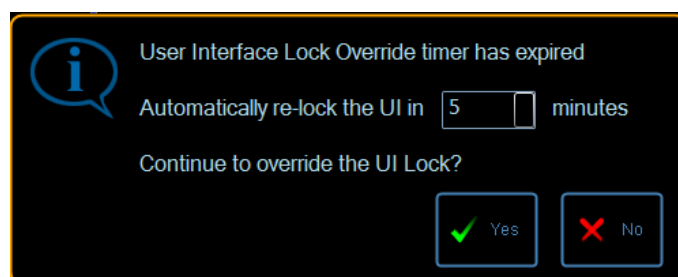


This feature replaces the previous Beacons Table locking scheme.

B.1.2 Override UI Lock

If a change in the setup has to be made while tracking, the UI lock can be temporarily unlocked for 1, 5 or 10 minutes. To override the UI lock:

1. Select **Override UI Lock** in the **System** menu.
2. Select the **Automatically re-lock the UI** time period from the drop-down list.
3. Click **Yes** to override the UI lock or **No** to cancel.



B.2 Sonardyne Resource Monitor

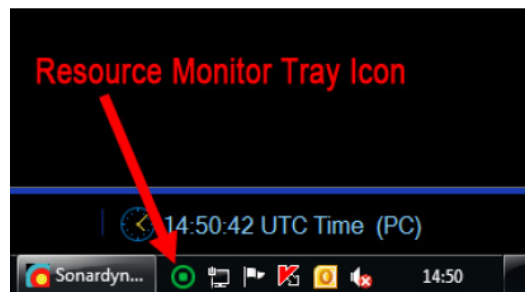
B.2.1 Overview

To help protect the system integrity, the system includes a system Resource Monitor which continually checks for correct operation. If it notices a trend that might lead to degraded operation, it issues warnings, and restarts the system if necessary.

B.2.2 General Operation

When the system starts, it automatically starts a background process called **_SN_ResourceMonitor.exe**.

This process continuously monitors and logs the system resources used (typically Memory, Handles, Threads and CPU usage). The Resource Monitor is visible in the Windows System Tray as shown below.



The Resource Monitor is controlled by a file that specifies the resources and processes to monitor, together with some resource trip thresholds. There is a warning and severe trip threshold for each resource type:

1. **Warning.**

If the Resource Monitor detects any processes resources are beyond a warning threshold, it displays the following:



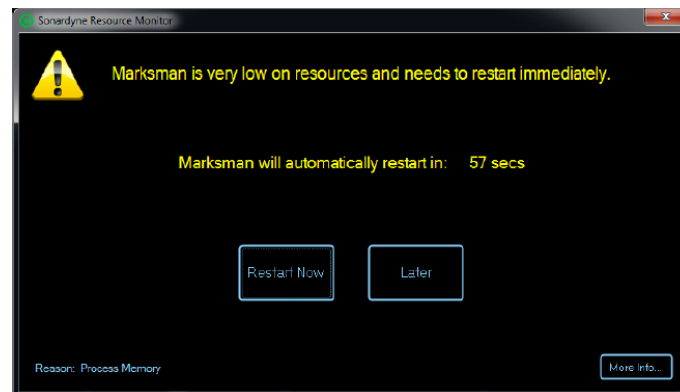
This it means that the system is using resources well above its normal levels. The system will probably still continue to run, but might encounter problems later on.

The user may either click:

- **Restart Now** – the system will completely restart.
- **Later** – the system will continue. If the resource issue has not disappeared, then the above dialog will return after a specified time (default = 60 seconds).

2. **Severe.**

If the Resource Monitor detects any process's resources are beyond a severe threshold, it displays the following, and sounds an alarm.



In this case the system is almost certainly not functioning correctly because resources are running extremely low.

This dialog box shows a restart counter, which starts at 60 seconds. If the timer expires, it behaves as if you clicked the **Restart Now** button (that is, it triggers a full system restart).

If you click the **Later** button, then the timer is cancelled and the system is allowed to continue. If the resource issue has not disappeared, then the above dialog will return after a specified time (default = 60 seconds).

In addition to resource threshold checking, the Resource Monitor also periodically logs the resource usage of all system processes to a file (typically every minute). The logged data can subsequently be examined if necessary using the Perflog Viewer tool.

B.2.3 Resource Monitor Warning Actions

In normal operation, Resource Monitor warnings should never be seen. However, if this happens:

1. Click on **More Info** on the Warning dialog and take a note of the text.
 - If other applications are running on the same computer, it is quite likely that these are causing the problem. Shut down any unauthorised applications.
 - Check whether the resource warning occurs for a particular user operation. Running several complex commands together may lead to low resources.
2. Get a CEF file using the **Help>Sonardyne Support** tool.
3. Report the problem and send the CEF to Sonardyne Support.

Appendix C – Installation

C.1 Introduction

Note

 This software is supplied under licence for use with Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP systems only. This software is the intellectual property of Sonardyne International Limited and is subject to the usual copyright restrictions.

Sonardyne installs the latest released version of the software on the Navigation Processor before shipment of a system. It is not necessary to install the software on the system before you begin to use the system.

The software installation instructions allow you to re-install the software if necessary, or to upgrade the software to a later release.

Click **Help > About** in the menu bar to see information about the version number of the installed software. Contact Sonardyne for upgrade details.

C.2 System Installation

Note

 Risk of equipment malfunction or interference with other systems. This system has been carefully designed to comply with the relevant Electro-Magnetic Compatibility (EMC) standards for marine use. In order to maintain EMC compliance, the system must be installed according to the Sonardyne User Manual and only Sonardyne approved parts may be used. Use of unapproved parts, such as unscreened cables, may put EMC compliance at risk. Please contact Sonardyne Support for further guidance.

This section is concerned with all aspects of installing the hardware of a typical system. Sonardyne ships the system with the most recent released version of the software already installed on the Navigation Computer.

Inevitably, because of the nature of applications that use L/USBL systems, each installation is likely to be unique and characterised by its own specific set of difficulties and special requirements. The guidance included here can therefore only be of a general nature.

If necessary, contact Sonardyne for advice if your specific installation configuration raises some special obstacles to achieving a successful deployment.

C.2.1 Navigation Processor

Navigation Processor is the term used to describe the top-side equipment comprising the following units:

- The Navigation Sensor Hub (NSH).
- The Navigation Computer.
- The LCD touchscreen.
- A combined mini-keyboard and touchpad.

In practice, it is usually necessary to consider only the hardware installation requirements. Software installation is necessary only if a later revision of that software has been supplied by Sonardyne, or if reinstallation of the supplied software version is required for any reason. If it becomes necessary to install or upgrade the software, refer to *Section C.7 "Software Installation"* for more information.

C.3 Hardware Installation

To install the hardware you must first install the Navigation Computer and the NSH and interconnect them using the supplied cables.

C.3.1 Before you Begin

Take the following steps before you begin to install the hardware of the Navigation Processor:

- Identify a suitable location for the Navigation Computer and the NSH where they can be installed near to each other.

Note



It is recommended that hardware installations are located at least 10 metres from any VHF radio antennas operating in the 156 – 165 MHz band.

- Ensure the installed location provides good ventilation for both units.
- For a fixed installation, you should ideally used a 19-inch rack.
- For transportable installations, select a location for both units on a secure desk or bench that allows convenient connection of power and data cables without causing a hazard or obstruction to users or to other personnel in the area.
- Ensure the installation location does not subject either of the units to extremes of vibration, temperature or humidity.
- Secure both units against movements of the vessel.
- Ensure there is a convenient AC power outlet near to the installed location, and sufficient space at the back of both units to allow easy access for connection of the power and signal cables and to operate the main power switches on the backs of both units.

Note



It is recommended that AC power feeds are clean and stable, and are suitable for use with IT equipment. If in doubt, then an external surge suppressor conforming to UL1449 (or equivalent) must be installed.

C.3.2 What you will Need

You will need (as a minimum) the following items and tools to complete the installation:

- One "Y" lead AC power cable for connection to the rear panels of the NSH and the Navigation Computer. The cable is supplied as standard with a 3-pin UK-style fused electrical plug and is also available with either a Euro or a US mains electrical adaptor if requested.
- A VGA cable to connect the monitor to the Navigation Computer.
- An Ethernet cable to provide an interface between the Navigation Computer and the NSH.
- An 8-pin Lemo-to-48V cable to provide an interface between the transceiver and the NSH (see *Figure D–5 "USBL Transceiver Cable – CPN 820-6484/DWG 8020-069"*).
- A yellow primary security key that indicates it is a system software security key (see *Section C.7.1 "Security Keys"* for more information). The system will not operate without this key.

C.3.3 Installation

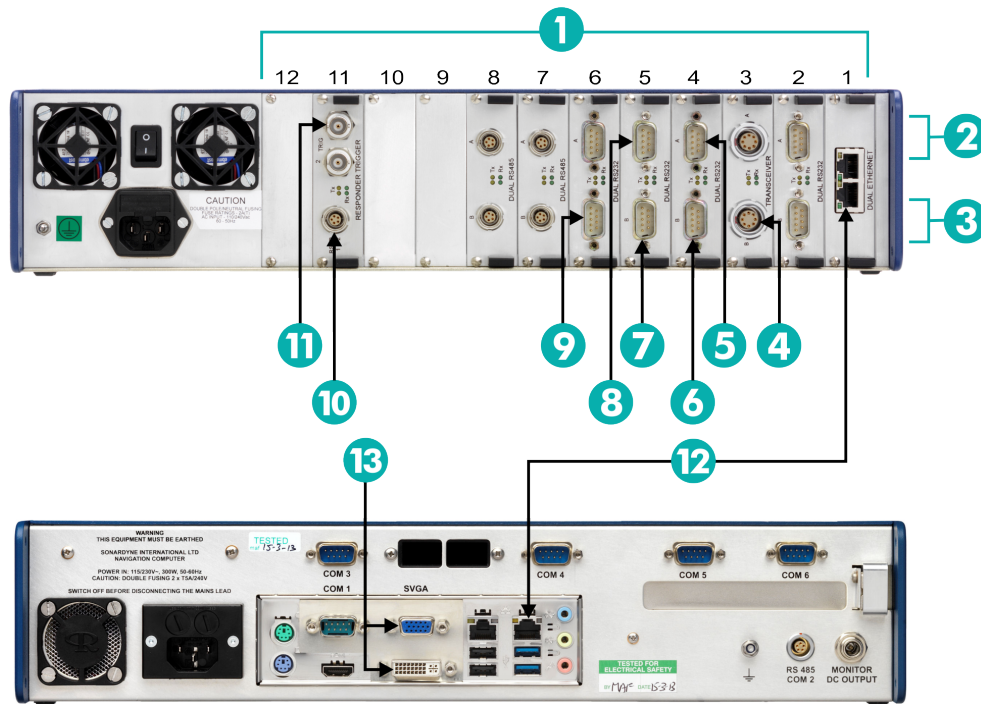
Follow the steps below to install the NSH and the Navigation Computer.

1. Make sure the power switches of both units are set to their OFF positions.
2. Secure the NSH and the Navigation Computer at the locations you have selected for them.
3. Make the connections to the NSH as required within your system (see *Figure C–1* below).

Note

 **Figure C–1** does not show the power connections to both units. The NSH rear panel arrangement and serial connections required within your installation may be different from those shown. Refer to **Section C.3.4 "NSH Interface Card Details"** for instructions to install additional interface cards.

Figure C–1 Typical Interconnections - NSH and Navigation Computer



Item	Description
1	Card Slots
2	Port A
3	Port B
4	Connector to USBL Transceiver. Lemo-to-48 V cable. Cable details depend on type of system (see the note below).
5	Serial Input: GNSS Time/Position
6	Serial Input: Depth Sensor
7	Serial Input: VRU
8	Serial Input: Gyrocompass
9	Serial Output: External Client or Navigation System
10	Output Trigger to Responder
11	Input from GNSS Receiver: 1 PPS Synchronisation Clock.
12	Ethernet Cross-over Cable: NSH to Navigation Computer
13	Monitor (DVI/VGA)

Note

 Details for the 8-way transceiver cable from slot 3 on the Navigation Computer depend on whether the system is portable or rack-mounted:

- If the system is portable, the cable will be terminated with a suitable connector to be attached to the main cable from the USBL transceiver.
- If the system is rack-mounted, the cable will have open tails for connection to the vessel's junction box or a terminal strip in the rack.

Refer to the cable drawings in *Appendix D "Interface Cables"*.

- Connect the two IEC connectors on the supplied AC power cables to the IEC electrical power inlets on the rear panels of both units.
 - Connect the mains electrical plug on each power cable to a convenient electrical supply outlet.
 - Connect the supplied Ethernet cable from a network connector on the Navigation Computer to the lower Ethernet port (Port B) in slot 1 at the rear panel of the NSH. This cable can be connected either way around.
 - Connect the Lemo end of the supplied 8-pin Lemo-to-48 V cable to Port A in slots 3, 4 or 5 on the rear panel of the NSH.
-

Note

 It is possible to fit 48 V transceiver interface cards in any of the slots 3 to 5 on the NSH. The NSH can support a maximum of six USBL transceivers.

- Connect the other end of the Lemo-to-48 V cable to the USBL transceiver.
 - Make whichever optional connections as are required within your system as follows:
 - Connect serial inputs from a GNSS receiver, a gyrocompass and a Vertical Reference Unit as required to any of the serial ports on the NSH.
 - Connect serial outputs from the system, supplying information such as position reports for external client or navigation computer systems as required, to any of the serial ports on the NSH.
 - Connect an external time synchronising signal, such as a 1PPS (pulse per second) clock from a GNSS receiver to the top input trigger port (Port A) on the Responder/Trigger interface card located in slots 10 or 11 on the NSH.
 - Connect the corresponding serial time message to one of the serial ports located on the NSH.
 - Connect an output trigger cable from the NSH to a Responder beacon, if you are using one, from the bottom port (Port B) on the Responder/Trigger interface card located in slots 10 or 11 on the NSH.
4. Make a written note of which input/output device is connected to which port (A or B) on each interface card installed in the NSH.
 5. The yellow 'primary' security key (dongle) is normally installed by -Sonardyne inside the Navigation Computer. If the dongle is supplied loose with the software, plug it into a suitable USB port at the rear of the Navigation Computer. See *Section C.7.1 "Security Keys"* for an explanation of the security key.
 6. Connect the keyboard and mouse supplied by Sonardyne to either of the USB ports on the Navigation Computer's front panel. Alternatively, make this connection to either of the USB ports on the Navigation Computer's rear panel.

7. Connect the display monitor, if one has been supplied by Sonardyne, to the SVGA port on the Navigation Computer's rear panel. The Navigation Computer can support a second external monitor. If necessary, connect a second monitor to the DVI port on the Navigation Computer's rear panel using a DVI-to-SVGA adapter.

Note



The minimum screen resolution is 1280 x 1024 pixels.

8. Set the power switches on the rear panels of the NSH and the Navigation Computer to ON. It does not matter which of the units is switched on first.
9. On the NSH check the following:
 - The three green indicator LEDs on the front panel should light up to show that the unit is receiving power and the 3.3 V and 5 V supplies are operating.
 - The three power-rail status LEDs should light up to show that the transceiver power supplies are at the correct operating voltage.
10. Press the **Power/Reset** button on the Navigation Computer's front panel to start the Navigation Computer.
11. On the Navigation Computer check the following:
 - The green **System Power** LED should light up to show that the system is receiving power.
 - The red **HDD** LED should light up to show that the Navigation Computer is reading the hard disk and is booting.
12. Check that the software starts automatically. If the software does not start automatically, use the mouse to double-click the software icon on the desktop.
13. While the software is starting, check that all the LEDs on the NSH front panel are flashing at the same time to indicate that the software has established communications with the NSH.

C.3.4 NSH Interface Card Details

The NSH can be configured with various interface cards depending on the sensor inputs required for the installation. *Table C–1* lists and describes the interface cards for use in the NSH.

Table C–1 Interface Cards

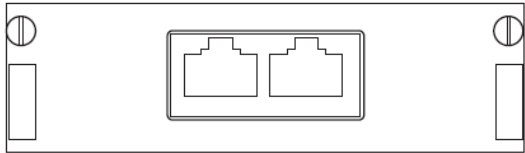
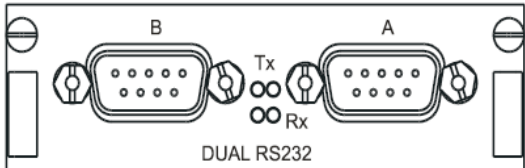
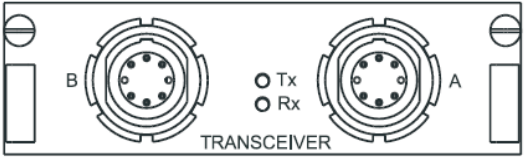
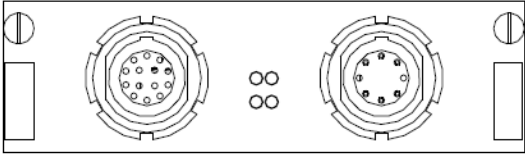
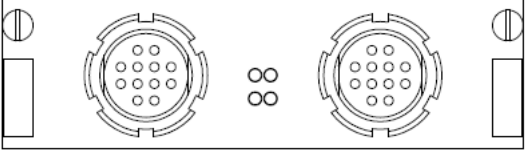
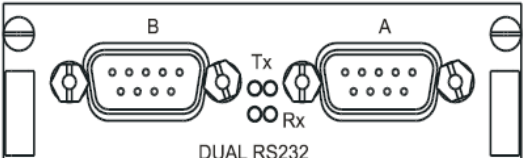
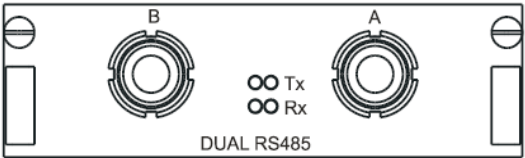
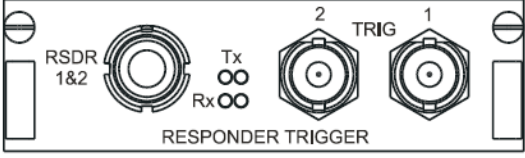
Slot	Notes	Part Number and Interface Card
1	Link Port: - Ethernet link to Navigation Computer.	CPN 631-7691/DWG 8098-050 
2	Reserved for Link/Management Ports: - RS232 link to Navigation Computer. - RS232 link for initial NSH setup using HyperTerminal.	CPN 631-8074/DWG 8098-053 

Table C–1 Interface Cards (continued)

Slot	Notes	Part Number and Interface Card
3, 4, 5	RS485 communications and 24V or 48V power for the following transceivers: - USBL - ROVNav	CPN 631-8165/DWG 8098-051 
3, 4, 5	RS485 communications and 24 V or 48 V power for a USBL transceiver, together with comms and power cross-link connection to other redundant system.	CPN 631-7624/DWG 8098-052  DUAL REDUNDANT TCVR MODULE
3, 4, 5	RS485 communications and 48 V power for Lodestar AHRS / INS, together with comms cross-link connection to associated co-located transceiver.	CPN 631-7977/DWG 8098-067  NSH LODESTAR TCVR MODULE
6, 7, 8, 9 *3, 4, 5	RS232 communications with: ROVNav Serial Gyrocompass GNSS Serial VRU	CPN 631-8074/DWG 8098-053  DUAL RS232
6, 7, 8, 9 *3, 4, 5	RS485 communications with: ROVNav Serial gyrocompass GNSS Serial VRU	CPN 631-8073/DWG 8098-057  DUAL RS485
10, 11	Two responder outputs and two BNC inputs for external triggers, such as 1 PPS from a GNSS receiver.	CPN 631–7623/Drg 8098–059  RESPONDER TRIGGER
12	Reserved for use by Sonardyne.	

Note

 Pin-outs, wiring and connector specifications for cable connections to the interface cards are detailed in *Appendix D "Interface Cables"*.

C.3.5 Interface Card Installation

Refer to *Table C–1* to identify which slots on the NSH's rear panel support which types of interface card.

Note

 Before you begin to add or remove interface cards in the NSH, power-off the NSH and disconnect it from the electrical power supply.

Installation and Removal Procedure

Follow the steps below to install or remove an interface card. To substitute one card for another already fitted to the NSH, follow the steps to remove an existing interface card and then install the new card in its place.

1. Power-off the NSH and disconnect it from the mains electrical supply.
2. Remove the NSH from its installed location, if necessary, to gain easy access to the unit's rear panel.
3. Either:
 - Identify the location to be used for the additional interface card, or
 - Identify the interface card you intend to remove from the NSH.
4. Use a medium flat-headed screwdriver either to release the blanking plate or to release the interface card.
5. Either:
 - Fit the new interface card into the slot vacated by the blanking plate, or
 - Withdraw the interface card from the NSH's rear panel.
6. Fit and tighten the two screws removed in step 4 to either:
 - Secure the new interface card into the NSH's rear panel, or
 - Fit and secure a blanking plate to the slot vacated by the removed interface card.
7. Return the NSH to its proper installed location.
8. Re-connect the NSH to the electrical power supply and power it on.
9. Conduct tests to ensure the NSH is operating correctly following the alterations made to the system.

C.3.6 Network Connection

The Navigation Computer is supplied with an RJ–45 Ethernet LAN connection port. Any network configuration settings within the Windows® operating system are at the risk of the operator. Sonardyne International Limited accepts no responsibility for network connections and configurations.

C.4 USBL Transceiver Installation

The USBL transceiver can be deployed in a number of ways, depending on the type of vessel in use and on operational requirements.

Note

 USBL transceivers contain delicate transducers and motion sensing elements. Take care to protect the transceiver during and after installation by following all the instructions in this section.

C.4.1 General Requirements

Observe the following general requirements when you install the USBL transceiver:

- Ensure the method of deployment protects the sensitive acoustic transducer elements from damage at all times during installation, deployment, and demounting. A red sleeve is supplied fitted to the transceiver to protect its transducer face during shipping. You **MUST** remove this protective sleeve before you deploy the transceiver; the transceiver will not perform correctly with this sleeve in place.
- Mount the transceiver on a rigid pole, supported so as to minimise vibration and reduce free movement of the transducer with respect to the vessel.

The main sources of vibration that could affect the transducer are; normal operation of the vessel's machinery; and vortex-shedding as the transducer's supporting pole moves through the water.

- Mount the transceiver so that it is pointing vertically downwards, with the connector at the top and the black acoustic transducer at the bottom.
- Ensure the white forward-pointing direction arrow on the transducer is pointing forward on the vessel.
- For best results, if possible deploy the transceiver at least 3 metres below the lowest part of the vessel's hull.

By increasing the separation distance between the transducer array and the hull in this way, you will reduce the risk of multipath reflections from the hull, reduce the amount of vessel noise received by the transducer, and reduce the chance of aerated water passing over the transducer's face.

Note



After installing the transceiver, measure the vertical offset between the bottom face of the transceiver and the vessel's waterline when the transceiver is fully deployed. You will require this information later, to configure the USBL software.

- Deploy the transducer as far away as practical from any source of noise or bubbles, such as propellers, thrusters, or other causes of aeration.
- Ensure the bottom face of the transducer is kept well clear of brackets, ropes, and other structures during deployment.
- To ensure correct 'wetting' of the transducer's polyurethane face, keep the transceiver face clean and free from oil or grease.

C.4.2 Pole Mounting

The design of any deployment mechanism should ensure that all unwanted movements of the transceiver with respect to the vessel are minimised.

Attitude Measurement Errors

To achieve best USBL performance it is necessary to use a high accuracy attitude sensor so that the system can adjust the measured direction of arrival of the acoustic signal to compensate for the vessel's motion. If the attitude sensor is installed on the vessel, then it is particularly important to minimise movement of the USBL transceiver with respect to the vessel.

The importance of correct transceiver deployment is greater if you intend to use external attitude measurement equipment, such as a Vertical Reference Unit, with the USBL System. These

instruments measure the roll, pitch and heading angles of the object they are attached to, which is usually the vessel. However, if the transceiver is mounted on a pole that is capable of moving significantly with respect to the vessel, then the attitude measurements will relate to the vessel, but not to the transceiver with any accuracy.

Pole movements can arise from different causes: Small quick movements are usually caused by water flowing past the pole, giving rise to vortex shedding, and larger, slow movements can arise as the vessel rolls or under the influence of tidal changes. Both effects can be reduced by ensuring the pole is mounted rigidly on the vessel.

In some cases it is possible to mount the attitude measurement instrument on top of the pole so that it always measures the attitude of the transceiver, even if the pole moves relative to the vessel.

Over-the-Side Deployment

If you intend to use an over-the-side deployment, attach the transceiver to a pole or frame designed so that transceiver alignment can be maintained or re-established on subsequent deployments.

The pole or frame should be aligned vertically with respect to the vessel as far as is possible and, ideally, should be adequately braced against the hull to limit movement during operation.

Long poles can be susceptible to vortex induced vibration. Various methods can be used to reduce the effects of this type of vibration. Contact Sonardyne for further advice in this area.

C.4.3 Through-Hull Mounting

The recommended way to mount a USBL transceiver is on a pole through the vessel's hull.

In this arrangement the pole should be stiff, rigidly mounted and long enough to locate the transceiver at least 1 metre below the lowest point on the hull (3 metres is recommended for best results). The mounting arrangement used must minimise any movement of the transceiver with respect to the vessel, and ensure optimal tracking accuracy.

For the 'standard' transceiver, this mounting arrangement requires a vertical tube of at least 254 mm or 10 inches internal diameter to be let into the ship.

For the 'Big Head' transceiver the vertical tube should be at least 350 mm or 14 inches internal diameter.

Galvanic isolation

The transceiver housing is made of aluminium bronze. The most common material used for the tube, pole and mounting frame is mild steel.

It is good practice to isolate the transceiver and the mounting arrangement both electrically and acoustically so as to reduce the effects of galvanic corrosion on the housing.

Sonardyne provide an isolation adapter within the installation kit. On no account should the aluminium bronze be in contact with a material more noble than itself (electro-chemically) — because galvanic corrosion will result.

Note



To avoid galvanic corrosion of the aluminium bronze transceiver housing, never allow the housing to remain in contact with a material more electro-chemically noble than itself.

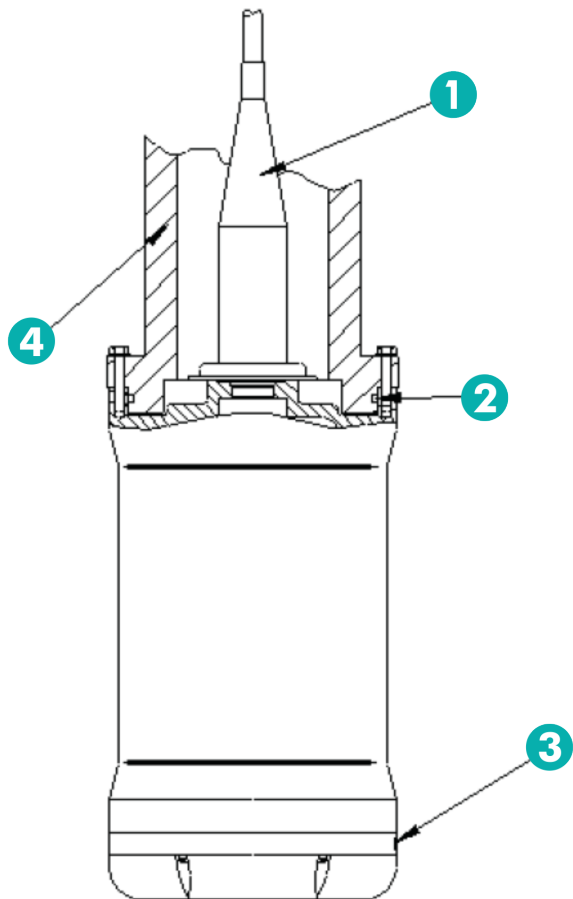
Before you mount the transceiver, always record the information detailed on the label on the outside of its housing. This information includes its serial number, the device serial number, and factory offsets for the internal inclinometer sensors.

Mounting Considerations

The most common through-hull deployment method is the use of a gate-valve and sea chest assembly that can accommodate the transceiver. Above this sea chest is a deployment machine capable of raising and lowering the transceiver and stem.

The USBL transceiver has been designed to fit to a type 7950 Sonardyne-supplied deployment machine, or to fit directly onto a fixed-head HPR deployment pole as shown in *Figure C–2*.

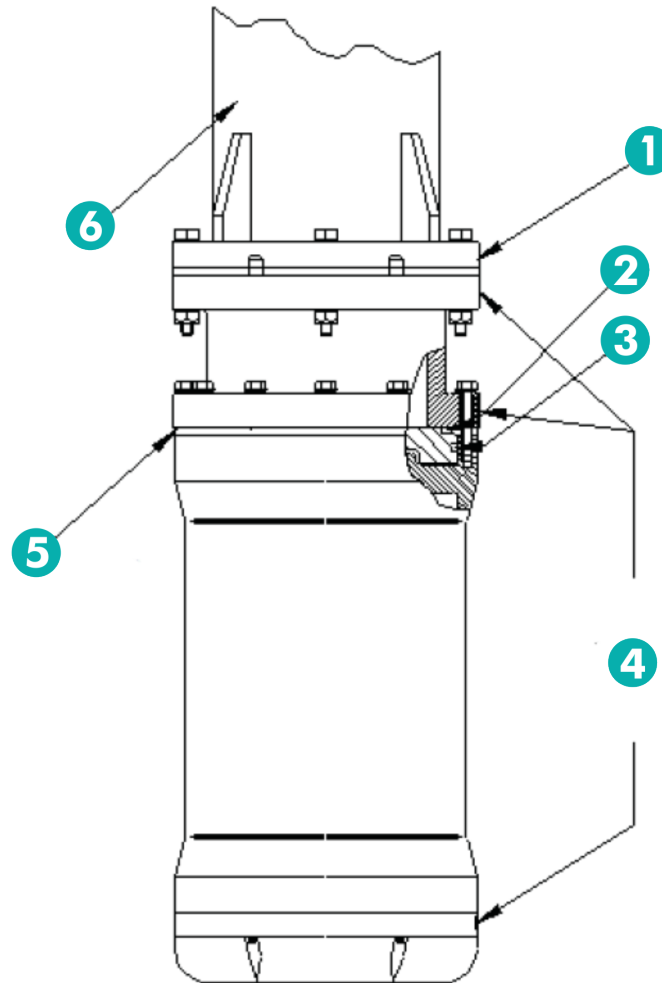
Figure C–2 Transceiver Mounting — Arrangement 1



Item	Description
1	Connector Cover
2	Piston Seal: 1 x 200-366 or 2 x 200-189
3	When installed on deployment pole, identification marks transceiver must face forward
4	Deployment Pole

A second popular mounting arrangement is to mount the transceiver on the end of a flanged pole, using a purpose-designed flange adapter if necessary, as shown in *Figure C–3*. In this second arrangement, the pole will normally have a number of flanges, each of which has a compliant outer edge that contacts the inside wall of the deployment tube.

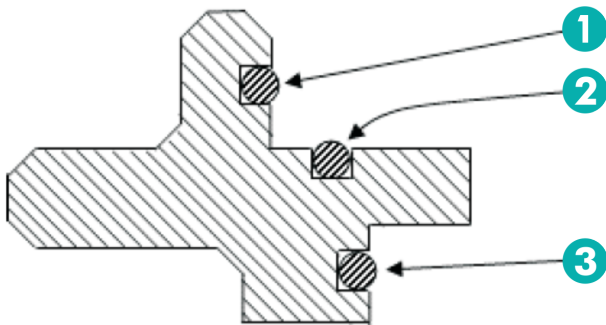
Figure C–3 Transceiver mounting — Arrangement 2



Item	Description
1	Flange machined to match customer deployment tube
2	Face Seal: 200-364
3	Piston Seal: 200-366
4	When installed on deployment pole, identification marks transceiver must face forward
5	Isolation Flange: 7769-117
6	Deployment Pole

An alternative isolation flange is also available for Sonardyne-supplied deployment machines, as shown in *Figure C–4*.

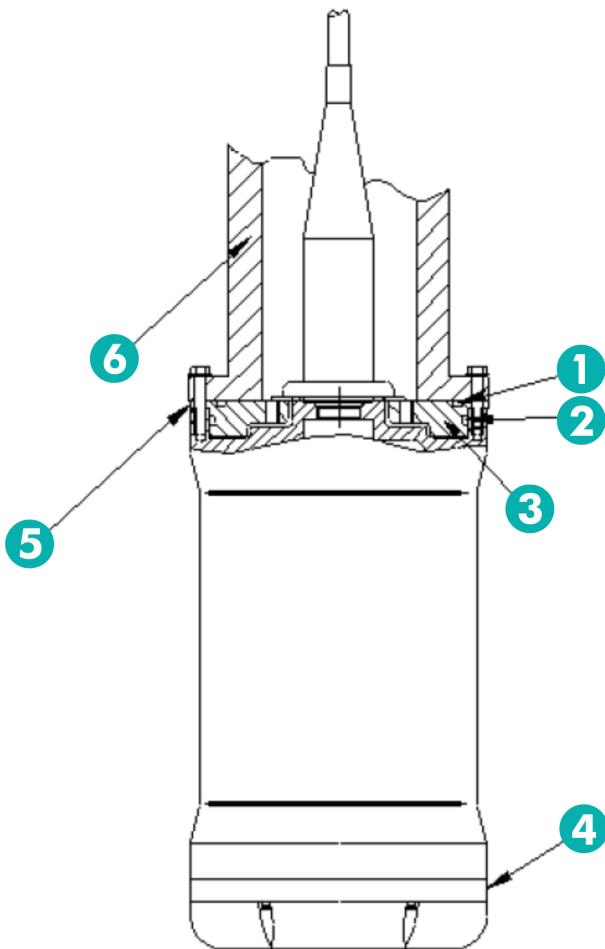
Figure C-4 Alternative Isolation Flange



Item	Description
1	O-Ring: 200-868
2	O-Ring: 200-364
3	O-Ring: 200-366

If the mounting flange already has the correct fixing holes, the transceiver can be bolted on without need of an adapter ring, as shown in *Figure C-5*. Note, however, that you **MUST** use an isolation flange in this arrangement if there is any possibility of galvanic corrosion occurring.

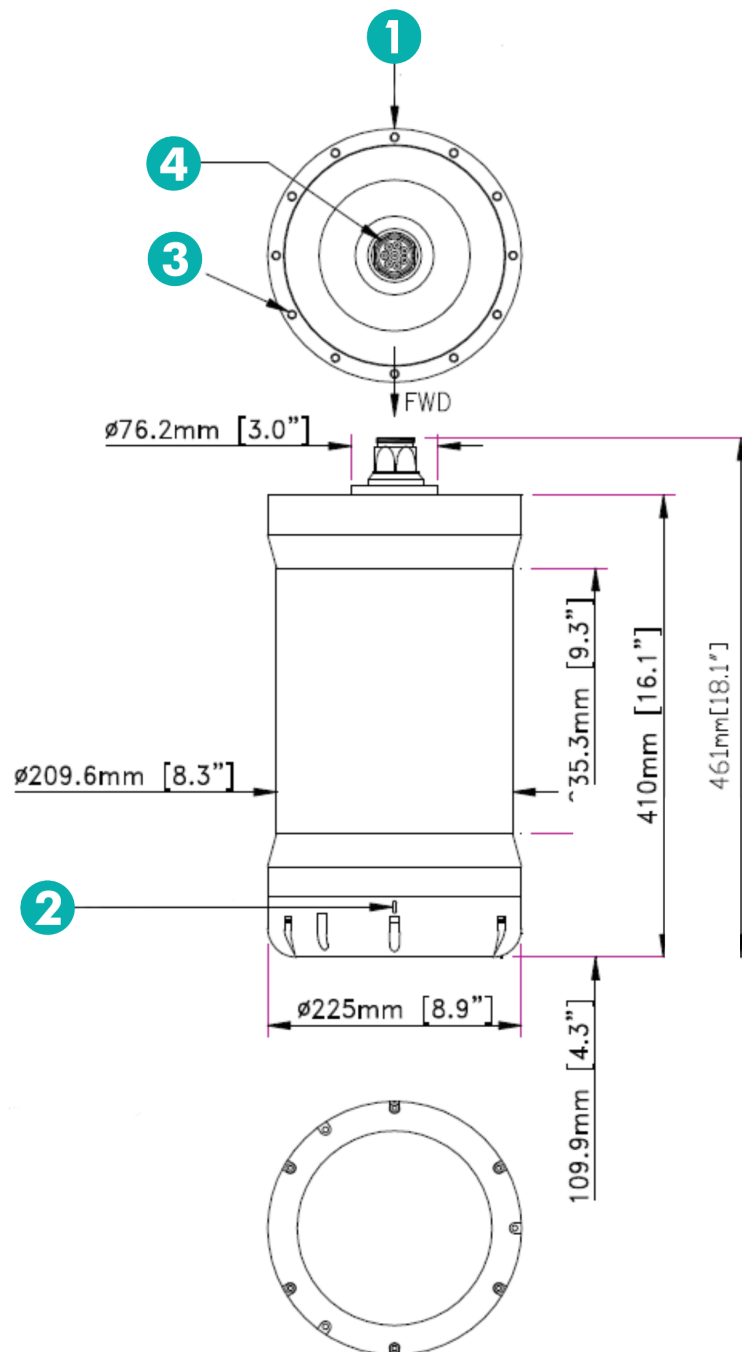
Figure C-5 Transceiver mounting — Arrangement 3



Item	Description
1	Face Seal: 200-364
2	Piston Seal: 200-366
3	Isolation Ring: 7769-117
4	When installed on deployment pole, identification marks transceiver must face forward
5	Sealing Flange
6	Deployment Pole

Transceiver Bolt Hole Pattern and Dimensions

Figure C-6 Transceiver Bolt Hole Pattern



Item	Description
1	Parallel with Lubber Line
2	Forward Direction Identification Mark
3	12 Holes, M8 x 1.25 mm Pitch Pitch 20.3mm (0.8") Deep Equally Spaced on 210 mm (8.27") Dia. 6 Holes Only Used for Mounting
4	AGP-2708-F

Alignment Criteria

When mounting the transceiver you should ensure that the mounting arrangement has some mechanical means to maintain alignment between the transceiver's centre line and the vessel's centre line. Adapters supplied as an option by Sonardyne have provision for two dowel pins to meet this requirement.

Accurate horizontal and vertical alignment between the transceiver and the vessel is not critical. However, it is important that the deployed alignment angles are repeatable to a much greater precision than the measurement sensors in use so as to avoid the need to recalibrate the deployed angles every time the pole is retracted and redeployed.

Transceiver Connection

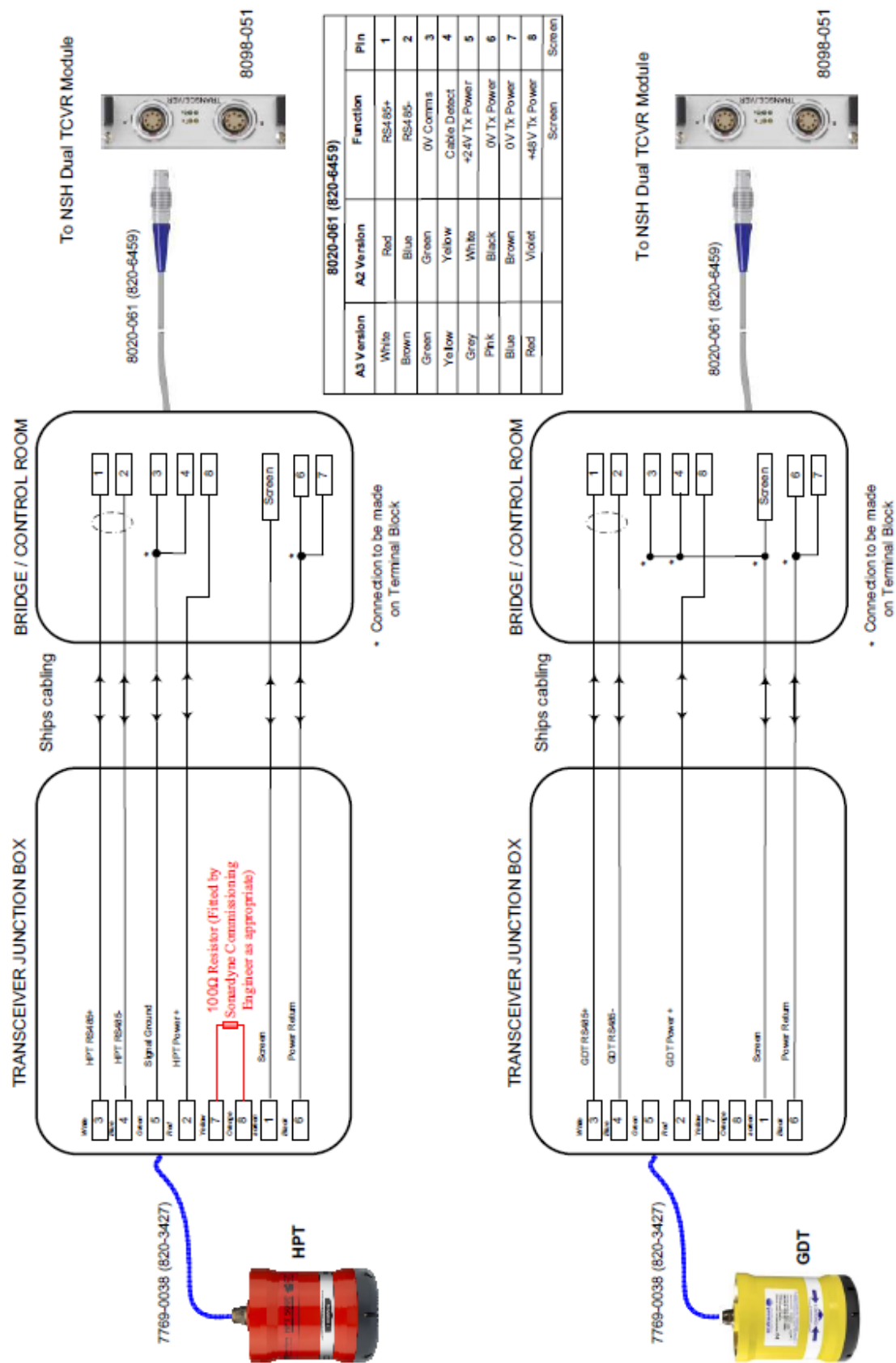
Connection between the transceiver and the NSH rear panel is through the Lemo-to-48 V cable supplied with the system. Connect the Lemo end of this cable to the top port (Port A) on the transceiver card in the NSH. Refer to *Section C.3 "Hardware Installation"* for more information about the transceiver connection.

System Calibration

You must perform a complete system calibration (CASIUS) when you deploy any transceiver for the first time in its mounting arrangement. Refer to *Appendix I "System Calibration"* for more information about the CASIUS calibration procedure.

C.4.4 Installation

Figure C-7 HPT – GDT Transceiver Wiring



C.4.5 GyroUSBL

Figure C–8 5-Element Lodestar GyroUSBL

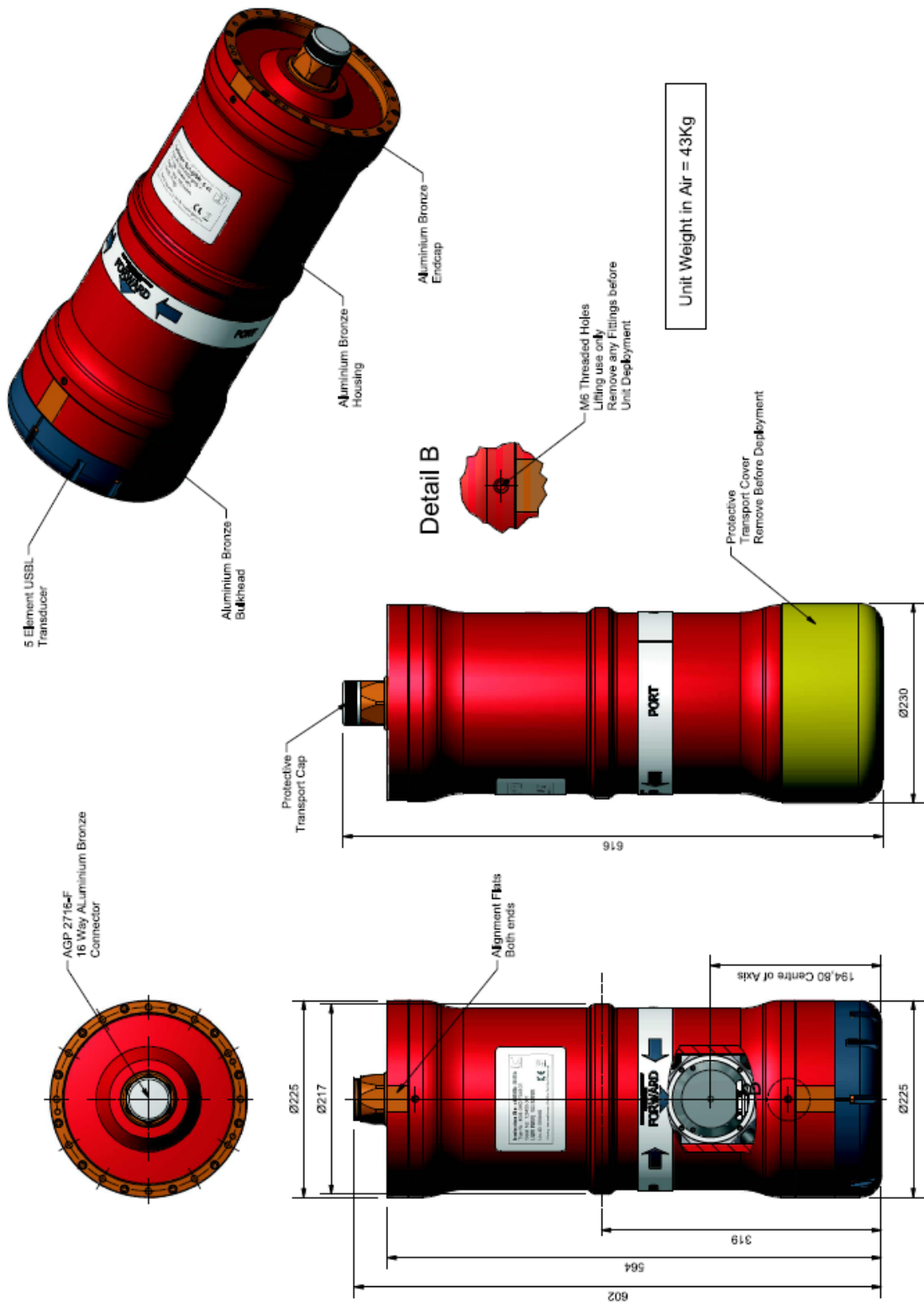
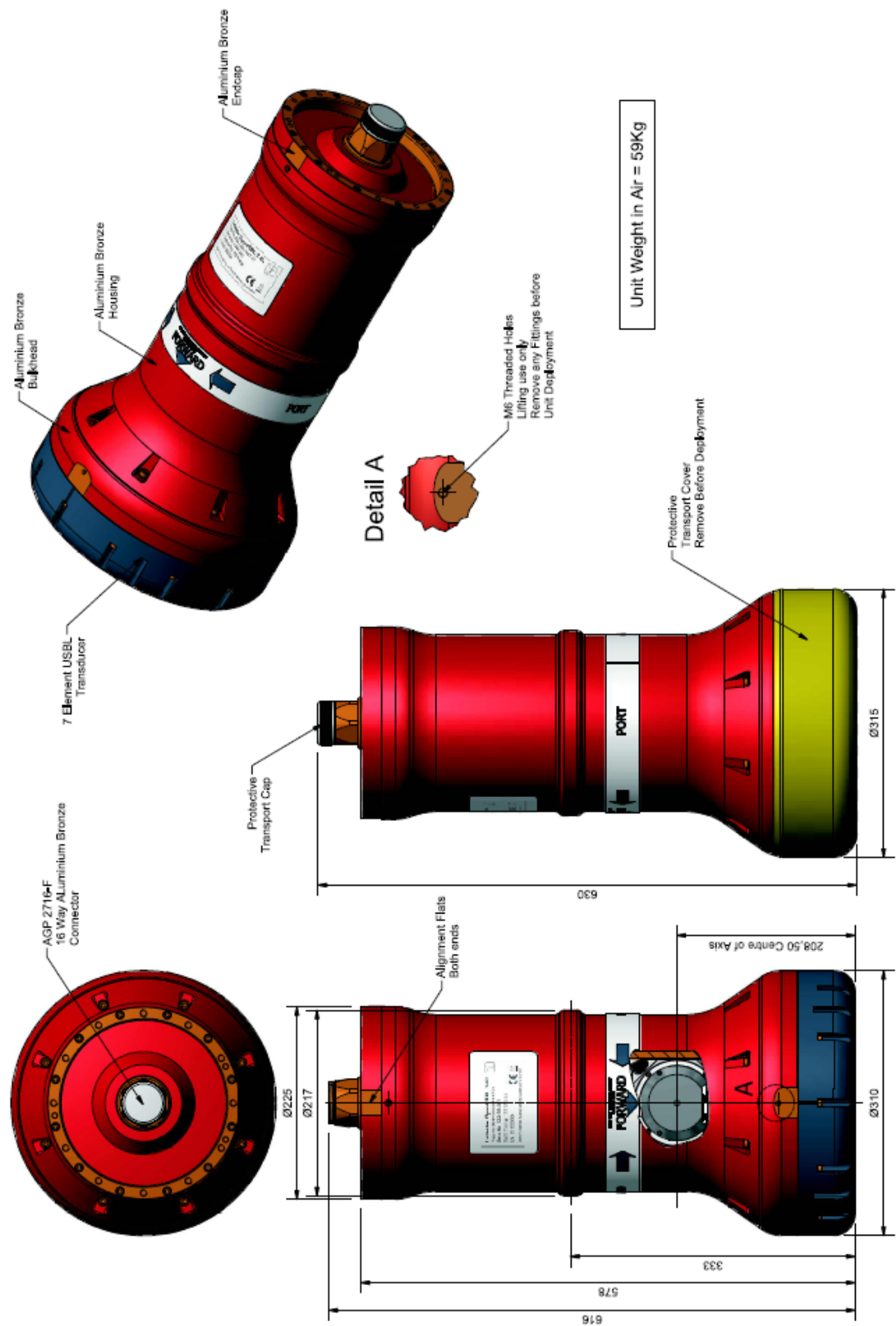


Figure C-9 7-Element Lodestar GyroUSBL



C.5 External Sensors

You should give careful consideration to the selection and installation of external sensors such as a Vertical Reference Unit (VRU), gyrocompass and GNSS antenna. In particular, the installation and calibration of the VRU and the gyrocompass will have a direct impact on the overall position measurement accuracy of the USBL.

Connections between external sensors and the USBL System are through serial ports on interface cards located on the NSH rear panel. Refer to *Section C.3 "Hardware Installation"* for more information.

The guidelines below will help you to establish the best installation location for the external sensors. However, you should also refer to the installation instructions supplied by the manufacturer of the external sensors for detailed installation instructions.

C.5.1 VRU

- Use a survey quality VRU providing dynamic roll and pitch measurement accuracy better than 0.05° for deep water operations.
- Ensure the VRU is fastened securely to prevent any movement with respect to the vessel or the USBL transceiver.
- Align the VRU to be parallel with the vessel's centre line by following the manufacturer's installation instructions.
- Install the VRU on the vessel's centre line if possible.
- If you have to install the VRU away from the vessel's centre line, measure and enter the relevant lever arm offsets into the VRU's configuration, as detailed in the manufacturer's instructions.
- Install the VRU as close as possible to the vessel's centre of gravity (CoG), or as close as possible to the USBL transceiver.
- Ensure the VRU configuration provides a serial output of the vessel's roll and pitch angles to the highest accuracy available and at the highest possible baud rate to minimise the effects of data latency.
- Ideally the measurement accuracy should be 0.01°, and the output rate should be at least 10 Hz.
- Some VRUs allow aiding input of speed and course made good (CMG) from external equipment such as a GNSS receiver. This enhancement improves the accuracy of VRU measurements in dynamic environments, and should be used if it is available.
- Complete all the manufacturer's recommended installation and calibration procedures.

Note



Sonardyne recommends that any manufacturer-recommended installation offsets should be entered into the VRU's configuration software, not into the USBL software.

- Ensure the conventions used for pitch and roll output from the VRU are the same as those used in the USBL software, because some VRU manufacturers use a different convention.

C.5.2 Gyrocompass

- For survey and towfish tracking operations in particular, it is essential to use a survey-quality gyrocompass that provides heading measurements with an accuracy of 0.05° or better.

- Ensure the gyrocompass is configured to output serial heading data to the highest accuracy available and at the highest possible baud rate to minimise the effects of data latency. Ideally the measurement accuracy should be 0.01° or better, and the output rate should be at least 5 Hz.
- Align the gyrocompass to be parallel with the vessel's centre line.
- Perform a gyrocompass calibration BEFORE you perform a calibration of the USBL System to measure any alignment offsets that may exist between the gyrocompass mounting arrangements and the vessel's centre line. Any offsets measured should be entered into the USBL software.
- Make regular and frequent checks of the gyrocompass against any other gyrocompass systems installed on the vessel, to detect and correct any long-term drift.

C.5.3 GNSS Receiver System

- Mount the GNSS antenna so that it has a clear and unobstructed view of the sky.
- For short-term operations where an over-the-side pole is used to mount the USBL transceiver, consider mounting the GNSS antenna over the top of the pole to minimise any effects arising from antenna offsets.
- Accurately measure and record the X, Y and Z offset distances between the GNSS antenna and the USBL transceiver. You will require these measurements later to configure the USBL software.
- If possible, supply measurements from the GNSS receiver directly to the USBL software so as to minimise any position latency inherent with computer-based GNSS solutions.
- Because the quality of the GNSS solution has a direct effect on the quality of any real-world positions determined by the USBL, you should use only differential GNSS (DGNSS) or carrier-phase based (such as Real-Time Kinematic — RTK) corrected GNSS inputs.

C.6 NSH Firmware Installation

C.6.1 Upgrade

You must have the appropriate *.mot file available for the firmware upgrade saved on the PC that you use to perform the upgrade. Contact -Sonardyne for advice if necessary.

Follow the steps below to upgrade the firmware:

1. Use HyperTerminal or another suitable terminal emulation program to connect to the TCP/IP management port.

Note



The management port is normally configured as port 4000.

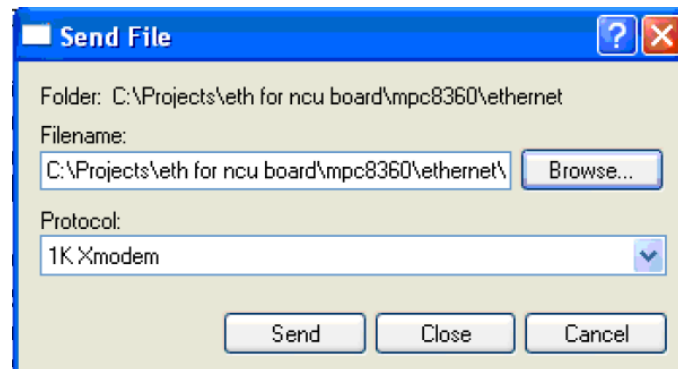
The NSH should produce a command prompt:

NSH>

2. Type the following command at the command prompt:

Software load

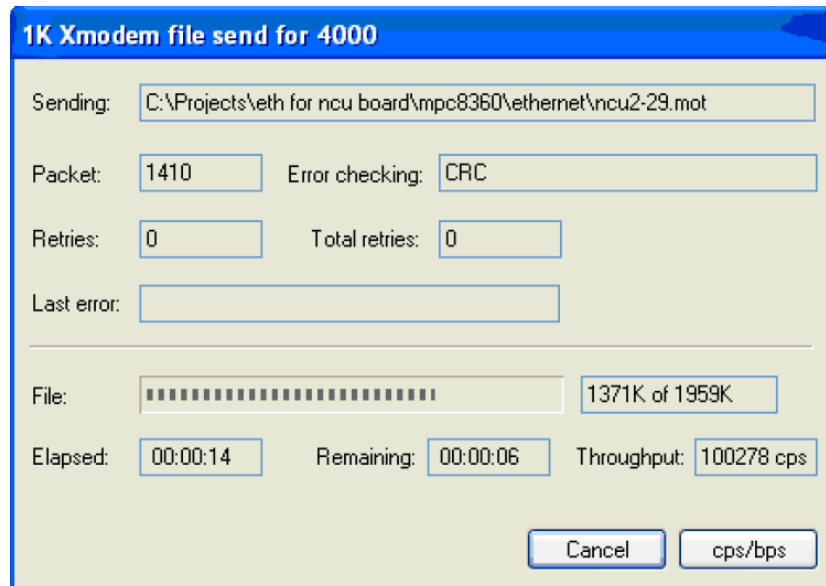
3. In HyperTerminal select **Transfer > Send File**.
4. Browse to and select the *.mot file to be transferred.
5. In the **Protocol** drop-down list, select **1K Xmodem** and click **Send**.



Note

 The NSH may send a series of 'C' characters. This is not a fault condition – it is part of the transfer protocol that confirms the receiving equipment is ready to receive data.

HyperTerminal transfers the firmware upgrade file to the NSH. This process should take approximately 20 seconds to complete.



Note

 The loader may time-out if you take too long to find the file to transfer. If this occurs, start the procedure again. HyperTerminal starts in the same folder that was in use when it closed previously, which means that the file to transfer should be easy to select on the second attempt.

6. After the transfer has completed successfully, click **Disconnect** on HyperTerminal to restart the instrument.

The new application firmware should start after approximately 10 seconds.

C.6.2 View Stored Applications

Follow the steps below to view stored applications:

1. Use HyperTerminal to connect to the instrument, as described in step 1 of *Section C.6.1 "Upgrade"* above.
2. At the command prompt type the following command :

Software status

The NSH responds with the current software status, for example:

```
*+NSH Oct 23 2008 0.1.0.29..... CRC = ok
NSH Oct 22 2008 0.1.0.27..... CRC = ok
```

These two lines show details of the firmware that is currently loaded into the instrument.

Note

 The line that has the asterisk * at the beginning indicates the firmware that is running currently. The line that the plus sign + in it, which is usually the same line that has the asterisk * at the beginning, indicates which default application is loaded on start up.

C.6.3 Firmware Roll-Back

There may sometimes be a need to roll back to the previous version of the firmware. Follow the steps below to do this:

1. Use HyperTerminal to connect to the instrument, as described in step 1 of *Section C.6.1 "Upgrade"* above.
2. Type the following command at the command prompt:

Software switch

After a short delay the default application is switched.

3. Type the following command at the command prompt to confirm that the default application is switched:

Software status

The NSH responds with the current software status, for example:

```
*NSH Oct 23 2008 0.1.0.29..... CRC = ok
+NSH Oct 22 2008 0.1.0.27..... CRC = ok
```

In this example, the + symbol has moved to the other line.

4. Disconnect from the instrument.
5. Wait approximately 10 seconds and then reconnect to the instrument.

The previous version of the firmware should now be running.

C.7 Software Installation

C.7.1 Security Keys

Sonardyne supplies a security key with the system that allows the software to run.

- The yellow key is the 'primary' key, which you should always use with the system.

Note

 For a Sonardyne-supplied system, the yellow security key is fitted inside the Navigation Computer to prevent loss, accidental damage, or tampering.

- The red key is the 'Emergency' key and is supplied in a sealed plastic bag.

In an emergency, the red USB security key can be fitted to either of the two USB ports on the Navigation Computer's front panel.

Note

 Remove the Emergency security key from its sealed plastic bag only if you need to use it. Use the Emergency key in place of the Primary key only if the Primary key fails, expires, or is damaged or lost.

After you have used the Emergency key for the first time, it is valid for only 10 days.

Contact -Sonardyne International Limited immediately if you have to use the Emergency key.

To avoid possible damage to the Navigation Computer or corruption of the computer's software, never attach any security key for another application to the Navigation Computer.

Never attach more than one of the security keys to the Navigation Computer at the same time.

The supplied security keys will be either of two types:

- 25-pin parallel-port style.

If your system has a 25-pin parallel-port style of security key, you must attach it to the parallel port on the rear-panel of the Navigation Computer.

- USB key.

If your system uses a USB security key, attach it to either of the two USB ports on the Navigation Computer's front panel.

Follow the steps below to install the software.

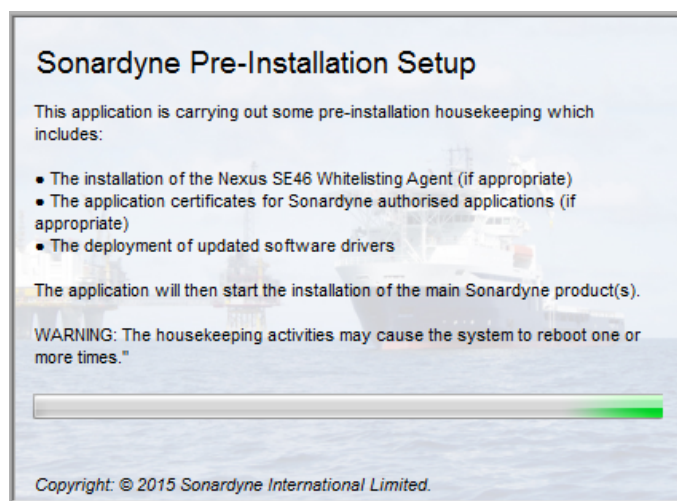
Note

 If you are upgrading an existing software installation, use the Add or Remove Programs facility accessible through the Windows Control Panel to remove the previous software version first.

C.7.2 For Sonardyne Navigation Computer Installations

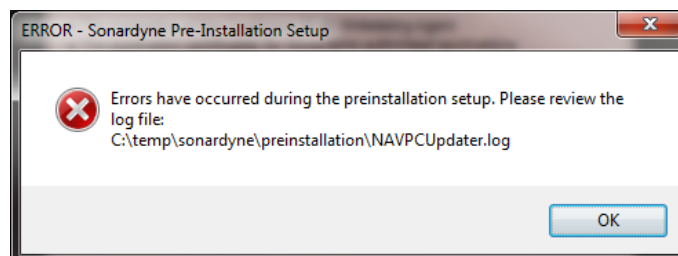
For a Sonardyne Navigation Computer installation follow the procedure below, or for a non-Sonardyne computer installation go to *Section C.7.3*.

1. If the Norton Anti-virus software is still installed, use the Control Panel's **Add or Remove Programs** facility to uninstall the Norton software.
2. Load the software installation DVD into the PC's DVD drive, and use Windows Explorer to navigate to the DVD and run the setup executable file.



The pre-installation housekeeping might require you to reboot the computer one or more times before it completes. This is normal, and the installation will continue after housekeeping completes and you log on as Administrator following a reboot.

The software alerts you if an error occurred during the pre-installation setup. If necessary, contact Sonardyne support for further assistance.

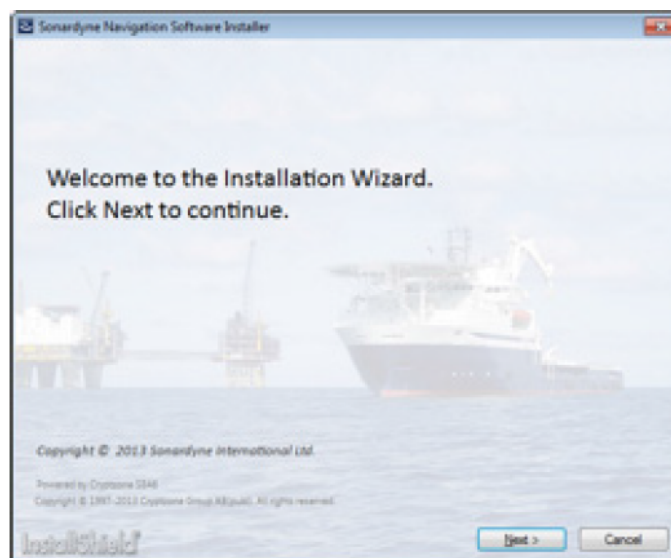


C.7.3 Non-Sonardyne Computer Installations

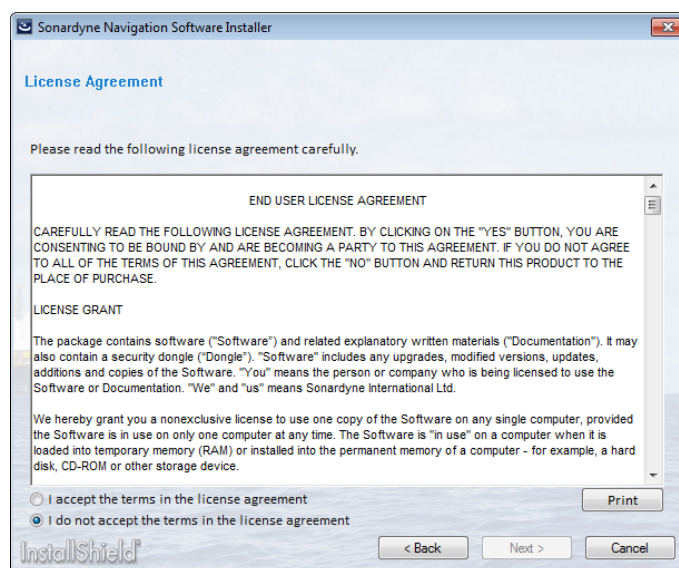
1. Insert the software installation DVD into the PC's DVD drive.
2. Use Windows Explorer to navigate to the DVD and run the setup executable file and proceed to step 1 below.

For all Computer Types

1. Wait for the wizard to unpack the files needed for the installation and to display the installation welcome screen.



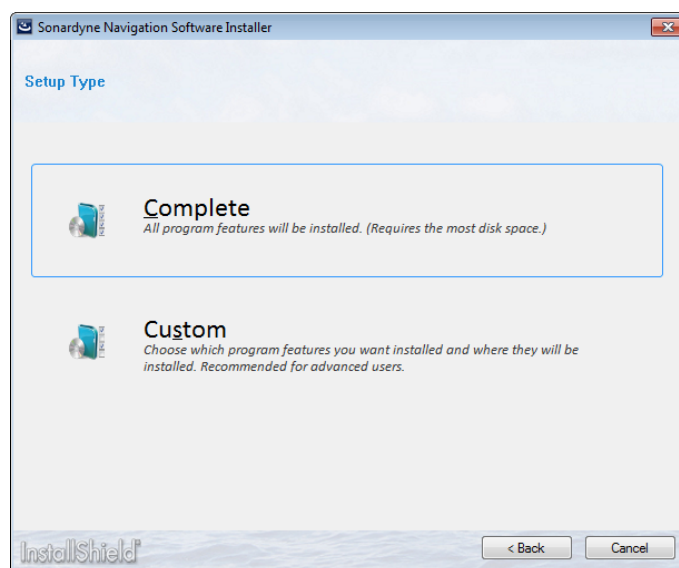
2. Click **Next** to start the installation.
3. Read the licence agreement under which the software is supplied, and click **Yes** to accept the agreement.



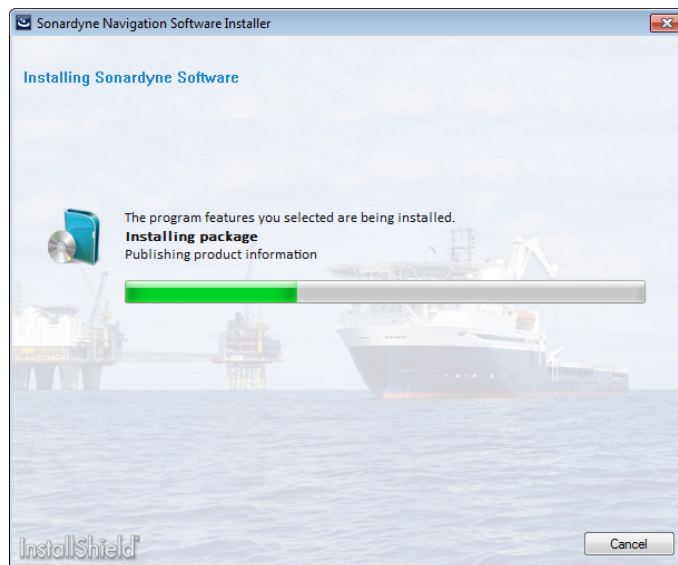
Note that you can print the licence agreement from this dialog box.

4. Select either:

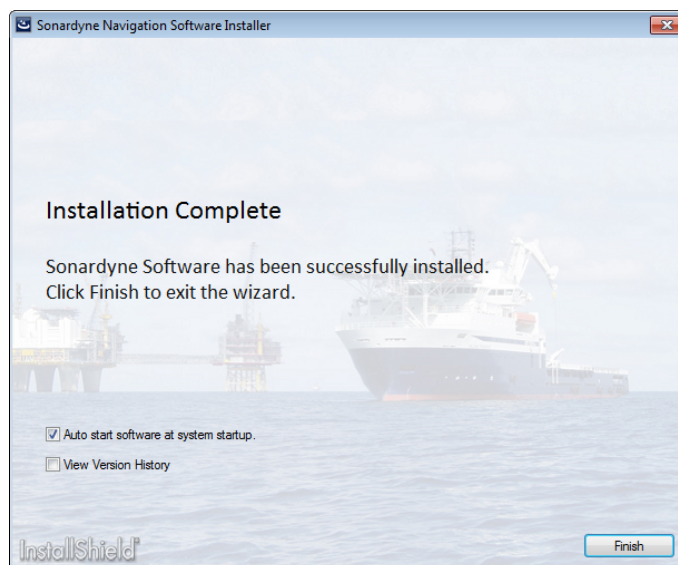
- **Complete** for a complete, regular installation, OR
- **Custom** to override the default contents for the installation.



5. Click **Next** to begin the installation process. A progress bar indicates the installation progress.



6. The final dialog allows you to:
- select whether to start the software automatically when the system starts, and
 - read the software release notes.
7. Select the options you want to use and click **Finish** to complete the installation.



Appendix D – Interface Cables

D.1 Serial Interfaces

Serial interfaces to the NSH are either RS232 or RS485.

The configuration of the interface cards in the NSH will define what connections are available. See *Figure C–1* in *Appendix C "Installation"* for a typical system configuration. Sonardyne supplies appropriate serial cables with each system.

D.2 Cable Diagrams

Note

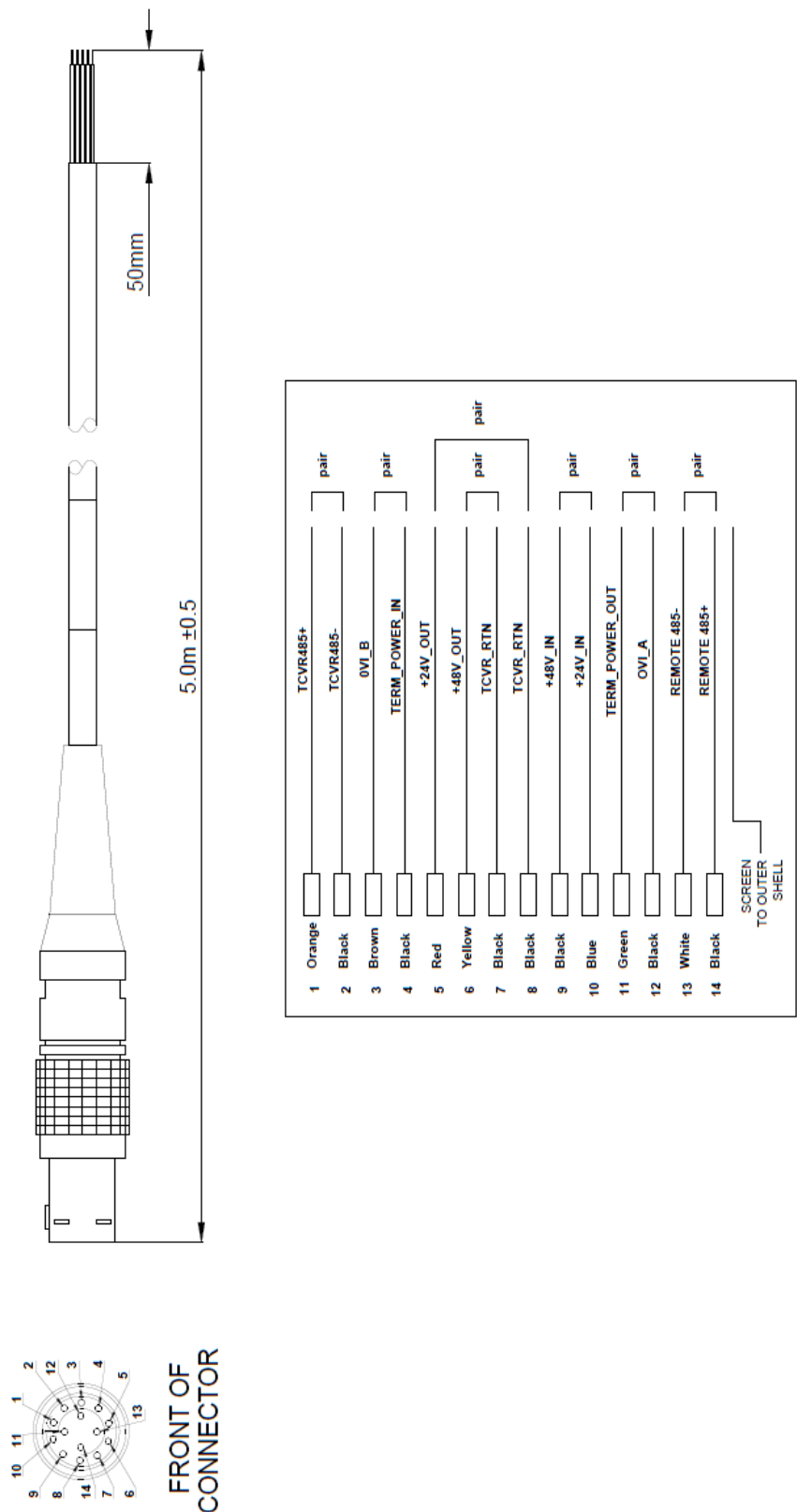


The following cable diagrams are for guidance only and are subject to change without notice.

Table D–1 Cable Diagrams

CPN	Drawing No.	Type	Notes
820-0118	8091-039-01	NSH Dual Redundant Transceiver Cable	
820-6608	8020-060	RS232 Serial Data Cable to Open Flylead	
820-6459	8020-061	NSH Transceiver Cable	
820-3349	8020-069	Responder cable	
820-6484	7784-049-02	USBL Transceiver Cable	Digital USBL Transceivers Only
820-3427	7769-038	Transceiver Cable	Wiring information is dependant on the instrument type. Refer to the instrument manual for wiring information
820-3650	7784-159	Serial I/O Cable	

Figure D–1 NSH Dual Redundant Transceiver Cable – CPN 820-0118/DWG 8098-039-01



Note

See the cross-over wiring details in *Figure 8–2 "Dual-Redundant System Transceiver Wiring"*.

Figure D–2 RS232 Serial Data Cable to Flylead – CPN 820-6608/DWG 8020-060

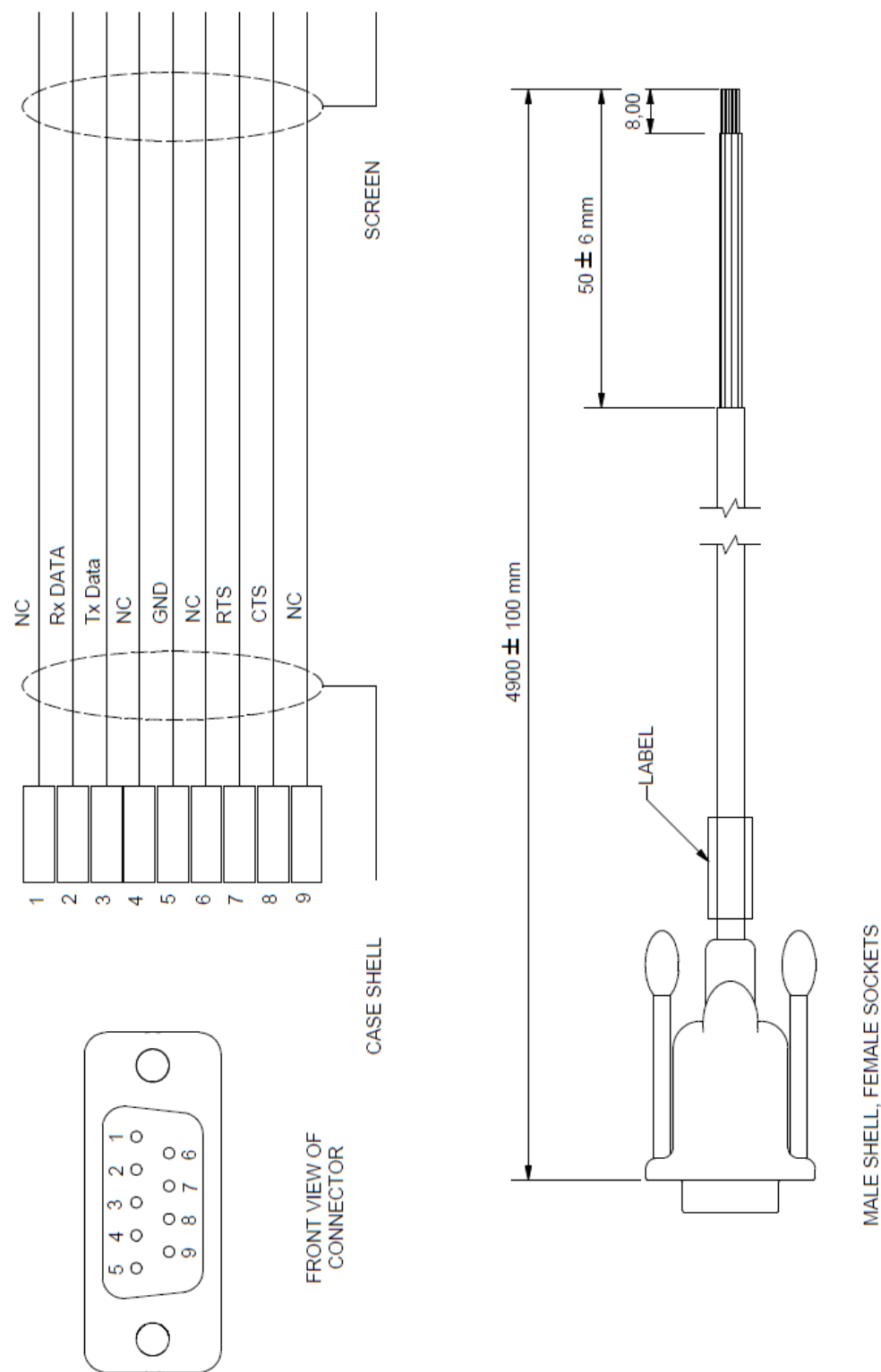
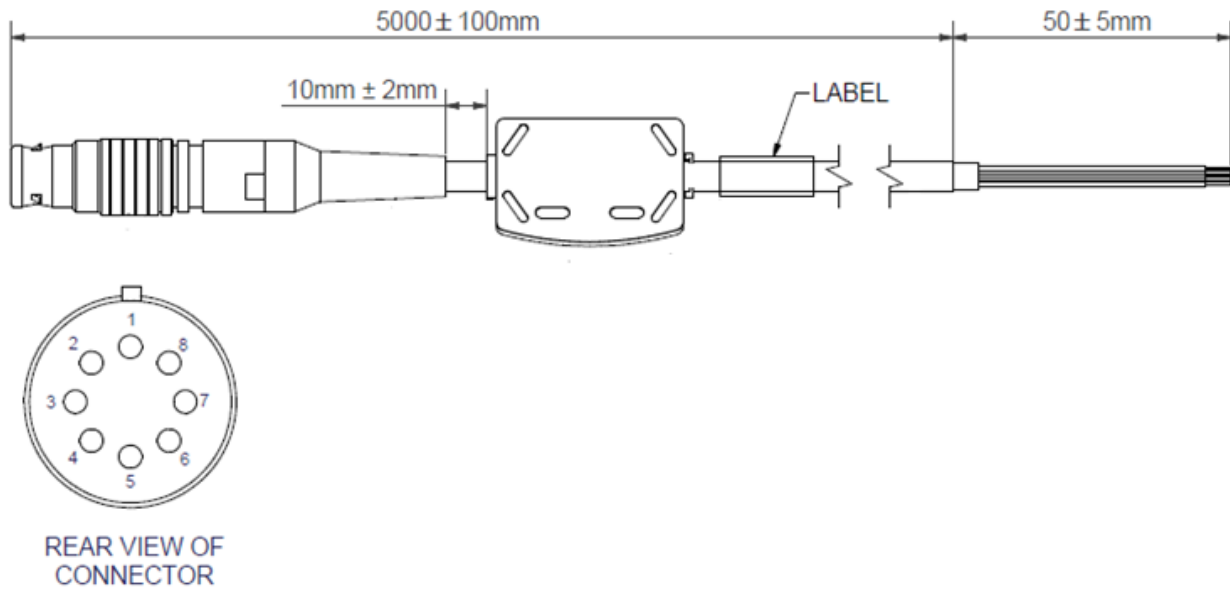
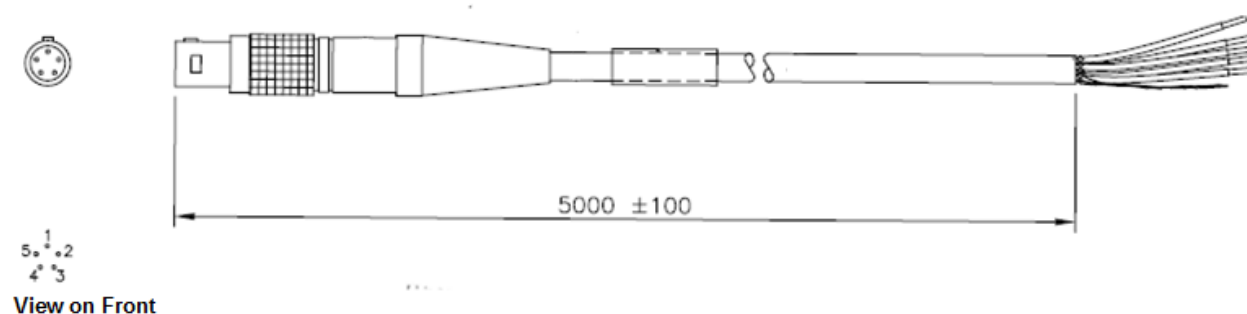


Figure D-3 NSH Transceiver Cable – CPN 820-6459/DWG 8020-061



Pin No.	Wire Colour (Issue A2 and Earlier)	Wire Colour (Issue A3 and Later)	Wire Colour (Issue A5)		Serial I/O RS422 Signal
1	Red	White	Red	Pair	RS485+
2	Blue	Brown	Black		RS485-
3	Green	Green	Black	Pair	0 VI
4	Yellow	Yellow	White		Cable Detect
5	White	Grey	Green	Pair	+24 V TCVR
6	Black	Pink	Black		TCVR RTN
7	Brown	Blue	Black	Pair	TCVR RTN
8	Violet	Red	Blue		+48 V TCVR
Body	Screen	Screen	Screen		Screen

Figure D-4 Responder Cable – CPN 820-3349/DWG 7784-049-02



Pin No.	Wire Colour (Issue D3 and Earlier)	Wire Colour (Issue E1)	Responder – 02 Signal
1	Red	Red	Responder Trigger 1/3
2	Black	Black	+24 VR 1/3
3	Blue	Brown	+24 VR 2/4
4	Green	Green	0 V
5	Yellow	Yellow	Responder Trigger 2/4
Body	Screen	Screen	Screen

Figure D–5 USBL Transceiver Cable – CPN 820-6484/DWG 8020-069

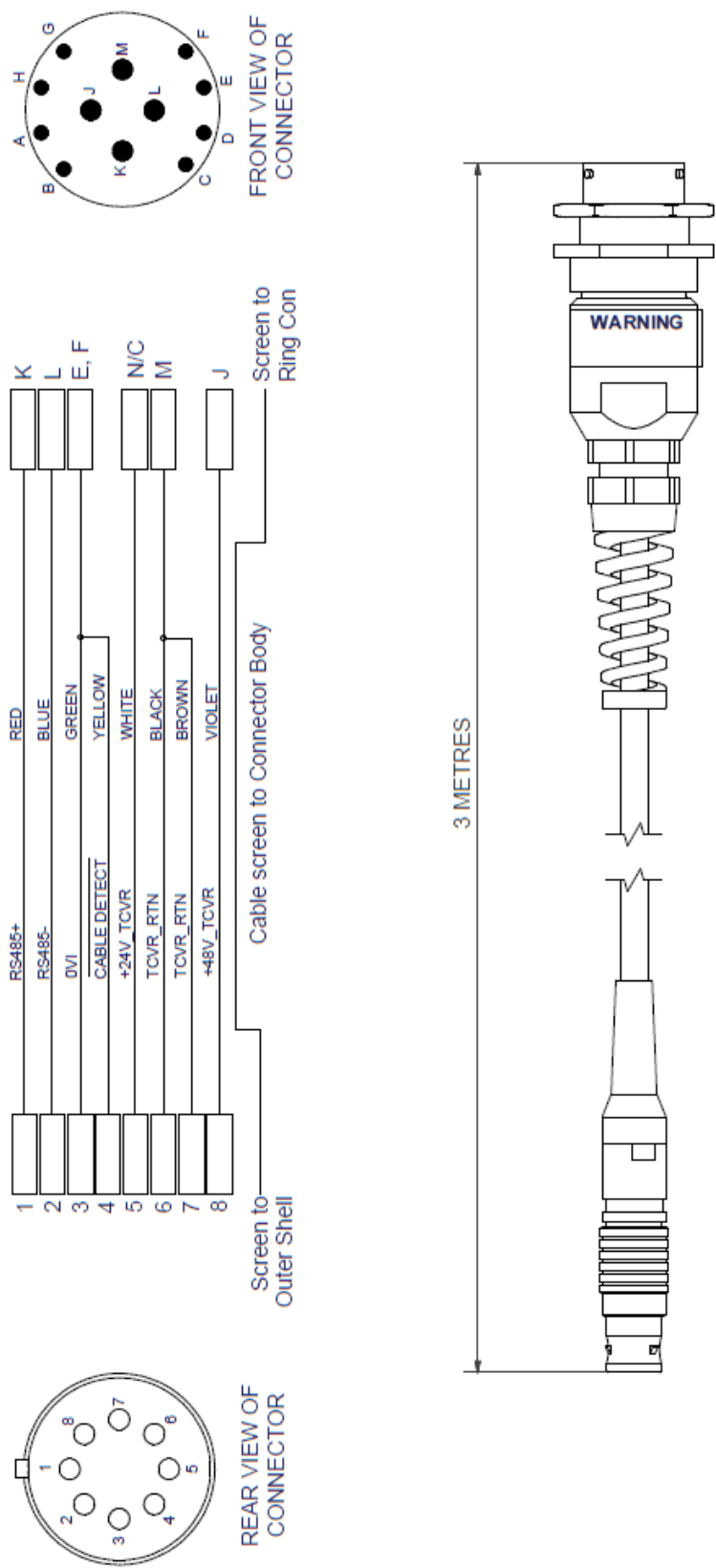


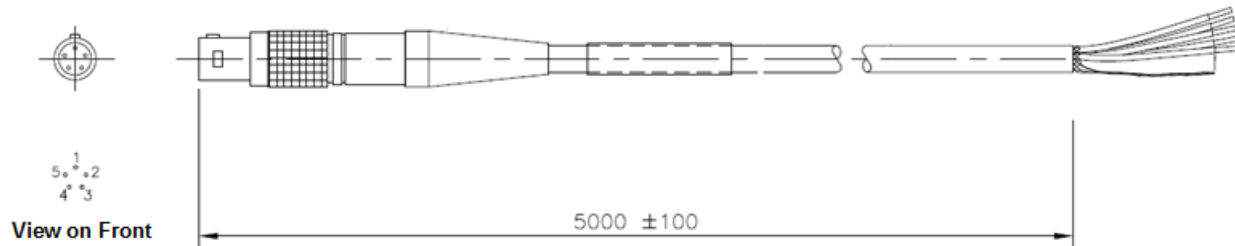
Figure D–6 Transceiver Cable – CPN 820-3427/DWG 7769-038



Note

 Wiring information is dependent on the instrument type. Refer to the instrument manual for wiring information.

Figure D-7 Serial I/O Cable – CPN 820-3650/DWG 7784-159



Pin No.	Wire Colour (Issue B3 and Earlier)	Wire Colour (Issue B4)	Wire Colour (Issue C1)	Serial I/O RS422 Signal	Serial I/O RS232 Signal
1	Red	White	Red	TX+	RTS Out
2	Black	Brown	Black	TX-	Data Out
3	Blue	Green	Green	RX+	CTS In
4	Green	Yellow	Black	RX-	Data In
5	Yellow	Grey	White	0 V	0 V
Body	Screen	Screen	Screen	Screen	Screen

D.3 Cable Diagrams for DP INS/Optimised Applications

Notes

- The following cable diagrams are for guidance only and are subject to change without notice.
- INS is available only with the Ranger 2 Pro system.

Table D-2 Cable Diagrams for DP INS/Optimised Applications

CPN	Drawing No.	Type
820-0065	8084-136-01	Subsea Lodestar Console Cable Assembly
820-0068	8084-137-01	Subsea Lodestar Comms C1 Cable Assembly
820-0071	8084-138-01	Subsea Lodestar Comms Ethernet Tail Cable Assembly
820-0072	8084-138-04	Subsea Lodestar Comms Ethernet Cable Assembly
820-0073	8084-139-01	Subsea Lodestar Transceiver Tail Cable Assembly
820-0147	8098-090-01	NSH Lodestar Tail Cable – 8098-090-01
820-6873	8130-170-01	GyroUSBL Mobile System Cable
820-6882	8130-175-01	GyroUSBL Mobile System Cable 30 m
820-6917	8130-175-01	GyroUSBL Mobile System Cable 50 m
820-6913	8130-175-01	GyroUSBL Mobile System Cable 100 m
312-8091	8130-200	GyroUSBL Tail Cable 5 m
312-8092	8130-200	GyroUSBL Tail Cable 30 m
312-8093	8130-200	GyroUSBL Tail Cable 50 m
312-8094	8130-200	GyroUSBL Tail Cable 100 m
312-8095	8130-200	GyroUSBL Tail Cable 200 m

Figure D–8 Subsea Lodestar Console Cable Assembly – CPN 820-0065

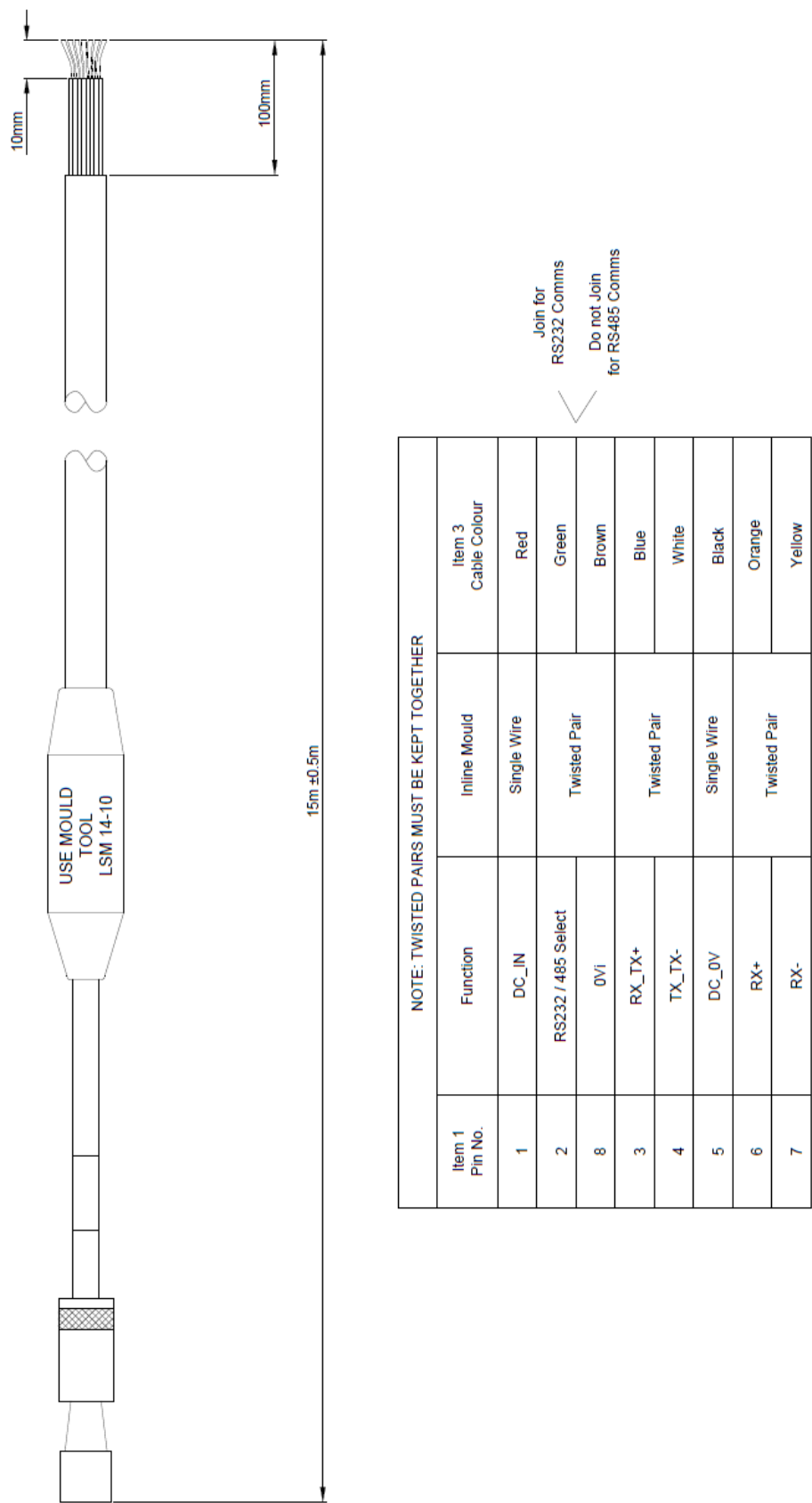


Figure D–9 Subsea Lodestar Comms C1 Cable Assembly – CPN 820-0068

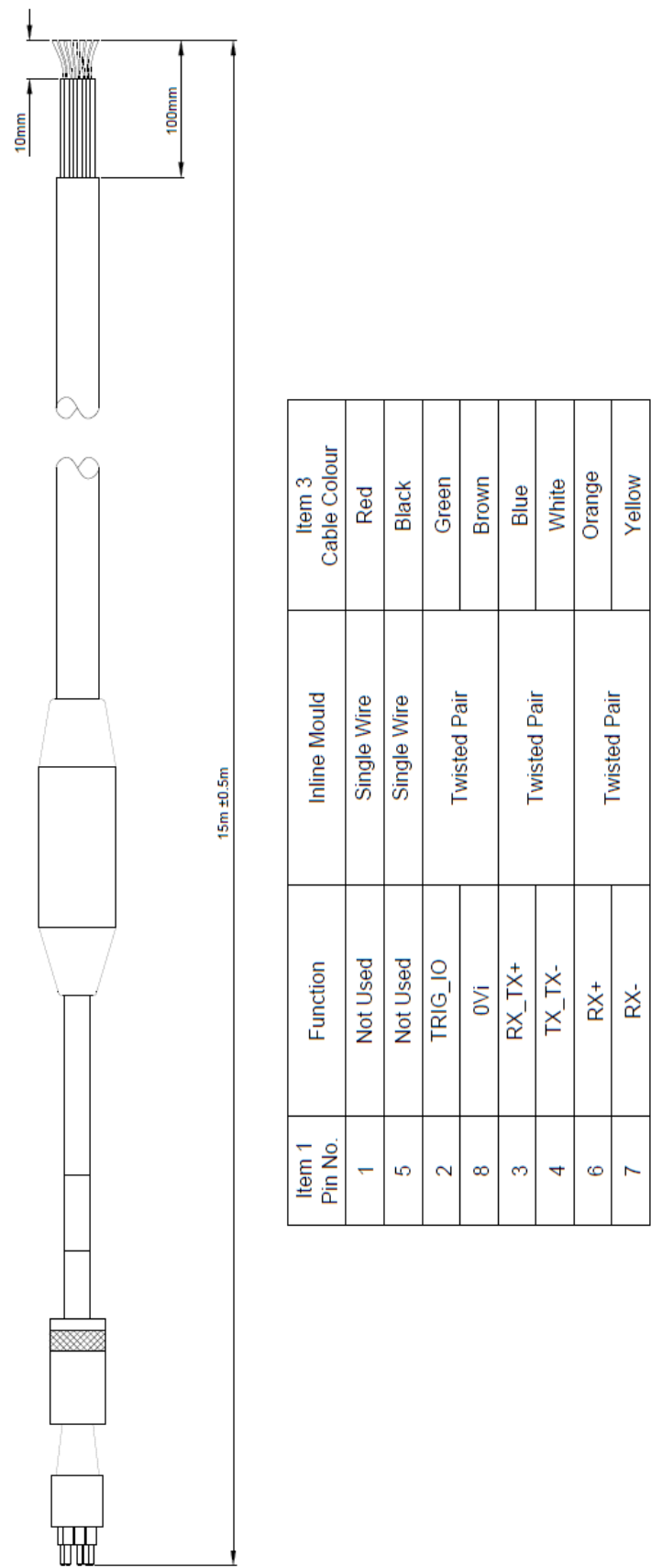


Figure D–10 Subsea Lodestar Comms Ethernet Tail Cable Assembly – CPN 820-0071

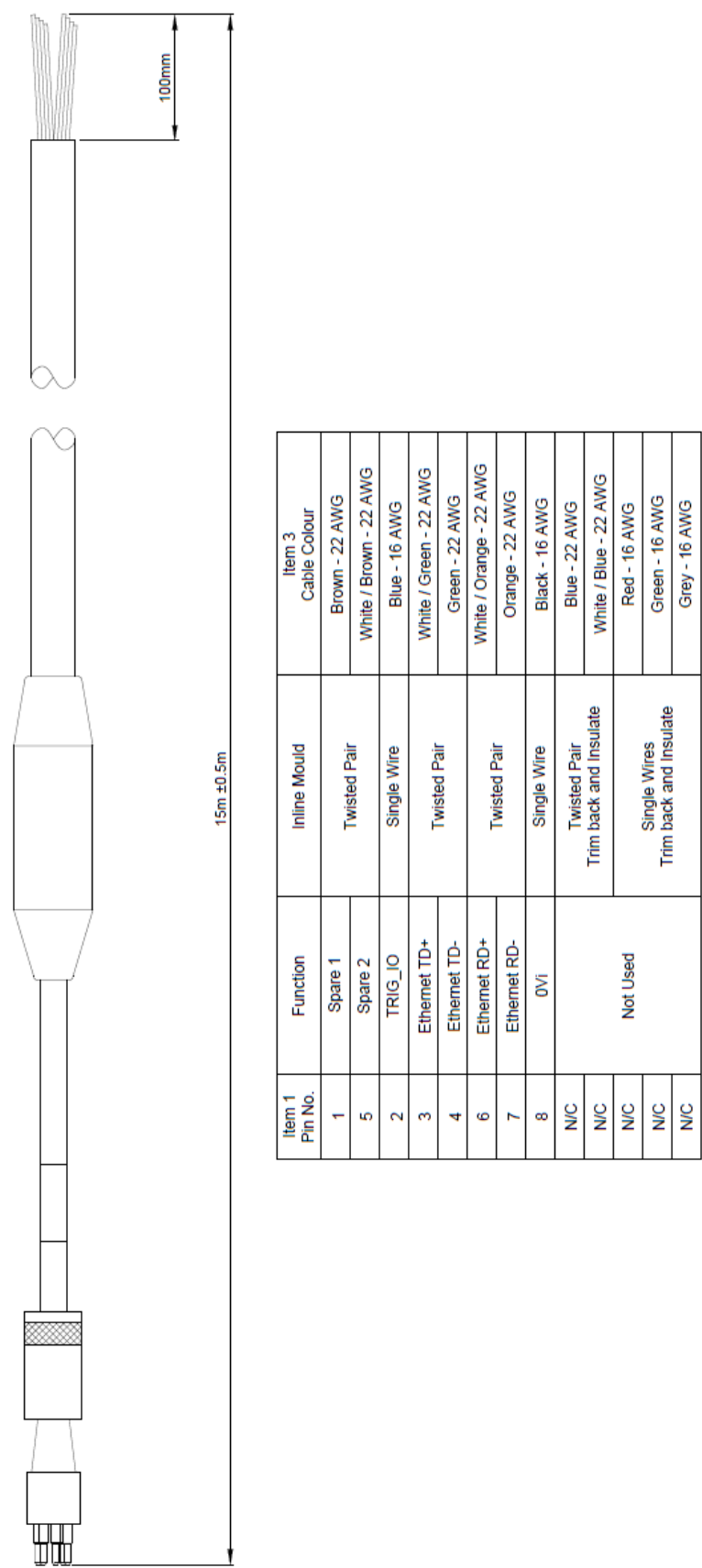


Figure D–11 Subsea Lodestar Comms Ethernet Cable Assembly – CPN 820-0072

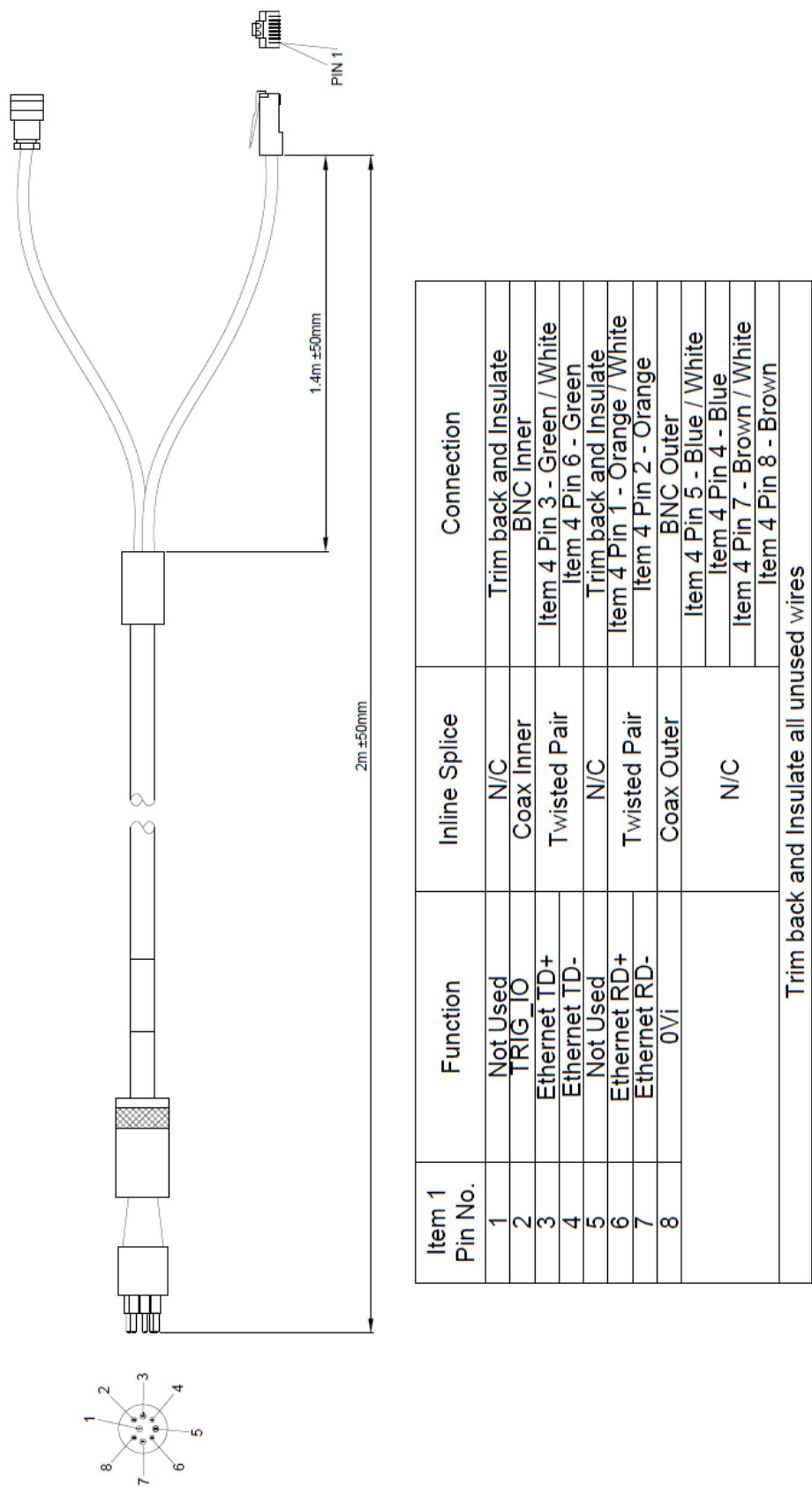
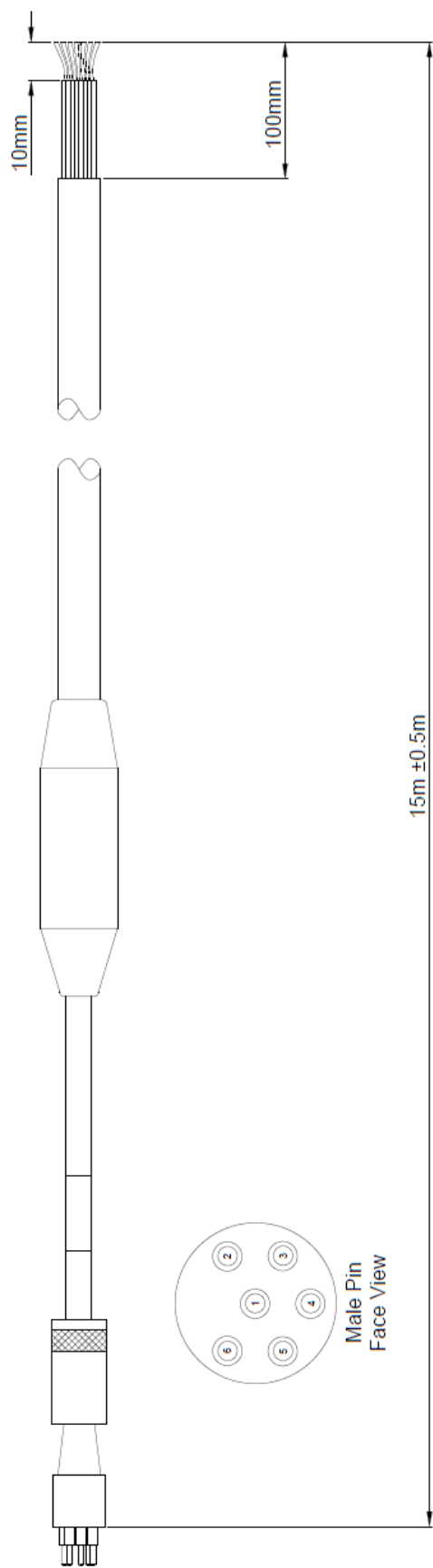


Figure D–12 Subsea Lodestar Transceiver Tail Cable Assembly – CPN 820-0073



NOTE: TWISTED PAIRS MUST BE KEPT TOGETHER			
Item 1 Pin No.	Function	Inline Mould	Item 3 Cable Colour
1	Not Used	Single Wire Trim back and Insulate	Red
2	RX_485+	Twisted Pair	White
3	TX_485-		Blue
4	Not Used	Single Wire Trim back and Insulate	Black
5	TRIG_IO	Twisted Pair	Brown
6	0Vi		Green
N/C	Not Used	Twisted Pair Trim back and Insulate	Orange
N/C			Yellow

Figure D-13 NSH Lodestar Tail Cable – CPN 820-0147

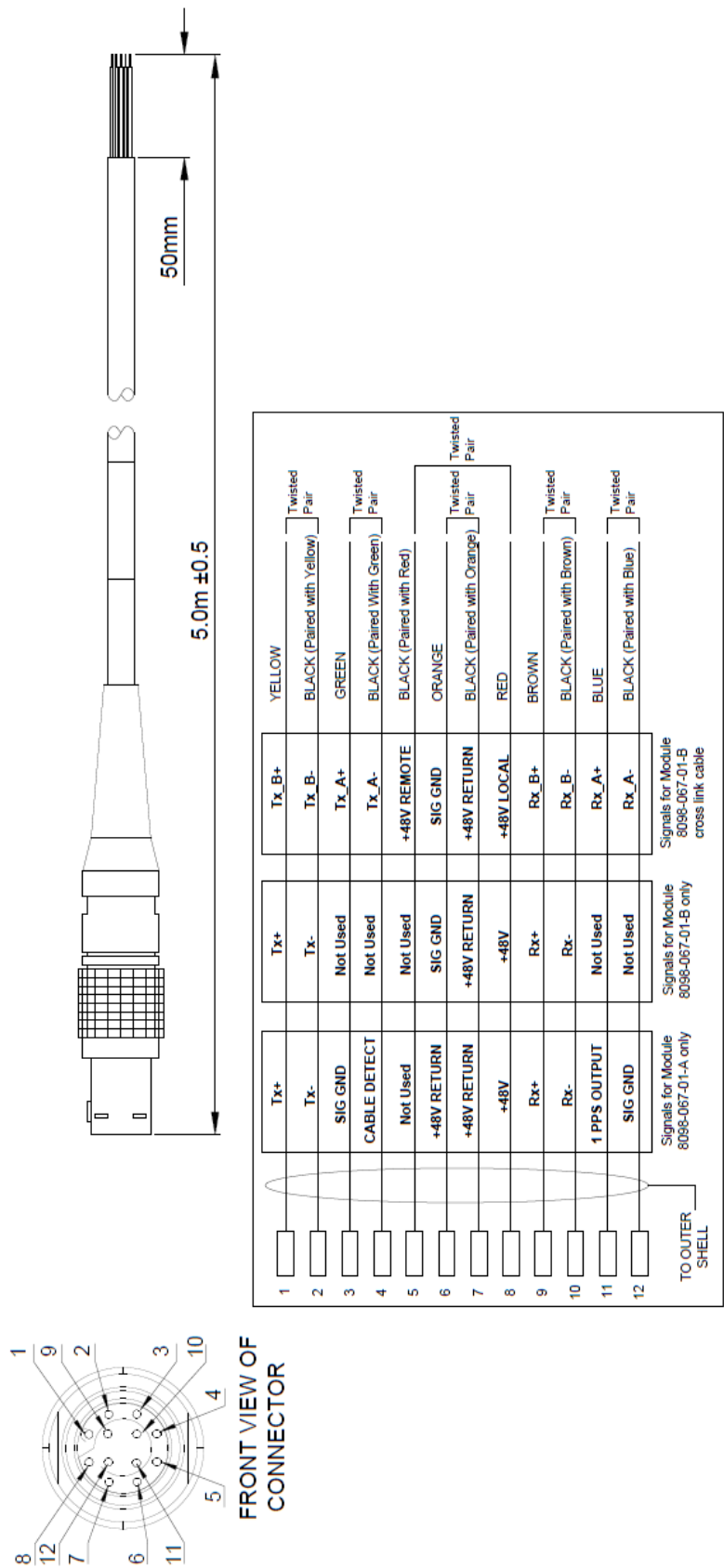


Figure D-14 GyroUSBL Mobile System Cable – CPN 820-6873

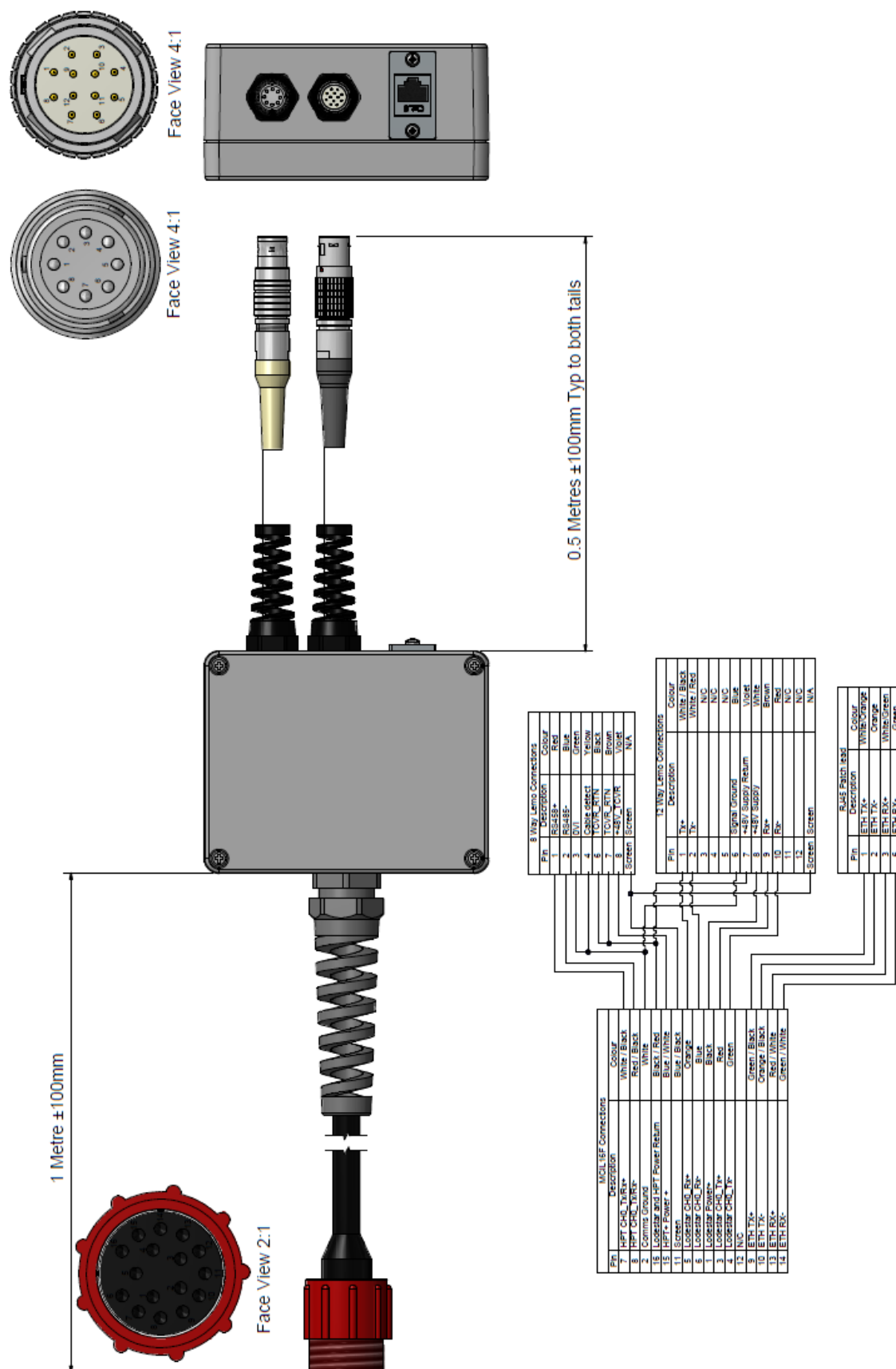


Figure D-15 GyroUSBL Mobile System Cable – CPN 820-6882, 820-6917, 820-6913

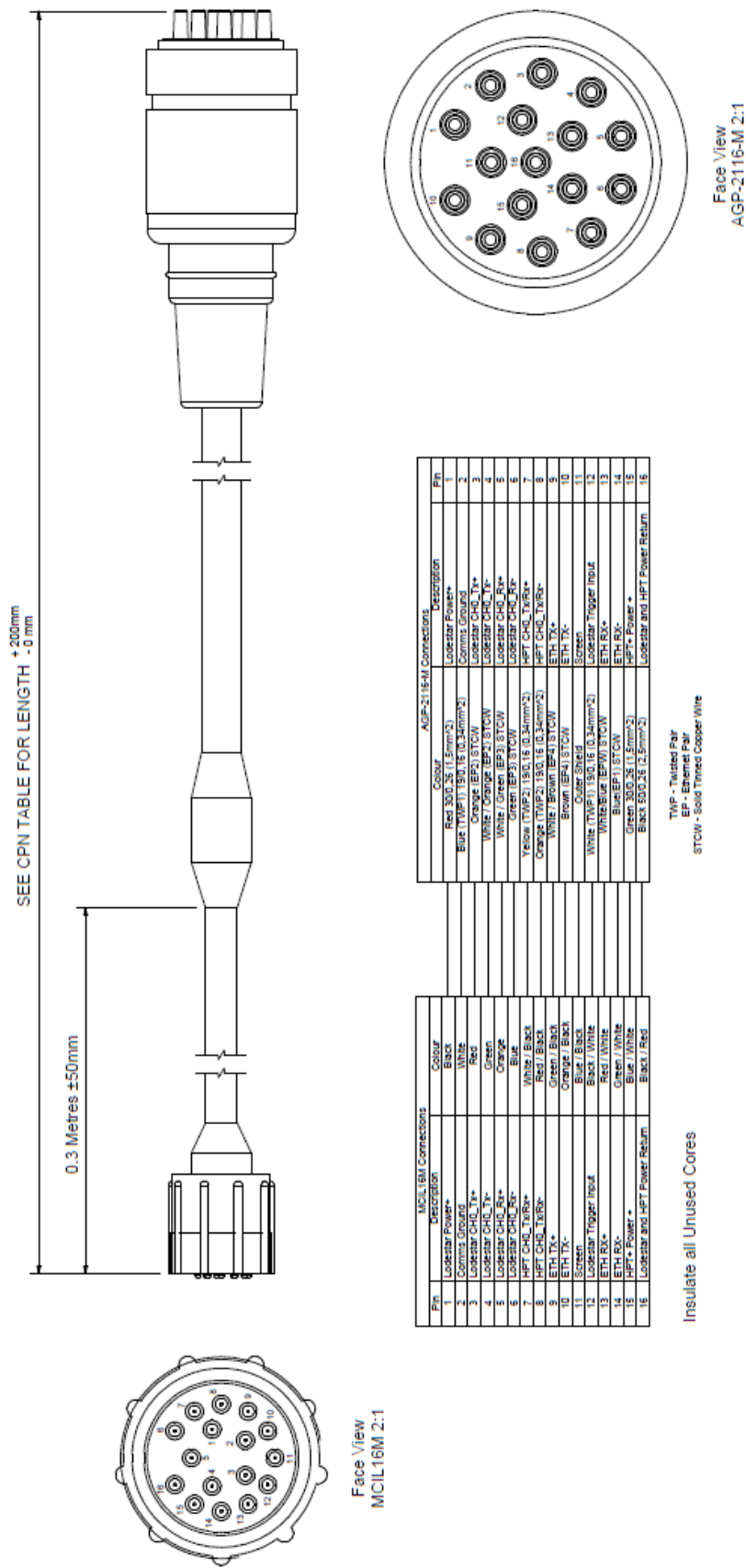
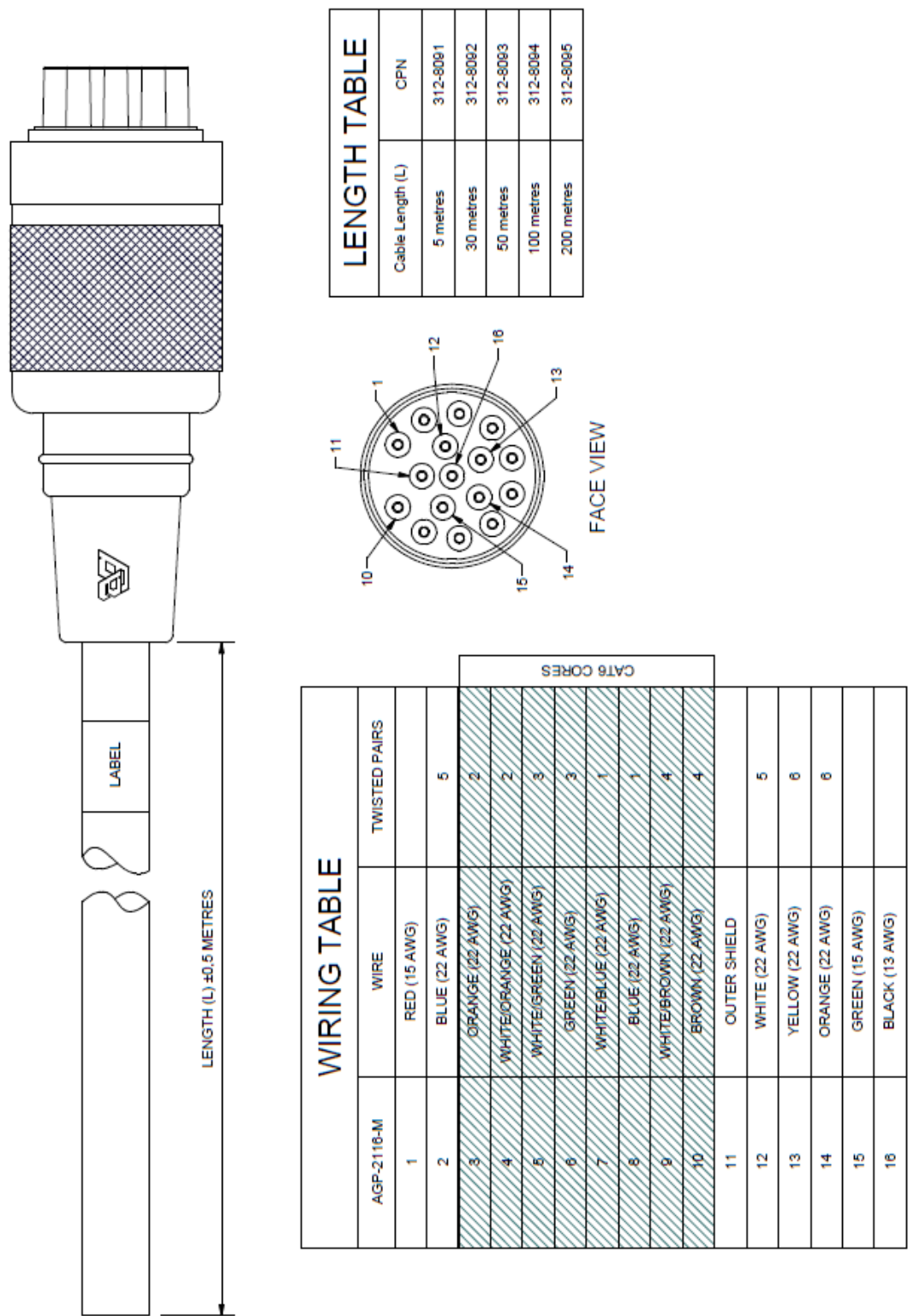


Figure D–16 GyroUSBL Tail Cable – CPN 312-8091 to 8095



Appendix E – Remote Control Interface

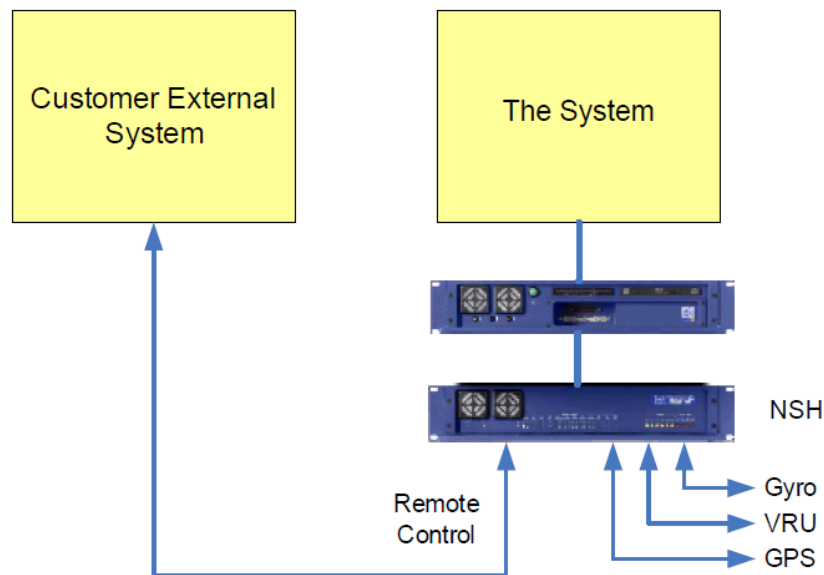
This section describes the Remote Control interface, which allows an External System to control and monitor a system. Typical uses for the Remote Control interface include:

- Starting or stopping acoustic tracking
- Interrogating the system status
- Controlling depth aiding

E.1 Hardware interface

The remote control link consists of an RS232 or RS485 connection from an external system to either the Navigation Computer or to its attached NSH (Ethernet is not currently supported).

Figure E–1 Remote Control Interface



RS485 permits higher baud rates over longer distances than RS232; hence the choice between these two protocols may depend on system deployment.

The external system is connected to the NSH using an NSH RS485 or RS232 interface card.

E.2 Software Protocol

All commands to and responses from the external system are encoded using standard XML. This enables a robust interface to which future commands and features can easily be added without affecting previous versions of the protocol.

E.3 Client Software

Client software can be written in any programming language and run on any operating system capable of sending and receiving XML via a serial port. A full Remote Control interface specification and sample C# .NET code is available on request from Sonardyne Support.

Sonardyne cannot be held responsible for the operation or debugging of any external system, and can only offer limited support for the use of the Remote Control feature.

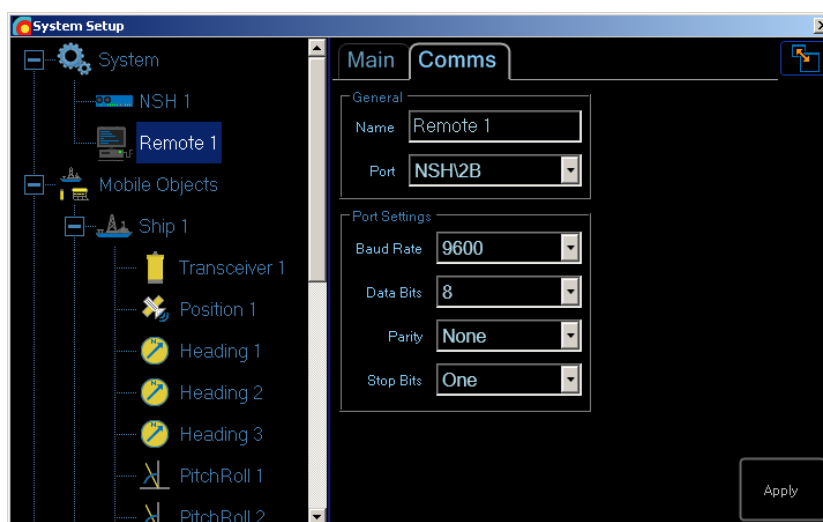
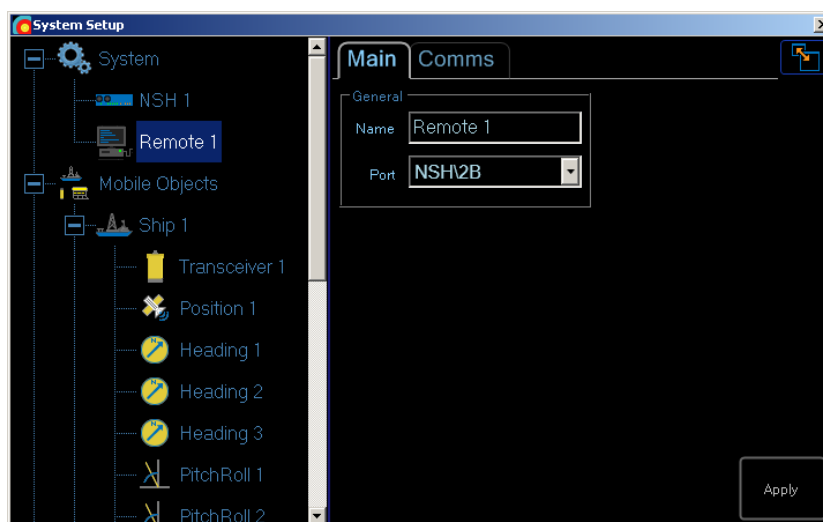
E.4 Operation

A Remote Control interface can be added to a system, just like any other device:

1. Connect an available NSH RS232 or RS485 port (as appropriate) to the external system.



2. Use the **System Setup** tool, right-click on the **System** branch of the job tree and select **Add Remote Control**:
3. Set the NSH port to the chosen port and click **Apply**.
4. Select the **Comms** tab and set the Baud rate and other parameters.

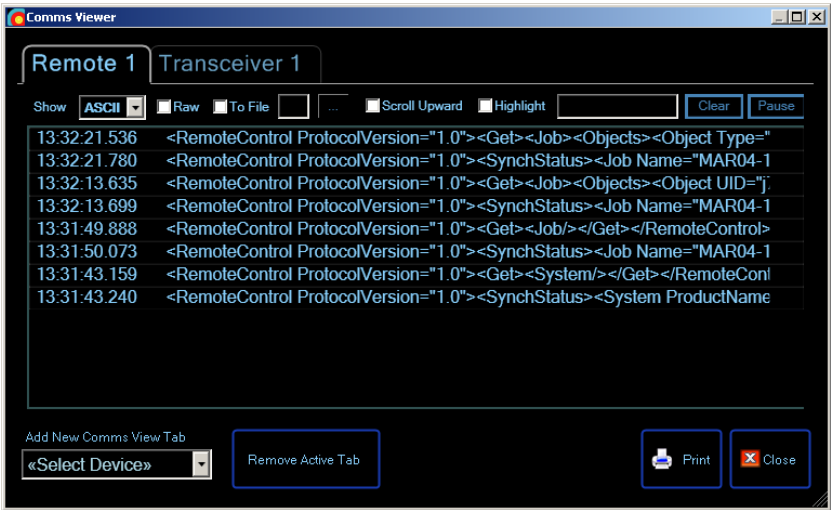


5. Run the external system's client software and establish communications.

Note

 Use the Comms Viewer to view and debug the Remote Control commands and responses:
To get started, use the Sonardyne sample Remote Control application from a Windows PC to prove the basic setup.

Figure E-2 Comms Viewer Window for the Remote Interface



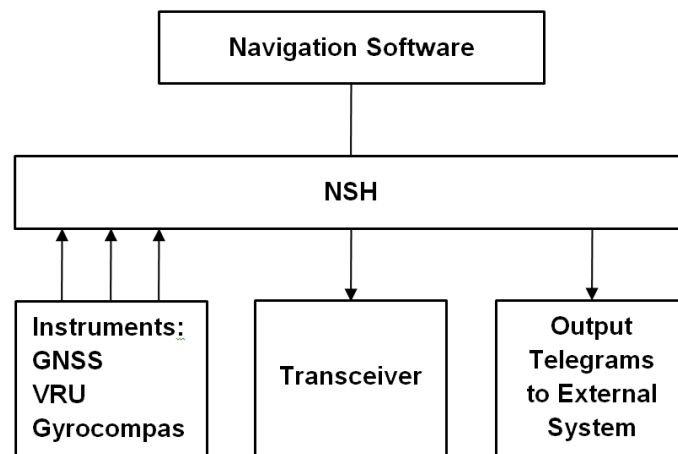
Appendix F – Output Telegram Formats and Interfaces

F.1 Introduction

Output Telegrams are used to send Reference Beacon or Mobile Vehicle position information to the Dynamic Positioning (DP) Desk or to the Navigation Package. *Table 4–1 "Position Out Telegrams"* lists the Output Telegrams supported by the system.

The HPR 309, HPR 418 BCD and HPR 418 F Output Telegrams are all industry standard formats used by DP vessels for the transfer of Hydro-acoustic Position Reference (HPR) beacon data.

Figure F–1 Interface Block Diagram



CAUTION

⚠ Risk of equipment malfunction. For DP applications, ensure that the DP Control System accepts the Position Estimate and Quality Factors published by the Acoustic Positioning Reference System in the Output Telegram, and that it weights the Estimate appropriately. Failure to do so can result in incorrect vessel positioning.

F.2 HPR 309

F.2.1 Description

The HPR 309 Telegram is the output telegram from the HPR 309 DP.

F.2.2 Format

Table F–1 Field description of the HPR 309 Telegram

Field	Size (Bytes)	Byte Offset
Head	1	0
Roll	2	1
Pitch	2	3
Heading	2	5
Transponder Index	1	7
X Position	3	8
Y Position	3	11
Z Position	3	14

Table F–1 Field description of the HPR 309 Telegram (continued)

Field	Size (Bytes)	Byte Offset
Position Status	1	17
Time Out	1	18
Transponders in Sequence	3	19
Not Used (Tracking TD Angle)	2	22
Not Used (Test)	1	24
Transponder Type	1	25
Transponder Specification	1	26
Not Used (Transducers)	1	27
Not Used (Transducer Status)	1	28
Kalman Filter Window	1	29
Checksum	1	30
End of Telegram	1	31

Notes

- This telegram will be sent only if the status shows OK.
- The co-ordinate frame for vessel position is the sea-bed LBL array co-ordinate frame.
 - Positive X is North.
 - Positive Y is East.
- Bits 0 to 5 contain data.
- Bit 6 is only ever set on the last byte of the telegram.
- If there is a bit 7, it is zero.

F.2.3 Definition of Field Names:

Head

This is the telegram header that defines the mode of operation.

- Bit 0 is set for normal acoustic navigation.
- Bit 1 Test mode is set in DP_test mode and Simulate mode.
- Bit 2 is not supported by Sonardyne.
- Bit 3 is set if the Cartesian Y direction is North.

The bit is cleared if the Cartesian Y direction is the vessel forward direction (ship relative co-ordinates).

- Bit 4 is set if the data is smoothed by a filter.
- Bit 5 is set if the position reference point is the spare reference point.

Roll

This is the roll of the ship or the differential roll for a Riser Angle Monitoring System (MRAMS).

- Positive direction is port side up.
- Scaled integer, 12 bit, 2's complement.
- Resolution = $360.0 / 4096$ degrees. (= 0.0878906 degrees).
- Min = 800000h = -2048 which relates to -180.0 degrees.
- 0 which relates to 0.0 degrees.
- Max = 7fffffh = 2047 which relates to (180 – resolution) degrees.

The first byte of this field in the telegram contains the six most significant bits, and the next byte contains the six least significant bits.

Pitch

This is the pitch of the ship or the differential pitch for a Riser Angle Monitoring System (MRAMS).

- Positive direction is bows up.
- Scaled integer, 12 bit, 2's complement.
- Resolution = $360.0 / 4096.0$ degrees
- Min = 800000h = -048 with relates to -180.0 degrees
- 0 which relates to 0.0 degrees.
- Max = 7fffffh = 2047 which relates to (180 – resolution) degrees.

The first byte of this field in the telegram contains the six most significant bits, and the next byte contains the six least significant bits.

Heading

- This is the vessel's heading.
- Positive direction is clockwise.
- Zero is north.
- Scaled integer, 12bit, 2's complement.
- Resolution = $360.0 / 4096.0$ degrees.
- Min = 800000h = -2048 which relates to -180.0 degrees.
- 0 which relates to 0.0 degrees.
- Max = 7fffffh = 2047 which relates to (180 – resolution) degrees.

The first byte of this field in the telegram contains the six most significant bits, and the next byte contains the six least significant bits.

Transponder Index

Zero means that the position is invalid. Otherwise, this field contains the index of the transponder.

- 1 to 9 = HPR Channels 1 to 9
- 10 to 14 = HPR Channels, □, △, ○, X, Y
- 15 to 63 = Undefined.

X Position

This is the X position of the transponder with respect to the vessel's datum.

- The positive direction is starboard.
- Valid when “transponder index” is not zero and when ‘Status’ is not zero.
- Scaled integer, 16-bit (sign-extended to 18 bits), 2’s complement.
- Resolution = 8192.0 / 65536 metres. (= 0.125 m).
- Min = 8000h which relates to –4096.0 metres.
- 0 which relates to 0.0 degrees.
- Max = 7fffh which relates to (4096.0 – Resolution) metres.

The first byte of this field in the telegram contains the six most significant bits, the next byte contains bits 6 to 11 and the next byte contains the six least significant bits.

Y Position

This is the Y position of the transponder with respect to the vessel’s datum.

- The positive direction is forwards.
- Valid when ‘transponder index’ is not zero and when ‘Status’ is not zero.
- Scaled integer, 16-bit (sign-extended to 18 bits), 2’s complement.
- Resolution = 8192.0 / 65536 metres. (= 0.125 m).
- Min = 8000 h which relates to –4096.0 metres.
- 0 which relates to 0.0 degrees.
- Max = 7fffh which relates to (4096.0 – Resolution) metres.

The first byte of this field in the telegram contains the six most significant bits, the next byte contains bits 6 to 11 and the next byte contains the six least significant bits.

Z Position

This is the Z position of the transponder with respect to the vessel’s datum.

- The positive direction is down.
- This is not depth. Depth is with respect to the surface of the water.
- Valid when ‘transponder index’ is not zero and when ‘Status’ is not zero.
- Scaled integer, 16-bit (sign-extended to 18 bits), 2’s complement.
- Resolution = 8192.0 / 65536 metres. (= 0.125 m).
- Min = 8000 h which relates to –4096.0 metres.
- 0 which relates to 0.0 degrees.
- Max = 7fffh which relates to (4096.0 – Resolution) metres.

The first byte of this field in the telegram contains the six most significant bits, the next byte contains bits 6 to 11 and the next byte contains the six least significant bits.

Position Status

This telegram will be sent only if the status shows OK.

Flags:

- Bit 0 is set when the position data is invalid.
- Bit 1 is set when the telegram has come from a Slave on a Dual Redundant system.

- Bit 2 is not used.
- Bit 3 is set when the riser angle data is not valid.
- Bit 4 is not used.
- Bit 5 is not used.

Watchdog telegrams do not contain valid position data, and bit 0 is therefore set. The roll pitch and heading data is valid in a watchdog telegram.

Time Out

Bit 1 is set when the riser angle data is not valid. 0 = Standard Transponder.

Transponders in sequence

These are flags to indicate which transponders are being used.

Table F-2 HPR Channel Flags

	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
1st byte	undefined	undefined	undefined	undefined	U	C
2nd byte	D	O	o	9	8	7
3rd byte	6	5	4	3	2	1

Bits are set for the transponders in use.

All other bits are cleared (including those whose meaning is undefined).

Not Used (Tracking TD Angle)

Zero.

Not Used (Test)

Zero.

Transponder Type

0 = Standard transponder.

6 = Differential angles from Riser Angle Monitoring System (MRAMS).

Transponder Specification

Flags.

Bit 0: Set for a mobile transponder, Cleared for a reference transponder.

Bits 1 to 5: Unused, all cleared.

Not Used (Transducers)

Zero.

Not Used (Transducer Status)

Zero.

Kalman Filter Window

This is the horizontal position quality, rounded to the nearest metre.

Checksum

This is the result of performing an exclusive-OR on all bytes in the telegram up to but not including this byte.

End of Telegram

This byte marks the end of a telegram. It is always 40h.

This byte is the only byte of the telegram with bit 6 set.

F.3 HPR 418 – Message 1 (USBL / SSBL)

F.3.1 Description

This sub-section describes the format and contents of the HPR 418 Rev. F Message 1 SSBL transponder position output telegram. REAL format and REAL_64 format as referred to in the 'Message Definition of Field Names' below are structured as follows:

- REAL = 32-bit floating point data
- REAL_64 = 64-bit floating point data

Both of these formats conform to IEEE standard 754. The 32-bit data uses the single precision data format; the 64-bit data uses the double precision format.

Table F–3 Field description of the HPR418 Telegram

Field	Byte	Byte Offset
Start character	1	0
Block length	2	1
Message type	1	3
Destination	1	4
Tp_index	2	5
Operation_mode	1	7
Sync_mode	1	8
Tp_type	1	9
TP_operation	1	10
Pos_data_form	1	11
Reply_status	1	12
Filt_X_pos	4	13
Filt_Y_pos	4	17
Filt_Z_pos	4	21
X_pos	4	25
Y_pos	4	29
Z_pos	4	33
Slant_range	4	37
P_course	4	41
P_roll	4	45
P_pitch	4	49

Table F–3 Field description of the HPR418 Telegram (continued)

Field	Byte	Byte Offset
Td_beam	1	53
Td_type	1	54
Td_num	2	55
Diagnostic	2	57
Stand_dev	4	59
Instr_data	4*n	63
Sumcheck	2	63+4*n
Stop character	1	64+4*n

Notes

The co-ordinate frame for SSBL transponder position data is relative to the vessel datum point.

- Positive Y is forward.
- Positive X is starboard.
- Positive Depth is down.

F.3.2 Definition of Field Names

Start Character

This is a single byte start character 55 hex.

Block length

A 2-byte block length number from 0 to 65536 defining the number of bytes after Destination field and before Sumcheck. It is 8 less than the message length.

In this case it is set to 3A hex plus the number of bytes of Instrument Data. There will usually be 0 bytes of Instrument Data. The number of Instrument Data bytes depends upon the type of transponder.

Message type

A single byte defining a number from 0 to 255 to indicate the type of message transmitted.

In this case it is 1.

Destination

A single byte number from 0 to 255 defining the device to which the message is transmitted.

This is not used by Sonardyne, but is set to 30 hex.

Tp_index

Two bytes defining the transponder channel.

On the -Sonardyne L/USBL it is possible to use a different Tp_index number from the acoustic channel in use. This is done to allow for the -Sonardyne Compatt transponders, which would not fit within the Simrad DP index system. An additional advantage is that, if a DP desk requires 418 telegrams and a survey desk requires 309 telegrams, by setting the index to a number between 1 and 16, both systems will work.

The selection of 9 as the Tp_index on the -Sonardyne L/USBL prior to V6.04 would cause 009 to be transmitted, which would be displayed as A09 on a DP desk. From V6.04 onwards, when index 9 is set, 109 is transmitted and the DP desk would display B09. The default value for DP_test is 1.

Operation_mode

A single byte containing the operation mode of the transceiver.

- 00 = standard navigation mode
- 01 = simulated position test mode. (Training)

Sync_mode

A single byte containing the synchronisation mode of the transceiver. It is not used. It is not used by -Sonardyne.

- 0 = no synchronisation

Tp_type

- 000 = transponder
- 003 = transponder with Riser Angle Monitoring System (MRAMS)

Tp_operation

A single byte defining the operation mode of the transponder:

- 000 = fixed standard transponder
- 001 = mobile standard transponder

Pos_data_form

A single byte defining the position co-ordinate format:

- Bit 0 = 0 vessel oriented, Cartesian
- Bit 0 = 1 North oriented, Cartesian

Reply_status

A single byte defining the transponder reply status:

- 000 = reply OK
- 001 = timeout 1 pulse (used as general data rejection status by -Sonardyne)

Filt_X_pos

A value in REAL format.

The filtered X – position co-ordinates of the transponder. Transponder's horizontal athwart ship distance from reference point in metres.

Filt_Y_pos

A value in REAL format.

The filtered Y – position co-ordinates of the transponder. Transponder's horizontal fore and aft ship distance from reference point in metres.

Filt_Z_pos (Depth)

A value in REAL format.

The filtered Z – position co-ordinates of the transponder. Transponder's vertical distance from reference point in metres.

X_pos

A value in REAL format.

The raw X – position co-ordinates of the transponder. Transponder's horizontal athwart ship distance from reference point in metres.

Y_pos

A value in REAL format.

The raw Y – position co-ordinates of the transponder. Transponder's horizontal fore and aft ship distance from reference point in metres.

Z_pos (Depth)

A value in REAL format.

The raw Z – position co-ordinates of the transponder. Transponder's vertical distance from reference point in metres.

Slant_range

A value in REAL format.

The direct raw slant range from the vessel's CRP to the transponder in metres.

Note

 **Simrad standard is from the Transducer to the Beacon. -Sonardyne deviate from this standard because the solution may be the result of measurements to more than one transducer.**

P_course

A value in REAL format.

The vessel's course at the time of transponder position measurement; 0 to 360 degrees.

P_roll

A value in REAL format.

The vessel's roll at the time of transponder position measurement +/-180 degrees.

P_pitch

A value in REAL format.

The vessel's pitch at the time of transponder position measurement +/-180 degrees.

Td_beam

A single byte defining the transducer beam.

- 0 = wide
- 1 = narrow.

Td_type

Defines the transducer type.

Sonardyne uses value 0 (30kHz wide beam only).

Td_num

A 16-bit word that defines the transducer number.

Sonardyne do not differentiate between transducers and transceivers and always use the value 1. This is because all positions are reported relative to the CRP, and because the solution may be the result from more than one transducer.

Diagnostic

Sonardyne do not use this field because it is specific to Simrad hardware. The value is always 0 (no errors).

Stand_dev

A value in REAL format.

This is the horizontal position quality in metres.

Instr_data (*)

If Tp_type = 3 then 8 bytes of differential riser angle (MRAMS) data are added: 4 bytes of differential roll in REAL format, followed by 4 bytes of differential pitch in REAL format.

Sumcheck

Sumcheck of the contents of the entire telegram except for the sumcheck itself and the stop character. The sumcheck is a 16-bit integer calculated by normal byte + byte addition.

Stop character

This is a single byte stop character AA hex.

F.4 HPR 418 – Message 2 (LBL / LUSBL)

F.4.1 Description

This describes the format and contents of the HPR 418 Rev F Message 2 LBL vessel position output telegram.

The LBL position contains the vessel's position relative to the origin at the LBL transponder array, which is transmitted after each position calculation. If the transponder array is north-oriented, the co-ordinates are relative to true North, otherwise they are relative to local North.

REAL format and REAL_64 format as referred to in Format: Message 2 LBL Vessel Position Data below are structured as follows:

- REAL = 32-bit floating point data
- REAL_64 = 64-bit floating point data

Both of these formats conform to IEEE standard 754. The 32-bit data uses the single precision data format and the 64-bit data uses the double precision format.

Table F-4 Field Description of the HPR418 Telegram Message 2

Field	Byte	Byte Offset
Start character	1	0
Block length	2	1
Message type	1	3

Table F–4 Field Description of the HPR418 Telegram Message 2 (continued)

Field	Byte	Byte Offset
Destination	1	4
Sequence_number	2	5
Time_header (7)	7	7
Interrogation_age	2	14
Tp_array	1	16
Td_num	1	17
Pos_east	8	18
Pos_north	8	26
Depth	4	34
Hor_err_ellipse_direction	4	38
Hor_err_ellipse_major	4	42
Hor_err_ellipse_minor	4	46
Z_standard_deviation	4	50
Pos_type	1	54
Pos_status	1	55
P_course	4	56
P_roll	4	60
P_pitch	4	64
Diagnostic	2	68
Sumcheck	2	70
Stop character	1	72

F.4.2 Notes

- This telegram will be sent only if the status is OK.
- The co-ordinate frame for vessel position is the seabed LBL array co-ordinate frame.
 - Positive X is North
 - Positive Y is East

F.4.3 Definition of Field Names

Start character

This is a single byte start character 55 hex.

Block length

A 2-byte block length number from 0 to 65536 that defines the number of bytes after the Destination field and before Sumcheck. It is 8 less than the message length. In this case it is set to 36 hex.

Message type

A single byte defining a number from 0 to 255 to indicate the type of the message transmitted.

In this case it is 2.

Destination

A single byte number from 0 to 255 that defines the device to which the message is transmitted.

This is not used by -Sonardyne, but is set to 30 hex.

Sequence_number

This number is set to zero when navigation starts and is incremented for each LBL interrogation. The range is from 0 to 65535 and will wrap around to 0 when 65535 is reached.

Time_header (7)

Defines the clock when the position is valid.

Table F–5 describes the format of the time_header.

Table F–5 Time_header format

Block Content	Size	Index	Resolution	Range
Day	Byte	0	1 Day	1 to 31
Month	Byte	1	1 Month	1 to 12
Year	Byte	2	1 Year	0 to 99
Hours	Byte	3	1 Hour	0 to 23
Minutes	Byte	4	1 Minute	0 to 59
Seconds	Byte	5	1 Second	0 to 59
1/100th seconds	Byte	6	1/100th Second	0 to 99

Interrogation_age

Time interval since the previous interrogation of the array. The time resolution is 1ms.

Tp_array

A single byte that defines the number of the transponder array in use. Its value can be 0, 1, 2 or 3. - Sonardyne sets this to 0.

Td_num

A 16-bit word that defines the transducer number.

Sonardyne do not differentiate between transducers and transceivers and always use the value 1. This is because all positions are reported relative to the CRP, and because the solution may be the result from more than one transducer.

Pos_east

A value in REAL_64 format.

East co-ordinates in metres, with a positive value meaning East. Negative values indicate West.

The co-ordinates are either local co-ordinates or global UTM co-ordinates.

Pos_north

A value in REAL_64 format.

North co-ordinates in metres, with a positive value meaning North. Negative values indicate South.

The co-ordinates are either local co-ordinates or global UTM co-ordinates.

Depth

A value in REAL format.

The depth co-ordinate with a positive value meaning downwards.

For the vessel, the depth is the vertical distance from the sea level to the vessel's CRP. For ROVs and relay transponders, the depth is the depth below the sea surface of the transducer on the unit.

Hor_err_ellipse_ direction

Each LBL position measurement has a likelihood ellipse associated with it. It is based on 1δ in each of the axes. The direction is the angle in degrees between the North axis and the major axis of the ellipse. It is a value in REAL format.

Hor_err_ellipse_ major

The major axis of the likelihood ellipse in metres. A value in REAL format.

Hor_err_ellipse_ minor

The minor axis of the likelihood ellipse in metres. A value in REAL format.

Z_standard_ deviation

The standard deviation (δ) of the depth in metres.

Pos_type

A single byte with value:

- 0 = Vessel position
- 1 = ROV 1 position
- 16 = ROV 16 position
- 17 = Relay 1 position
- 20 = Relay 4 position

Bit 7 acts as a switch for local co-ordinates or UTM co-ordinates:

- 0 = local
- 1 = UTM

Sonardyne currently only set this bit to zero. However, if large numbers appear in the **Pos_east** and **Pos_north** fields then they are very likely to be UTM values because local numbers tend to be less than 3000 m.

Pos_status

A single byte with value 0.

This variable tells the status of the position calculation. It will always show 0 to indicate the status of the position calculation, because the telegram will not be sent unless this status is OK.

- 0 = OK position

P_course

A value in REAL format.

The vessel's course at the time of transponder position measurement; 0 to 359.9°.

P_roll

A value in REAL format.

The vessel's roll at the time of transponder position measurement $\pm 180^\circ$.

P_pitch

A value in REAL format.

The vessel's pitch at the time of transponder position measurement $\pm 180^\circ$.

Diagnostic

Sonardyne do not use this field because it is specific to Simrad hardware. It is always set to zero to indicate no errors.

Sumcheck

Sumcheck of the contents of the entire telegram except for the sumcheck itself and the stop character. The sumcheck is a 16-bit integer calculated by normal byte + byte addition.

Stop character

This is a single byte stop character AA hex.

F.5 HPR 418 BCD – Message 1

F.5.1 Description

This sub-section describes the format and contents of the HPR 418 BCD Message 1 SSBL transponder position output telegram. This is a condensed 418 telegram form designed to fit within the length of a 309 telegram so as to overcome hardware buffer size constraints on older DP desks.

BCD

BCD stands for Binary Coded Decimal, and requires 4 bits (a 'nibble') to encode a single character.

In conventional BCD the values 0 to 9 inclusive are the only valid characters. However some of the bytes in the Simrad specification allow the use of alpha Hexadecimal (hex) characters A to F inclusive. The most common use among these is D, because it is used as a negative indicator in the most significant nibble of a 3-byte field.

The Start- and End-of-Message fields include fixed alpha hex values in both nibbles. The Status bytes, which are assembled bit-by-bit, can in some conditions also include alpha hex characters. The checksum byte is also likely to contain alpha hex characters.

Table F-6 Field Description of the HPR418BCD Telegram Message 1

Field	Byte	Sample BCD Data
SOT (Start of Telegram)	1	DF
Head Byte	2	01
Status Byte 1	3	01
Status Byte 2	4	00

Table F–6 Field Description of the HPR418BCD Telegram Message 1 (continued)

Field	Byte	Sample BCD Data
Transponder Type	5	02
Transponder Index	67	0133
X Position Raw	8910	001234
Y Position Raw	111213	D05678
Z Position Raw	141516	012345
Heading	1718	3599
Optional Data 1	192021	000003
Optional Data 2	222324	D00075
Horizontal Error Ellipse Direction	2526	0000
Horizontal Error Ellipse Major	2728	0000
Horizontal Error Ellipse Minor	2930	0000
Checksum	31	XX
EOR (End of Record)	32	FF

Notes

- The co-ordinate frame for SSBL transponder position data is relative to the vessel datum point.
 - Positive Y is forward
 - Positive X is Starboard
 - Positive Depth is down

F.5.2 Definition of Field Names

SOT (Start of Telegram)

This is a single byte start character DF hex.

Head Byte

This byte indicates the message type and is always 01 hex for a transponder message type 1.

Status Byte 1

- Bit 0 set = position measurement OK
- Bit 1 set = position is filtered
- Bit 2 not used by Sonardyne. Bit set to 0
- Bit 3 not used by Sonardyne. Bit set to 0
- Bit 4 not used by Sonardyne. Bit set to 0
- Bit 5 set = data from Slave system; clear = data from Master system
- Bit 6 set = BCD conversion error
- Bit 7 not used by Sonardyne. Bit set to 0

Status Byte 2

- Bits 0 to 1 = Transducer number. Not used by Sonardyne. Bits are set to 01 — Tdr 1
- Bits 2 to 3 = Transceiver number. Not used by Sonardyne. Bits are set to 01 — Tcvr 1
- Bit 4 set = Simulate mode
- Bit 5 set = Mobile transponder
- Bit 6 not used by Sonardyne. Bit set to 0
- Bit 7 set = data from Slave system; clear = data from Master system

Transponder Type

A single byte defining the transponder type.

- 00 = standard transponder
- 03 = Riser Angle Monitoring System (MRAMS) transponder

Transponder Index

Two bytes that define the transponder channel.

The software allows you to use a different TP_index number from the acoustic channel in use. This is done so as to cater for the Sonardyne COMPATT transponders, which would not fit within the Simrad DP index system. This also has another advantage in that if a DP desk requires 418BCD telegrams and a survey desk requires 309 telegrams, by setting the index to a number between 1 and 16, both systems will work.

The selection of 9 as the Tp_index on the -Sonardyne L/USBL prior to V6.04 would cause 00 09 hex to be transmitted, which would be displayed as A09 on a DP desk. From V6.04 onwards, when index 9 is set, 01 09 hex is transmitted and the DP desk would display B09. The default value for DP_test is index 1.

X Position Raw

Three bytes used for the beacon athwartship position.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

Y Position Raw

Three bytes used for the beacon along-ship position.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

Z Position Raw

Three bytes used for the beacon depth.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

Heading

Two bytes used for the vessel heading.

The LSB is 1/10th of a degree.

Optional Data 1 (Vessel Roll)

Three bytes used for the vessel roll or differential roll for a Riser Angle Monitoring System (MRAMS).

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

Optional Data 2 (Vessel Pitch)

Three bytes used for the vessel pitch or differential pitch for a Riser Angle Monitoring System (MRAMS).

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

Horizontal Error Ellipse Direction

Each position measurement has a likelihood ellipse associated with it. It is based on 1 σ in each of the axes.

Two bytes are used to indicate the direction of the major axis in degrees between the North axis and the major axis of the ellipse. The LSB is 1/10th of the unit.

Horizontal Error Ellipse Major

Two bytes used to indicate the major axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit.

Horizontal Error Ellipse Minor

Two bytes used to indicate the minor axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit.

Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte. Bit 7 is always zero.

EOR (End of Record)

This byte marks the end of a telegram. It is always FF.

F.6 HPR 418 BCD – Message 2

F.6.1 Description

This sub-section describes the format and contents of the HPR 418 BCD Message 2 LBL position output telegram. This is a condensed 418 telegram form designed to fit within the length of a 309 telegram so as to overcome hardware buffer size constraints on older DP desks.

BCD

BCD stands for *Binary Coded Decimal* and requires 4 bits (a 'nibble') to encode a single character.

In conventional BCD the values 0 to 9 inclusive are the only valid characters. However some of the bytes in the Simrad specification allow the use of alpha Hexadecimal (hex) characters A to F inclusive. The most common use among these is D, because it is used as a negative indicator in the most significant nibble of a 3-byte field.

The Start- and End-of-Message fields include fixed alpha hex values in both nibbles. The Status bytes, which are assembled bit-by-bit, can in some conditions also include alpha hex characters. The checksum byte is also likely to contain alpha hex characters.

Table F–7 Field Description of the HPR418BCD Telegram Message 2

Field	Byte	Sample BCD Data
SOT (Start of Telegram)	1	DF
Head Byte	2	02
Status Byte 1	3	01
Status Byte 2	4	00
Object Type	5	02
Transponder Array	6	01
X Position Raw	7891011	0000123456
Y Position Raw	1213141516	D000098765
Z Position Raw	171819	122345
Heading	2021	3599
Not Used	222324	000000
Horizontal Error Ellipse Direction	2526	0000
Horizontal Error Ellipse Major	2728	0000
Horizontal Error Ellipse Minor	2930	0000
Checksum	31	XX
EOR (End of Record)	32	FF

Notes

- This telegram will be sent only if the status is OK.
- The co-ordinate frame for vessel position is the sea-bed LBL array co-ordinate frame.
 - Positive X is North
 - Positive Y is East

F.6.2 Definition of Field Names

SOT (Start of Telegram)

This is a single byte start character DF hex.

Head Byte

This byte indicates the message type and is always 02 hex for an object message type 2.

Status Byte 1

- Bit 0 set = position measurement OK
- Bit 1 set = position is filtered
- Bit 2 not used by Sonardyne. Bit set to 0
- Bit 3 not used by Sonardyne. Bit set to 0
- Bit 4 not used by Sonardyne. Bit set to 0

- Bit 5 set = data from Slave system; clear = data from Master system
- Bit 6 set = BCD conversion error
- Bit 7 not used by Sonardyne. Bit set to 0

Status Byte 2

- Bits 0 to 1 = Transducer number. (not used by Sonardyne. Bit are set to 01 - Tdr 1)
- Bits 2 to 3 = Transceiver number. (not used by Sonardyne. Bit are set to 01 - Tcvt 1)
- Bit 4 set = Simulate mode.
- Bit 5 Not used by Sonardyne. Bit set to 0
- Bit 6 LBL co-ordinates in UTM
- Bit 7 set = data from Slave system; clear = data from Master system

Object Type

A single byte defining the object type.

- 00 = Vessel position
- 01 = ROV position
- 16 = ROV 16 position
- 17 = Relay 1 position
- 18 = Relay 2 position
- 19 = Relay 3 position
- 20 = Relay 4 position

Transponder Array

Sonardyne fix this byte to 01 hex.

X Position Raw

Five bytes used for the object position in Northings.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/100th of the unit.

Y Position Raw

Five bytes used for the object position in Eastings.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/100th of the unit.

Z Position Raw

Three bytes used for the beacon depth.

The MSB is used for the sign and therefore the most significant nibble only returns 0 hex for positive or D hex for negative. The LSB is 1/10th of the unit.

Heading

Two bytes used for the vessel heading. The LSB is 1/10th of a degree.

Not Used

Three bytes filled with 00 hex.

Horizontal Error Ellipse Direction

Each position measurement has a likelihood ellipse associated with it. It is based on 1δ in each of the axes.

Two bytes are used to indicate the direction of the major axis in degrees between the North axis and the major axis of the ellipse. The LSB is 1/10th of the unit.

Horizontal Error Ellipse Major

Two bytes used to indicate the major axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit

Horizontal Error Ellipse Minor

Two bytes used to indicate the minor axis of the likelihood ellipse in metres.

The LSB is 1/10th of the unit.

Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte. Bit 7 is always zero.

EOR

This byte marks the end of a telegram. It is always FF.

F.7 NMEA 0183 SSB – (USBL / SSBL Position)**F.7.1 Description**

The maximum length of the NMEA 0183 SSB Telegram is 82 characters, including the start character <\$> and the termination characters <CR> and <LF>. However the telegram will typically be less than this and will be of variable length, because leading zeros are suppressed.

Table F–8 Field Description of the SSBL Telegram

Field	Data Format	Sample Data
Start Character	\$	\$
Address	PSIMSSB	PSIMSSB
Time	,hhmmss.ss	,130700.43
Tp_code	,ann	,B22
Status	,a	,A (Always)
Error_code	,aaa	,
Coordinate_system	,a	,C
Orientation	,a	,H
SW_filter	,a	,M
X_coordinate	,x.x	,-100000.40
Y_coordinate	,x.x	,-100000.89
Depth	,x.x	,4329.10

Table F–8 Field Description of the SSBL Telegram (continued)

Field	Data Format	Sample Data
Expected_accuracy	,x.x	,3.16
Additional_info	,a	,l
First_add_value	,x.x	,-12.3
Second_add_value	,x.x	,-14.0
Checksum	*hh	*hh
Termination	<CR><LF>	<CR><LF>

Notes

- This telegram will be sent only if the status is OK.
- The co-ordinate frame for SSBL transponder position data is relative to the vessel datum point.
 - Positive Y is forward
 - Positive X is Starboard
 - Positive Depth is down

F.7.2 Definition of Field Names

Start_character

The single ASCII character <\$>.

Address

The ASCII character string <PSIMSSB> to indicate that the telegram is a Simrad SSBL message.

Time

The time at which the fix was valid.

An ASCII character string preceded by a comma, indicating the time in hh (hours) mm (minutes) ss (seconds). (decimal point) ss (hundredths of seconds)

<,hhmmss.ss>

Example: <,035623.19>

Alternatively the field may be left blank, for example <,>.

Tp_code

The index of the transponder used.

B01 to B99 = MF channels

Examples: B05, B55, B58

The format is three ASCII characters preceded by a comma <,ann>, for example <,B17>

Status

This will always show OK because this telegram is sent only if the status is OK.

Error_code

This is always blank because the telegram will not be sent if there is an error code (meaning that the status is not OK).

Coordinate_system

A single ASCII character preceded by a comma <,a>

C = Cartesian co-ordinates, U = UTM, R = Radians.

Orientation

A single ASCII character preceded by a comma <,a>

H = Vessel head up, or N = North up.

SW_filter

A single ASCII character preceded by a comma <,a>

F = filtered, or M = measured.

X_coordinate

When no position has been calculated the field will be empty and only the comma field separator will be sent <,>

When data is present the field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed (see *Table F-9*).

Y_coordinate

When no position has been calculated the field will be empty and only the comma field separator will be sent <,>

When data is present the field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed (see *Table F-9*).

Table F-9 Supported options for NMEA SSB Telegram

Coordinate system	Orientation	X_coordinate	Y_coordinate
C	H	Starboard	Forwards
C	N	North (m)	East (m)
U	N	Northings (m)	Eastings (m)
R	N	Latitude (degrees)	Longitude (degrees)

Additional_info

A single ASCII character preceded by a comma <,a>

I = inclinometer, T = time, D = depth and N = none <,N>

First_add_value

- When the **Additional_info** field is I then the field will represent differential roll for a Riser Angle Monitoring System (MRAMS).
- When the **Additional_info** field is T then the field will represent range time in seconds.
- When the **Additional_info** field is D then the field will represent measured depth in metres.

The data field takes the form <,xxx.xx>. It is of variable length with leading zeros suppressed.

Second_add_value

When the Additional_info field is N then this field will be empty and only the comma field separator will be sent <,>

When data is present its meaning is controlled by the Additional_info field. The only option supported by -Sonardyne is differential pitch for a Riser Angle Monitoring System (MRAMS).

The data field takes the form <,>xxx.xx>. It is of variable length with leading zeros suppressed.

Checksum

The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte. Bit 7 is always zero.

Termination

The ASCII for Carriage Return followed by Line Feed are sent <CR><LF>.

F.8 NMEA 0183 – LBP (LBL / LUBSL Position)

F.8.1 Description

The maximum length of the NMEA 0183 LBP Telegram is 82 characters, including the start character <\$> and the termination characters <CR> and <LF>. However, the telegram will typically be less than this and will be of variable length, because leading zeros are suppressed.

F.8.2 Field Description

Table F–10 Field Description of the LBP Telegram

Field	Data Format	Sample Data
Start_character	\$	\$
Address	PSIMLBP	PSIMLBP
Time	,hhmmss.ss	,130700.43
Tp_array	,C–C	,1
Type	,a_	,Ve
Status	,A	,A
Coordinates	,a_	,C
X_coordinate	,x.x	123.45
Y_coordinate	,x.x	678.90
Depth	,x.x	456.78
Major	,x.x	1.23
Minor	,x.x	1.32
Direction	,x.x	0.00
Res_rms	,x.x	0.97
Checksum	*hh	*hh
Termination	<CR><LF>	<CR><LF>

F.8.3 Definition of Field Names

Type

Ve = vessel.

R1 to R4 = ROV 1 to ROV 4.

Status

The Status field is A when the measurements are OK. The possible statuses are as shown below:

- A OK
- ??? Simulating or error condition

F.8.4 X_coordinate, Y_coordinate, Coordinate_system

The contents of the **X_coordinate** and the **Y_coordinate** fields are controlled by the settings in the **Configure** dialog box.

The **Coordinate_system** field should be used to decode the X_ and Y_ coordinate fields as shown in *Table F-11*.

Table F-11 NMEA 0183 LBP Coordinate Fields

APOS Configure Setting	Coordinate system	X_coordinate	Y_coordinate
Cartesian N/E	C	North	East
UTM N/E	U	Northings	Eastings
Radians	R	Latitude	Longitude

Depth - the depth in meters

Major, Minor, Direction - the major axis, minor axis and direction of the error ellipse.

F.9 PSONALL – Sonardyne General Position Report

F.9.1 Description

The PSONALL telegram is an extended version of a standard PSONOG grid co-ordinate position telegram for use when transferring vehicle positions to client navigation systems. The included co-ordinates use the selected projection system defined in software.

F.9.2 Format

The PSONALL telegram format shown below consists of a single string, separated across two lines here for clarity.

```
$PSONALL,Name,Offset,HHMMSS.ss,EEEEEEEE. ee,NNNNNNNNN.nn,  
DDDD.dd,HHH.hh,CCC.cc,T,PP.PP,RR.RR,VVV.vv,AAA.AA,BBB.BB*hh<CR><LF>
```

F.9.3 Field Descriptions

Table F-12 Field Description for the PSONALL Telegram

Field	Description
\$PSONALL	Header to identify the telegram.
Name	The name of the vehicle the string relates to.

Table F–12 Field Description for the PSONALL Telegram (continued)

Field	Description
Offset	Offset on vehicle the position relates to.
HHMMSS.ss	The valid time of the sentence.
EEEEEEEE.ee	Grid Easting.
NNNNNNNN.nn	Grid Northing.
DDDD.dd	Depth.
HHH.hh	Heading ¹
CCC.cc	Course made good (CMG) ¹
T	Heading type: G = grid T = True M = Magnetic
PP.PP	Vehicle Pitch ¹
RR.RR	Vehicle Roll ¹
VVV.vv	Velocity ¹
AAA.AA	Position accuracy (95%).
BBB.BB	Depth accuracy.
*hh	Checksum.
<CR><LF>	Termination characters, carriage return plus linefeed.

¹ Empty fields are null by default as shown above, or replaced with '0.00' values (see Section 4.20 "Configuring Output Telegrams").

Checksum

The Checksum value is the resultant XOR of all characters in the report string, excluding the <CR><LF> termination characters.

Example

```
$PSONALL,Rangeaster,Dunker,123443.56,419876.56,5567887.45,
6789.07,234.56,235.67,T,15.12,17.34,2.4,1.22,0.39*hh<CR><LF>
```

With null fields:

```
$PSONALL,2404,Transducer,085741.262,650883.02,5688721.58,999.91,,,G,,,,7.858,0.806*05<C
R><LF>
```

With 0.00 replacing null fields:

```
$PSONALL,2404,Transducer,085227.318,650816.89,5688781.67,372.58,0.00,0.00,G,0.00,0.00,0.
00,3260605850.979,22753659635.223*2B<CR><LF>
```

F.10 PSONUSBL – Sonardyne USBL Report

F.10.1 Description

This sentence is intended to include all of the information necessary to provide USBL position and attitude/heading information to an external system.

Null fields with their delimiters can have the following appearance, depending on where they are located in the sentence: “,” “,” “*”

The ASCII NULL character (HEX 00) shall not be used as the null field.

F.10.2 Format

The PSONUSBL telegram format shown below consists of a single string, separated across two lines here for clarity

```
$PSONUSBL,HHMMSS.ss,ddd,C,aaaa.aa,bbbb.bb,dddd.dd,pp.pp,srr.rr,hhh.hh,
qq.q*hh<CR><LF>
```

F.10.3 Field Description

Table F-13 Field Description for the PSONUSBL Telegram

Field	Description
\$PSONUSBL	Header to identify the telegram.
HHMMSS.ss	The valid time of the sentence.
ddd	Beacon index - the index of the beacon that the string relates to (valid range 1 to 999 with 0 not valid).
C	Co-ordinate frame orientation: H = vehicle head up N = North up
aaaa.aa	Vehicle-centred East or Starboard co-ordinate.
bbbb.bb	Vehicle-centred North or Forward co-ordinate.
dddd.dd	Depth.
pp.pp	Pitch.
rr.rr	Roll.
hhh.hh	Heading (true).
qq.q	1 sigma position accuracy (39.4 %).
*hh	ASCII Hex checksum (XOR of all characters between, but not including, the \$ and * characters).
<CR><LF>	Termination characters, carriage return, line feed.

F.10.4 Example

```
$PSONUSBL,123456.12,101,H,-1234.56,-1234.56,1234.56,-12.34,
-12.34,123.45,12.3*70 <CR><LF>
```

F.11 PSONDP - Sonardyne DP Report

F.11.1 Description

This sentence includes all of the information necessary to provide position, velocity and attitude/heading information to a DPS. In addition to the positional information it also provides error metrics that allow the DPS to determine that the data is valid, and the correct weight to give to the data.

Null fields with their delimiters can have the following appearance depending on where they are located in the sentence: ",", " ", ""

The ASCII NULL character (HEX 00) shall not be used as the null field.

This telegram is subject to change, although additions will only be made immediately before the '*' that marks the beginning of the checksum.

F.11.2 Format

\$PSONDP,HHMMSS.ss,0000,M,Q,DDMM.mmmmmm,N,DDDMM.mmmmmm,E,A.aa,A.aa,AAA.a
a,D.dd,S.ss,C.c,A.aa,A.aa,AAA.aa,P.ppp,R.rrr,
HHH.hhh,A.aa,CCC,N,,, *hh<CR><LF>

F.11.3 Field Description

Table F-14 Field Description for the PSONDP Reports

Field	Description
\$PSONDP	Header (fixed)
HHMMSS.ss	The valid time of the contents. See Note 1.
0000	Target ID.
M	Status: M:Master, S:Slave.
Q	Quality Indicator (0:No Data, 1:Degraded Data, 2:Full Accuracy.
DDMM.mmmmmm	Latitude. See Note 2.
N	Direction of latitude (N or S).
DDDMM.mmmmmm	Longitude. See Note 2.
E	Direction of longitude (E or W).
A.aa	Position accuracy error ellipse major axis (metres). See Note 3.
A.aa	Position accuracy error ellipse minor axis (metres). See Note 3.
AAA.aa	Position accuracy error ellipse direction (True - degrees). See Note 3.
D.dd	Depth below sea surface (metres), see Note 4.
S.ss	Speed over ground (m/s).
C.c	Course over ground (True - degrees). 0.0-359.9
A.aa	Speed over ground accuracy error ellipse major axis (m/s). See Note 3.
A.aa	Speed over ground accuracy error ellipse minor axis (m/s). See Note 3.
AAA.aa	Speed over ground accuracy error ellipse direction (True - degrees). See Note 3.
P.ppp	Pitch (degrees). Bow up: positive. See Note 5
R.rrr	Roll (degrees). Port up: positive.
HHH.hhh	Heading (True - degrees). 0.0 - 359.999
A.aa	Heading accuracy (Standard deviation - degrees)
CCC	Aiding: N:None,U:USBL,L:LBL,G:GNSS,D:DVL,P:Pressure. See Note 6.
A,x.xxx,x.xxx,x.xxx	Additional data: N: None. TBD See Note 7.
*hh	Checksum. See Note 8.
<CR><LF>	Terminator, return plus linefeed .

Notes

1. The DP-INS system time for which the data is valid. If the system is connected to a GNSS time source this will be UTC time.
2. Latitude and longitude values are always displayed in the degrees, minutes, decimal minutes (DDMM.mmmmmm) format. All values are relative to the WGS-84 datum. Leading zeros are not required. Latitude range (DD) = 0 - 89, longitude range (DDD) = 0 - 179.
3. The accuracy values contain the length of the vehicle's error ellipse axes and direction of the major axis. Error ellipse values are always displayed to 2 DPs.
4. The depth value is always displayed in metres and fixed to 2 DPs. Negative depth indicates the target is above the water surface.
5. Pitch and roll angles are defined as the angle between the gravity vector and the deck plane in the direction of the roll and pitch axes of the vessel.
6. The Aiding source indicates what type of aiding data is currently in use.
7. Additional data is reserved to contain data received from the target instrument. Empty data slots will be left null when no data is present.
8. The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including ",", delimiters, between but not including the "\$" and the "*" delimiters. The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0-9, A-F) for transmission. The most significant character is transmitted first.

F.11.4 Modifications

The maximum number of characters in a normal NMEA sentence should be 82, consisting of a maximum of 79 characters between the starting "\$" and the terminating <CR><LF>. This telegram currently could be as long as 180 characters.

F.11.5 Example

```
$PSNDP,123456.43,0010,M,2,5020.234502,N,12345.324576,E,12.34,12.34,123.45,1234.56,12.34,359.9,0.45,0.23,123.45,-12.345,-12.345,359.999,1.23,UP,N,,, *2E
```

F.12 NMEA 0183 GGA

F.12.1 Description

The NMEA GGA telegram is a simulation of a standard NMEA GGA string and is used to show fix-related data for a GNSS receiver.

You should use this sentence only where the receiving installation does not support a more suitable sentence.

F.12.2 Format

The NMEA GGA telegram format shown below consists of a single string, separated across two lines here for clarity.

```
$GP GGA,HHMMSS.ss,DDMM.mmmmmm,N,DDMM.mmmmmm,  
E,2,12,A.AA,Z.ZZ, M,0.0,M,0.0,0000*hh<CR><LF>
```

F.12.3 Field Description

Table F–15 Field Description for the NMEA GGA Telegram

Field	Description
\$GPGGA	Header to identify the report (fixed).
HHMMSS.ss	The valid time of the position.
DDMM.mmmmmm	Latitude. See Note 2.
N	Direction of latitude (N or S).
DDDMM.mmmmmm	Longitude. See Note 2.
E	Direction of longitude (E or W).
2,12	Fixed values.
A.AA	Accuracy (semi-major axis). See Note 3.
Z.ZZ	Height, see Note 4.
M,0.0,M,0.0,0000	Fixed values.
*hh	Checksum. See Note 5.
<CR><LF>	Termination characters, carriage return, linefeed.

Notes

1. Latitude and longitude values are always displayed in the DDDMM.mmmmmm format.
All values are relative to the WGS84 datum. Leading zeros are not required. Latitude range (DD) = 0 to 89; Longitude range (DDD) = 0 to 179.
2. The accuracy value is the semi-major axis value for the vehicle. It is always displayed in metres and is fixed to two DPs.
3. The height value is always displayed in metres and fixed to DPs.
Because this string format has no concept of depth, depth values for the vehicle should be displayed as negative values so that, for example when depth = 56.7 m, depth is formatted as – 56.7.
4. The checksum is the 8-bit exclusive OR (no start or stop bits) of all characters in the sentence, including "," delimiters, between but not including the "\$" and the "*" delimiters.
The hexadecimal value of the most significant and least significant 4 bits of the result is converted to two ASCII characters (0 to 9, A to F) for transmission. The most significant character is transmitted first.

The maximum number of characters in a sentence is 82, consisting of a maximum of 79 characters between the starting "\$" and the terminating <CR><LF>.

Example

```
$GPGGA,123456.43,5020.234502,N,134.324576,E,2,12,6.7,  
–56.78,M,0.0,M,0.0,0000*hh
```


F.13 ATS ASCII

F.13.1 Description

The ATS ASCII Telegram is used by Nautronix ATS-S02 SO4 and S08 Systems. Each line of the data contains position data for one object terminated by a <LF> then <CR>

F.13.2 Format

The ATS ASCII format shown below consists of a single string, separated across two lines here for clarity.

```
dd mmm yy hh:mm:ss B:d X:ddd.d Y:ddd.d D:ddd.d P:d.d R:d.d H:ddd.d E:d A:ddd.d C:ddd.d
E:d<LF><CR>
```

F.13.3 Field Description

Table F-16 Field Description for the ATS ASCII Telegram

Field	Description
dd mmm yy hh:mm:ss	Date and time of receipt or the acoustic reply.
B:d	Beacon Index 0 = Ship, 1-10=beacons 1 to 10
X:ddd.d	X Coordinate in metres.
Y:ddd.d	Y Coordinate in meters.
D:ddd.d	Depth in metres.
P:d.d	Ships pitch in degrees. Positive pitch is bow up +/-9,9
R:d.d	Ships roll in degrees. Positive roll is port up +/-9,9
H:ddd.d	Ships heading relative to North in degrees 0-360
A:ddd.d	(Optional) Riser angle monitoring – Lower flex joint pitch in degrees.
C:ddd.d	(Optional) Riser angle monitoring – Lower flex joint roll in degrees.
E:d	Error code: bit 0 = simulating; bit 2 = position data is invalid.
<LF><CR>	Line feed, Carriage return.

Notes

- The co-ordinate frame for beacon position data is relative to the ship datum point.
 - Positive Y is forward
 - Positive X is starboard
 - Positive depth is down

Example

```
30 Sep 04 13:47:55 B:0 X:-84.2 Y:-11.6 D:31.0 P:0.0 R:0.0 H:189.1 E:0<LF><CR>
```

F.14 Trackpoint II

F.14.1 Description

The Trackpoint II Telegram is a fixed length 66 character ASCII based transponder position telegram. Each line of the data contains position data for one object terminated by a <CR> then <LF>.

F.14.2 Field Description

Table F–17 Field Description for the Trackpoint II Telegram

Field	Description
d	Index of the transponder.
hh:mm:ss	Time of receipt or the acoustic reply.
ddd	Ships heading relative to North in degrees 0-360
ddd.d	Bearing to target in degrees 0-360
d.d	Slant range to target in metres.
d.d	X Coordinate in metres.
d.d	Y Coordinate in meters.
d.d	Depth in metres.
d	Error code (0 indicates good position).
<CR>	Carriage return.
<LF>	Line feed.

Notes

- The co-ordinate frame for beacon position data is relative to the ship datum point.
 - Positive Y is forward
 - Positive X is starboard
 - Positive depth is down

Example

1 15:53:53 12 104.9 141.1 97.9 -26.0 98.2 0<CR><LF>

F.15 HPR 300P

F.15.1 Description

The HPR 300P Telegram is a 66 character ASCII based transponder position. Each line of the data contains position data for one object terminated by a <CR> then <LF>.

F.15.2 Field Description

Table F–18 Field Description for the HPR 300P Telegram

Field	Description	Position
dd	Index of the transponder.	1-2
c	Space.	3
d	Transducer number (Always 1).	4
cc	Spaces.	5-6
c	Beam used (Always W).	7
cc	Spaces.	8-9
ccc	Reply status. OK=Good position. NRY=No reply.	10-12
c	Space.	13

Table F–18 Field Description for the HPR 300P Telegram (continued)

Field	Description	Position
dddd.d	Vessel course 0-359.9 (degrees).	14-19
c	Space.	20
dddd.d	X Coordinate in metres.	21-26
c	Space.	27
dddd.d	Y Coordinate in meters.	28-33
c	Space.	34
dddd.d	Z Coordinate in metres or Depth.	35-40
c	Space.	41
ddd.d	QUA. Position quality.	42-46
cc	Spaces.	47-48
ccc	Riser angle status. Always NRY.	49-51
c	Space.	52
dddd.d	Riser X-angle or tilt with sign.	53-58
c	Space.	59
dddd.d	Riser Y-angle or azimuth with sign.	60-65
<CR>	Carriage return.	66
<LF>	Line feed.	67

Notes

- The co-ordinate frame for beacon position data is relative to the ship datum point.
 - Positive Y is forward
 - Positive X is starboard
 - Positive depth is down

Example

33 1 W OK 0 18.9 40.5 30.0 0.1 NRY 0.0 0.0<CR><LF>

F.16 PSONMEAS – Sonardyne Measurements Report

F.16.1 Description

This report is a custom sentence for outputting measurement data from peripheral sensors.

F.16.2 Format

\$PSONMEAS,hhmmss.ss,I,A,B,X.X,Y.Y,Z.Z*hh <CR><LF>

F.16.3 Field Description

Table F–19 Field Description for the PSONMEAS Format

Field	Description
\$PSONMEAS	Header.

Table F–19 Field Description for the PSONMEAS Format (continued)

Field	Description
hhmmss.ss	Valid time of the position.
I	Information source.
A	Name of Instrument Or Source.
B	Name sensor or Destination.
X.X	Data Field 1.
Y.Y	Data Field 2.
Z.Z	Data Field 3.
*hh	Check Sum.
<CR><LF>	Terminator - carriage return, line feed.

F.16.4 Definition of Field Names

Information Source

INCINT for Inclinator with Heading

INCEXT for Inclinator without Heading

DEPTH for depth sensor

TEMP for temperature sensor

RNG for range measurement

Table F–20 Format Data field 1, Data Field 2, Data Field 3 for PSONMEAS Format

	Data Field 1	Data Field 2	Data Field 3
INCINT	Grid Heading.	Roll	Pitch
INCEXT	0.00	Roll	Pitch
DEPTH	Depth.	0.00	0.00
TEMP	Temperature.	0.00	0.00
RNG	Distance in meters.	0.00	0.00

F.17 PSONLLD – Sonardyne Lat, Long, Depth Report

F.17.1 Description

This report is a custom sentence for outputting latitude, longitude and depth information.

F.17.2 Format

\$PSONLLD, hhmmss.sss, id, status, lat, long, depth, hor_err_major, hor_err_minor, hor_error_dir, depth_error, optional_spec, opt1, opt2, op3*hh<CR><LF>

F.17.3 Field Description

Table F–21 Field Description for the PSONLLD Format

Field	Description
\$PSONLLD	Header.
hhmmss.sss	Time of validity.
id	id of tracked object; in the case of a beacon, the beacon's Address.
status	A = valid, V = invalid.
lat	Latitude in decimal degrees, +ve value indicates North, -ve value indicates South.
long	Longitude in decimal degrees, +ve value indicates East, -ve value indicates West.
depth	Depth in metres, with respect to the water surface. +ve = down.
hor_err_major	Horizontal error ellipse major axis in metres (1 S.D.).
hor_err_minor	Horizontal error ellipse minor axis in metres (1 S.D.).
hor_err_dir	Direction of Horizontal error ellipse major axis in decimal degrees relative to true North.
depth_error	Depth error in metres (1 S.D.).
optional_spec	Optional fields specifier, a code denoting what the optional fields contain or blank for no optional data.
opt1	Optional field 1.
opt2	Optional field 2.
opt3	Optional field 3.
*hh	NMEA style checksum.
<CR><LF>	Carriage return & line feed.

F.18 PSONMRAMS – Sonardyne MRAMS Report

F.18.1 Description

The PSONMRAMS telegram is used for the exclusive transport of MRAMS data. The system sends this telegram each time it successfully measures the attitude of the BOP or Riser beacon.

This telegram has been designed to be independent of any position information, allowing the acoustic system to be used for measurement of MRAMS data without the requirement to be performing USBL positioning at the same time.

The maximum length of the telegram is 82 characters, including the start character <\$> and the termination characters <CR> and <LF>. However, the telegram will typically be less than this and will be of variable length, because leading zeros are suppressed.

F.18.2 Format

\$PSONMRAMS, hhmmss.ss, x.xx, x.xx, x.xx, x.xx, x.xx, x.xx, x.xx, x.xx, x.xx, xxx.xx*hh<CR><LF>

F.18.3 Field Description

Table F–22 Field Description for the NMEA PSONMRAMS Format

Field	Description
\$PSONMRAMS	Header (fixed).

Table F–22 Field Description for the NMEA PSONMRAMS Format (continued)

Field	Description
hhmmss.sss	The valid time of the contents. See Note 1.
x.xx	BOP Pitch (degrees). See Note 2.
x.xx	BOP Roll (degrees). See Note 3.
x.xx	BOP Age (seconds). See Note 4.
x.xx	Riser Pitch (degrees). See Note 5.
x.xx	Riser Roll (degrees). See Note 6.
x.xx	Riser Age (seconds). See Note 7.
x.xx	Differential Pitch (degrees). See Note 8.
x.xx	Differential Roll (degrees). See Note 9.
x.xx	Differential Tilt (degrees). See Note 10.
xxx.xx	Course to steer (degrees). See Note 11.
*hh	Checksum. See Note 12.
<CR><LF>	Termination.

Notes

1. The data in this telegram is only updated when pitch and roll is successfully received from either the BOP or Riser beacon. If the system is connected to a GNSS time source this will be UTC time.
2. BOP Pitch (degrees). The pitch angle of the BOP reported by the beacon attached to the BOP, corrected for any offsets. Sign convention: Bows up = +ve.
3. BOP Roll (degrees). The roll angle of the BOP reported by the beacon attached to the BOP, corrected for any offsets. Sign convention: Starboard down = +ve.
4. BOP Age (seconds). Riser and BOP data will be collected at different times although this telegram will be output when data is received from either. The BOP Age reports how old the BOP attitude is in seconds.
5. Riser Pitch (degrees) The pitch angle of the Riser reported by the beacon attached to the Riser, corrected for any offsets. Sign convention: Bows up = +ve.
6. Riser Roll (degrees). The roll angle of the Riser reported by the beacon attached to the Riser, corrected for any offsets. Sign convention: Starboard down = +ve.
7. Riser Age (seconds). Riser and BOP data will be collected at different times although this telegram will be output when data is received from either. The Riser Age reports how old the Riser attitude is in seconds.
8. Differential Pitch (degrees). The differential pitch angle of the BOP and Riser calculated from BOP and Riser Roll data. Sign convention: Bows up = +ve.
9. Differential Roll (degrees). The differential roll angle of the BOP and Riser calculated from BOP and Riser Roll data. Sign convention: Starboard down = +ve.
10. Differential Tilt (degrees) The included angle between the axis of the BOP stack and the Riser. Sign Convention: Zero represents Riser in line with BOP axis. All realistic angles will be positive.

11. Course to Steer (degrees). The true bearing of the course to be made good to minimise the differential tilt angle.
12. Checksum. The result of performing an exclusive OR on all bytes in the telegram up to but not including this byte.

Examples

\$PSONMRAMS,164324.801,0.26,-1.25,0.00,-0.67,0.49,24.83,-0.93,1.74,1.97,241.88*61

\$PSONMRAMS,164330.645,0.26,-1.25,5.89,-0.67,0.49,0.11,-0.93,1.74,1.97,241.88*53

\$PSONMRAMS,164359.864,0.26,-1.25,0.00,-0.67,0.49,29.33,-0.93,1.74,1.97,241.88*6E

\$PSONMRAMS,164405.707,0.26,-1.25,5.89,-0.67,0.49,0.11,-0.93,1.74,1.97,241.88*55

Appendix G – Alarms and Events

G.1 Alarms

G.1.1 System Manager

Table G–1 Alarm Details - System Manager

ID:	1000
Default Severity:	Critical
Summary:	"Security key authentication failed"
Description:	"The system was unable to detect a valid security key. Please ensure that a valid security key is fitted."
Solution URL:	"SolutionsSolution 1000.htm"
ID:	1001
Default Severity:	Critical
Summary:	"Failed to start 0 component(s)"
Description:	"System component(s) 0 could not be started within a timeout period of 1 second."
Solution URL:	"SolutionsSolution 1001.htm"
ID:	1002
Default Severity:	Critical
Summary:	"Unable to stop the System Manager"
Description:	"An unknown failure occurred at time 0, when trying to stop the SystemManager. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 1002.htm"
ID:	1003
Default Severity:	High
Summary:	"Job save failed. 0"
Description:	"The system was unable to save the job. It is advised that you restart the system. This will result in the last used job being reloaded."
Solution URL:	"SolutionsSolution 1003.htm"
ID:	1004
Default Severity:	High
Summary:	"Slave failure"
Description:	"Unable to communicate with the Slave system. Updates to the Slaves's job will not be possible."
Solution URL:	"SolutionsSolution 1004.htm"

Table G–1 Alarm Details - System Manager (continued)

ID:	1005
Default Severity:	High
Summary:	"Master failure - becoming Master"
Description:	"The Slave system is unable to detect the presence of a Master and will therefore take over as Master."
Solution URL:	"SolutionsSolution 1005.htm"
ID:	1006
Default Severity:	Critical
Summary:	"Attached security key has expired."
Description:	"The system was unable to detect a valid security key, as the security key found attached to the system has expired. Either ensure that a valid security key is fitted, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1006.htm"
ID:	1007
Default Severity:	High
Summary:	"Attached security key has less than 0 time left"
Description:	"The system found a valid security key attached, however there is only 0 left before it expires. Ensure that a valid security key is available to replace it, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1007.htm"
ID:	1008
Default Severity:	Critical
Summary:	"Attached security key has less than 0 time left"
Description:	"The system found a valid security key attached, however there is only 0 left before it expires. Ensure that a valid security key is available to replace it, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1008.htm"
ID:	1009
Default Severity:	Critical
Summary:	"Transceiver cross link failed"
Description:	"This is a Dual Redundant system which requires a cross-link cable between the local and remote transceiver. The local transceiver has failed to detect comms activity on the remote transceiver."
Solution URL:	"SolutionsSolution 1009.htm"
ID:	1010

Table G–1 Alarm Details - System Manager (continued)

Default Severity:	High
Summary:	"Unable to function as Master. The NSH or its instruments have failed."
Description:	"If this system was functioning as Master when the problem occurred, an attempt will be made to pass control to the Slave."
Solution URL:	"SolutionsSolution 1010.htm"
ID:	1011
Default Severity:	Critical
Summary:	"Communication failure between Master and Slave"
Description:	"The Master and Slave NAV PCs are unable to communicate over the Ethernet cross-link. The other system may be not running, or the ethernet cross link may have failed. The Master will not be able to update the Slave's job until the connection is restored."
Solution URL:	"SolutionsSolution 1011.htm"
ID:	1012
Default Severity:	Low
Summary:	"Job Save unable to log the current job state."
Description:	"The problem reported is not a critical problem, and one which has only been seen rarely. Please get a system support (CEF) file and sent to support@sonardyne.com to help us track down and fix this issue. (Further Info to check: 0)"
Solution URL:	"SolutionsSolution 1012.htm"
ID:	1013
Default Severity:	Critical
Summary:	"Attached security key time is later then current time"
Description:	"The system was unable to detect a valid security key, as the security key found attached to the system has a time stamp later than the current time. Either ensure that a valid security key is fitted, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1013.htm"
ID:	1014
Default Severity:	High
Summary:	"Attached security key has less than 1 day left"
Description:	"The system found a valid security key attached, however there is less than 1 day left before it expires. Ensure that a valid security key is available to replace it, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1014.htm"
ID:	1015
Default Severity:	Critical

Table G–1 Alarm Details - System Manager (continued)

Summary:	"Attached security key has less than 1 hour left"
Description:	"The system found a valid security key attached, however there is less than 1hour left before it expires. Ensure that a valid security key is available to replace it, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1015.htm"
ID:	1016
Default Severity:	Low
Summary:	"Attached security key has less than 0 time left"
Description:	"The system found a valid security key attached, however there is only 0 left before it expires. Ensure that a valid security key is available to replace it, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1016.htm"
ID:	1017
Default Severity:	Low
Summary:	"Attached security key has less than 5 days left"
Description:	"The system found a valid security key attached, however there is less than 5 days left before it expires. Ensure that a valid security key is available to replace it, or contact Support to remotely update the security key."
Solution URL:	"SolutionsSolution 1017.htm"

G.1.2 Device Manager

Table G–2 Alarm Details - Device Manager

ID:	2000
Default Severity:	Critical
Summary:	"Unable to start the DeviceManager system"
Description:	"An unknown failure occurred at time 0, when trying to start the DeviceManager System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 2000.htm"
ID:	2001
Default Severity:	Critical
Summary:	"Unable to stop the DeviceManager system"
Description:	"An unknown failure occurred at time 0, when trying to stop the DeviceManager System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 2001.htm"

Table G–2 Alarm Details - Device Manager (continued)

ID:	2100
Default Severity:	Critical
Summary:	"Connection to the device 0 has been lost"
Description:	"No data has been received by the device. Please check port settings, cabling and hardware."
Solution URL:	"SolutionsSolution 2100.htm"
ID:	2101
Default Severity:	Critical
Summary:	"Connection to the device 0 has been lost"
Description:	"No data has been received by the NSH. Please check the IP Address and port setting, cabling and hardware."
Solution URL:	"SolutionsSolution 2101.htm"
ID:	2102
Default Severity:	Critical
Summary:	"HDOP value for positioning device 0 indicates very bad positioning"
Description:	"GNSS HDOP value indicates very bad positioning - please check GNSS equipment."
Solution URL:	"SolutionsSolution 2102.htm"
ID:	2103
Default Severity:	Critical
Summary:	"0 has invalid firmware, requires V8.01 and above only"
Description:	"Transceiver firmware requires V8.01 and above - please install latest firmware."
Solution URL:	"SolutionsSolution 2103.htm"
ID:	2104
Default Severity:	Critical
Summary:	"0 has invalid address, check firmware is installed"
Description:	"Transceiver address is invalid - please check valid firmware is installed."
Solution URL:	"SolutionsSolution 2104.htm"
ID:	2105
Default Severity:	Critical
Summary:	"Input to device 0 indicates lack of GNSS aiding"
Description:	"To get best performance from an attitude sensor it needs GNSS aiding so that it can separate movement from roll and pitch. Please add GNSS aiding to this device."
Solution URL:	"SolutionsSolution 2105.htm"

Table G–2 Alarm Details - Device Manager (continued)

ID:	2106
Default Severity:	High
Summary:	"The Lodestar INS system is currently not time synchronised"
Description:	"Application should be time synchronised to allow the INS solution to function optimally."
Solution URL:	"SolutionsSolution 2106.htm"
ID:	2107
Default Severity:	Critical
Summary:	"NOT USED! Lodestar INS system failure"
Description:	"The Lodestar INS has indicated a system failure has occurred"
Solution URL:	"SolutionsSolution 2107.htm"
ID:	2108
Default Severity:	Critical
Summary:	"Phase calibration data span has exceeded 0 degrees"
Description:	"The transceiver has indicated that the phase calibration data span has exceeded 0 degrees. Span = 1. Please refer to the Transceiver Phase Calibration Tool for details concerning the exact receiver card(s) that failed."
Solution URL:	"SolutionsSolution 2108.htm"
ID:	2109
Default Severity:	Critical
Summary:	"Beacon 0 has an incompatible address"
Description:	"The system is configured to use pulse position angles, the address conflicts with this. Tracking will be impaired."
Solution URL:	"SolutionsSolution 2109.htm"
ID:	2110
Default Severity:	Critical
Summary:	"Telegram 0 stopped - error exceeds SD limit"
Description:	"Positions are not being sent because the SD of the position is beyond the configured limit. Raising the limit would allow the positions to be sent but the impact of low quality positions on the receiving system must first be considered."
Solution URL:	"SolutionsSolution 2110.htm"
ID:	2111
Default Severity:	Critical
Summary:	"The GNSS fix quality is unsuitable for navigation"
Description:	"The GNSS device is reporting the fix quality is unsuitable for navigation please check GNSS input."

Table G–2 Alarm Details - Device Manager (continued)

Solution URL:	"SolutionsSolution 2111.htm"
ID:	2112
Default Severity:	Critical
Summary:	"The Lodestar is not receiving a 1 PPS Signal"
Description:	"The Lodestar is not receiving a 1 PPS Signal, please check cabling and configuration."
Solution URL:	"SolutionsSolution 2112.htm"
ID:	2113
Default Severity:	Critical
Summary:	"Attitude device is not yet settled"
Description:	"The attitude device is currently unsettled, tracking whilst the device is in this state may lead to undesirable results."
Solution URL:	"SolutionsSolution 2113.htm"
ID:	2114
Default Severity:	High
Summary:	"Gyro Compatt attitude device is settling"
Description:	"The Gyro Compatt is currently settling, attitude observation will not be used."
Solution URL:	"SolutionsSolution 2114.htm"
ID:	2115
Default Severity:	Critical
Summary:	"Gyro Compatt attitude device is switched OFF"
Description:	"The Gyro Compatt is currently switched OFF, attitude collection cannot proceed. Enable the gyro via the beacon property 'Sensors' page."
Solution URL:	"SolutionsSolution 2115.htm"
ID:	2116
Default Severity:	Critical
Summary:	"0 unaided for more than 30 seconds"
Description:	"No aiding data has been sent for more than 30 seconds."
Solution URL:	"SolutionsSolution 2116.htm"
ID:	2117
Default Severity:	Critical
Summary:	"0 rejecting aiding for more than 30 seconds"
Description:	"All aiding data has been rejected for more than 30 seconds."

Table G–2 Alarm Details - Device Manager (continued)

Solution URL:	"SolutionsSolution 2117.htm"
ID:	2118
Default Severity:	Critical
Summary:	"Beacon 0 has been tilted more than 45 degrees. Maximum power will not be available."
Description:	"Ensure the beacon position is not tilted beyond 45 degrees if maximum power is required. If maximum power is required and it is necessary for operations to have the beacon tilted then the user will need to press the Override button - this will override the tilt flag and allow maximum power."
Solution URL:	"SolutionsSolution 2118.htm"
ID:	2119
Default Severity:	Critical
Summary:	"Beacon 0 is not set for navigation"
Description:	"The beacon navigation functionality is not enabled."
Solution URL:	"SolutionsSolution 2119.htm"
ID:	2120
Default Severity:	Critical
Summary:	"0 aiding data shows too few good acoustic samples."
Description:	"The acoustic observation data number of samples are below the minimum specified in the Lodestar configuration."
Solution URL:	"SolutionsSolution 2120.htm"
ID:	2121
Default Severity:	Critical
Summary:	"0 acoustic aiding limit exceeded."
Description:	"The acoustic observation data rejection value has exceeded the maximum specified in the Lodestar configuration."
Solution URL:	"SolutionsSolution 2121.htm"
ID:	2122
Default Severity:	Critical
Summary:	"0 acoustic quality (QJSum) limit exceeded."
Description:	"The acoustic observation quality indicator has exceeded the maximum specified in the Lodestar configuration."
Solution URL:	"SolutionsSolution 2122.htm"
ID:	2123
Default Severity:	Critical

Table G–2 Alarm Details - Device Manager (continued)

Summary:	"0 acoustic signal to noise ratio exceeded."
Description:	"The acoustic observation signal to noise ratio has exceeded the maximum specified in the Lodestar configuration."
Solution URL:	"SolutionsSolution 2123.htm"
ID:	2124
Default Severity:	Critical
Summary:	"0 signal level limit exceeded."
Description:	"The acoustic observation signal level has exceeded the maximum specified in the Lodestar configuration."
Solution URL:	"SolutionsSolution 2124.htm"
ID:	2126
Default Severity:	Critical
Summary:	"0 age of beacon position information has exceeded 180 seconds."
Description:	"The lodestar has not received PSONBCN messages for more than 180 seconds."
Solution URL:	"SolutionsSolution 2126.htm"
ID:	2127
Default Severity:	Critical
Summary:	"0 age of lever arm information has exceeded 180 seconds."
Description:	"The lodestar has not received PSONLVR messages for more than 180 seconds."
Solution URL:	"SolutionsSolution 2127.htm"
ID:	2128
Default Severity:	Critical
Summary:	"0 maximum horizontal distance has been exceeded."
Description:	"The horizontal distance to transponder depth ratio as specified in the Lodestar configuration has been exceeded."
Solution URL:	"SolutionsSolution 2128.htm"
ID:	2129
Default Severity:	Critical
Summary:	"0 Kalman sigma test failed."
Description:	"the current acoustic observations are failing to pass the Lodestar kalman sigma test criteria."
Solution URL:	"SolutionsSolution 2129.htm"
ID:	2130

Table G–2 Alarm Details - Device Manager (continued)

Default Severity:	Critical
Summary:	"0 Kalman filter is not using acoustic observations."
Description:	"The current acoustic observation are not being used be the Lodestar kalman filter."
Solution URL:	"SolutionsSolution 2130.htm"
ID:	2132
Default Severity:	Critical
Summary:	"Output Telegram 0 cannot sustain data rate"
Description:	"Output Telegram 0 cannot sustain the required data rate - Reduce the Telegram Spacing and increase the Baud Rate. Telegrams will be dropped until this is resolved"
Solution URL:	"SolutionsSolution 2132.htm"
ID:	2133
Default Severity:	High
Summary:	"External time synchronisation failed"
Description:	"NSH not externally time synchronised with the TOD. Please verify that you are correctly receiving the time of day telegrams in the comms viewer"
Solution URL:	"SolutionsSolution 2133.htm"
ID:	2134
Default Severity:	High
Summary:	"0 is reporting invalid blue data."
Description:	"The ERA device is reporting invalid data. Please check port settings, cabling and hardware."
Solution URL:	"SolutionsSolution 2134.htm"
ID:	2135
Default Severity:	High
Summary:	"0 is reporting invalid yellow data."
Description:	"The ERA device is reporting invalid data. Please check port settings, cabling and hardware."
Solution URL:	"SolutionsSolution 2135.htm"
ID:	2511
Default Severity:	Critical
Summary:	"0 position error greater than 5 metres"
Description:	"The position error being received has been greater than 5 metres for more than 5 seconds."
Solution URL:	"SolutionsSolution 2511.htm"

Table G–2 Alarm Details - Device Manager (continued)

ID:	2512
Default Severity:	Critical
Summary:	"0 position accuracy out of bounds"
Description:	"Lodestar AINS expected position error has reached defined upper limit (1km) and has reset itself automatically to protect integrity of the inertial solution"
Solution URL:	"SolutionsSolution 2512.htm"
ID:	2513
Default Severity:	Critical
Summary:	"0 depth error greater than 5 metres"
Description:	"The depth error being received has been greater 5 meters for more than 5 seconds."
Solution URL:	"SolutionsSolution 2513.htm"
ID:	2514
Default Severity:	Critical
Summary:	"Lodestar hardware error"
Description:	"The Lodestar has detected an IMU hardware error causing operation to halt or navigation solution to become unreliable"
Solution URL:	"SolutionsSolution 2514.htm"
ID:	2515
Default Severity:	Critical
Summary:	"Lodestar is not initialised"
Description:	"Lodestar is uninitialised. Time to settle can be set using the GC SETTLE command."
Solution URL:	"SolutionsSolution 2515.htm"
ID:	2516
Default Severity:	Critical
Summary:	"Lodestar orientation error"
Description:	"No initial orientation - AHRS unsettled."
Solution URL:	"SolutionsSolution 2516.htm"
ID:	2517
Default Severity:	Critical
Summary:	"Lodestar position error"
Description:	"No initial position has been available for the last 3 seconds."
Solution URL:	"SolutionsSolution 2517.htm"

Table G–2 Alarm Details - Device Manager (continued)

ID:	2518
Default Severity:	Critical
Summary:	"Lodestar horizontal position 1DRMS exceeds limit"
Description:	"Horizontal position 1DRMS > 1km for more than 5s - inertial solution will re-initialise."
Solution URL:	"SolutionsSolution 2518.htm"
ID:	2519
Default Severity:	Critical
Summary:	"Lodestar INS/AHRS heading error exceeds limit"
Description:	"INS and AHRS heading different by more than 2 degrees for more than 5 seconds."
Solution URL:	"SolutionsSolution 2519.htm"
ID:	2520
Default Severity:	Critical
Summary:	"Lodestar INS/AHRS attitude error exceeds limit"
Description:	"Lodestar INS and AHRS pitch and/or roll different by more than 0.2 degrees for more than 5 seconds."
Solution URL:	"SolutionsSolution 2520.htm"
ID:	2521
Default Severity:	Critical
Summary:	"Lodestar gyro error estimate exceeds limit"
Description:	"The AINS Kalman filter estimates gyro sensor errors. Estimate consistently exceeds 3 times its expected RMS value."
Solution URL:	"SolutionsSolution 2521.htm"
ID:	2522
Default Severity:	Critical
Summary:	"Lodestar accelerometer error estimate exceeds limit"
Description:	"The AINS Kalman filter estimates accelerometer sensor errors. Estimate consistently exceeds 3 times its expected RMS value."
Solution URL:	"SolutionsSolution 2522.htm"
ID:	2523
Default Severity:	Critical
Summary:	"Transceiver power output 1 problem"
Description:	"Transceiver power output 1 is not as set."
Solution URL:	"SolutionsSolution 2523.htm"

Table G–2 Alarm Details - Device Manager (continued)

ID:	2524
Default Severity:	Critical
Summary:	"Transceiver power output 1 has tripped"
Description:	"Transceiver power output 1 has tripped."
Solution URL:	"SolutionsSolution 2524.htm"
ID:	2525
Default Severity:	Critical
Summary:	"Transceiver power output 2 problem"
Description:	"Transceiver power output 2 is not as set."
Solution URL:	"SolutionsSolution 2525.htm"
ID:	2526
Default Severity:	Critical
Summary:	"Transceiver power output 2 has tripped"
Description:	"Transceiver power output 2 has tripped."
Solution URL:	"SolutionsSolution 2526.htm"
ID:	2527
Default Severity:	Critical
Summary:	"The PSU on 0 has failed at 48v"
Description:	"The PSU on the NSH has failed for 48v. If possible try and use a different voltage."
Solution URL:	"SolutionsSolution 2527.htm"
ID:	2528
Default Severity:	Critical
Summary:	"The PSU on 0 has failed at 24v"
Description:	"The PSU on the NSH has failed for 24v. If possible try and use a different voltage."
Solution URL:	"SolutionsSolution 2528.htm"
ID:	2529
Default Severity:	Critical
Summary:	"The PSU on 0 has failed at 5v"
Description:	"The PSU on the NSH has failed for 5v. If possible try and use a different voltage."
Solution URL:	"SolutionsSolution 2529.htm"
ID:	2530

Table G–2 Alarm Details - Device Manager (continued)

Default Severity:	Critical
Summary:	"The PSU on 0 has failed at 3v3"
Description:	"The PSU on the NSH has failed for 3v3. If possible try and use a different voltage."
Solution URL:	"SolutionsSolution 2530.htm"
ID:	2531
Default Severity:	Critical
Summary:	"0 has overheated"
Description:	"The NSH has overheated, please check the cooling fans and filters."
Solution URL:	"SolutionsSolution 2531.htm"
ID:	2533
Default Severity:	High
Summary:	"0"
Description:	"The received acoustic ranges are approaching the systems maximum range limit. Try increasing the range in the Environmental settings."
Solution URL:	"SolutionsSolution 2533.htm"
ID:	2534
Default Severity:	Critical
Summary:	"0 has invalid protocol version, requires 1.10 and above only"
Description:	"Transceiver requires protocol version 1.10 and above - please install latest firmware version."
Solution URL:	"SolutionsSolution 2534.htm"
ID:	2535
Default Severity:	Critical
Summary:	"0 has invalid firmware, requires 1.0.6.91 and above only"
Description:	"NSH firmware requires 1.0.6.91 and above - please install latest firmware."
Solution URL:	"SolutionsSolution 2535.htm"
ID:	2536
Default Severity:	Critical
Summary:	"0 has failed to send power through transceiver card 3"
Description:	"The NSH has failed to power the transceiver in slot 3."
Solution URL:	"SolutionsSolution 2532.htm"
ID:	2537

Table G–2 Alarm Details - Device Manager (continued)

Default Severity:	Critical
Summary:	"0 has failed to send power through transceiver card 4"
Description:	"The NSH has failed to power the transceiver in slot 4."
Solution URL:	"SolutionsSolution 2532.htm"
ID: 2538	
Default Severity:	Critical
Summary:	"0 has failed to send power through transceiver card 5"
Description:	"The NSH has failed to power the transceiver in slot 5."
Solution URL:	"SolutionsSolution 2532.htm"
ID: 2566	
Default Severity:	0
Summary:	"Vessel depth bias exceeded threshold"
Description:	"INS vessel depth bias can be reduced by either recalibrating the reference beacon array, or adjusting the mean sound speed."
Solution URL:	"SolutionsSolution 2566.htm"

G.1.3 Alarm Details - Scheduler

Table G–3 Alarm Details - Scheduler

ID:	3000
Default Severity:	Critical
Summary:	"Unable to start the Scheduler system"
Description:	"An unknown failure occurred at time 0, when trying to start the Scheduler System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 3000.htm"
ID: 3001	
Default Severity:	Critical
Summary:	"Unable to stop the Scheduler system"
Description:	"An unknown failure occurred at time 0, when trying to stop the Scheduler System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 3001.htm"
ID: 3002	
Default Severity:	High
Summary:	"The system cannot track: No interrogating transceiver"

Table G–3 Alarm Details - Scheduler (continued)

Description:	"Tracking is enabled, but the system cannot find a transceiver on an active vehicle that could be used to interrogate transponders from. Check a transceiver exists on an active vehicle, and that transceiver devices on active vehicles are working correctly."
Solution URL:	"SolutionsSolution 3002.htm"
ID:	3003
Default Severity:	High
Summary:	"The system cannot track: No receiving transceiver"
Description:	"Tracking is enabled, but the system cannot find a transceiver on an active vehicle that could be used to receive replies from beacons. Check a transceiver exists on an active vehicle, and that transceiver devices on active vehicles are working correctly."
Solution URL:	"SolutionsSolution 3003.htm"
ID:	3004
Default Severity:	High
Summary:	"The system cannot track: No beacons selected"
Description:	"Tracking is enabled, but the system cannot find a beacon to be tracked. Either enable a mobile beacon for tracking, or add one to the system."
Solution URL:	"SolutionsSolution 3004.htm"
ID:	3005
Default Severity:	High
Summary:	"Beacon 0 taken offline: No reply is being received"
Description:	"The system has not received a reply from Beacon 0 for some time. It has been taken offline to improve the update rate of other beacons."
Solution URL:	"SolutionsSolution 3005.htm"
ID:	3007
Default Severity:	High
Summary:	"System time synchronising"
Description:	"The systems internal time is still synchronising. If this alarm persists check the connection between the navigation PC and the NSH."
Solution URL:	"SolutionsSolution 3007.htm"
ID:	3008
Default Severity:	High
Summary:	"Common Interrogate Replies for beacons 0 are too close together"
Description:	"Signals from beacons 0 on a Common Interrogate are less than 1ms apart. Check the Travel Time display to diagnose the problem, and then adjust the beacon Turn Around Times (TAT) to resolve the issue"
Solution URL:	"SolutionsSolution 3008.htm"

G.1.4 Alarm Details - Tracker

Table G-4 Alarm Details - Tracker

ID:	4000
Default Severity:	Critical
Summary:	"Unable to start the Tracker system"
Description:	"An unknown failure occurred at time 0, when trying to start the Tracker System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 4000.htm"
ID:	4001
Default Severity:	Critical
Summary:	"Unable to stop the Tracker system"
Description:	"An unknown failure occurred at time 0, when trying to stop the Tracker System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 4001.htm"
ID:	4002
Default Severity:	Critical
Summary:	"No Heading data for 0 - attempting to compute heading"
Description:	"0 has a USBL Transceiver but does not have any Heading Data - If there are reference beacons, the system will compute heading, but if not this will result in incorrect tracking. Solution: Add a Heading Device to this vehicle, or fix a Heading device which is not working. Alternatively select Manual Heading for this vehicle."
Solution URL:	"SolutionsSolution 4002.htm"
ID:	4003
Default Severity:	High
Summary:	"No Pitch/Roll data for 0 - using USBL internal sensors"
Description:	"0 has a USBL Transceiver but does not have any Pitch/Roll Data - USBL Transceiver internal sensors will be used - this could result in degraded tracking. Solution: Add a Pitch/Roll Device to this vehicle, or fix a Pitch/Roll device which is not working."
Solution URL:	"SolutionsSolution 4003.htm"
ID:	4004
Default Severity:	Low
Summary:	"System is operating outside of its UTM Zone"
Description:	"System is operating outside of its UTM Zone - please reset geodesy or shutdown and restart the system."
Solution URL:	"SolutionsSolution 4004.htm"

Table G-4 Alarm Details - Tracker (continued)

ID:	4005
Default Severity:	Low
Summary:	"Ranging target is more than 0% beyond max. sound speed profile depth"
Description:	"The System is trying to obtain the Sound Velocity for a depth which is more than 0% greater than the maximum depth in the currently loaded Sound Velocity Profile - load a new profile which covers a greater depth."
Solution URL:	"SolutionsSolution 4005.htm"
ID:	4006
Default Severity:	Low
Summary:	"No Heading data for 0 - using best alternative: 1"
Description:	"The selected Heading sensor for 0 is not available - best alternative device 1 is being used."
Solution URL:	"SolutionsSolution 4006.htm"
ID:	4007
Default Severity:	Low
Summary:	"No Pitch/Roll data for 0 - using best alternative: 1"
Description:	"The selected Pitch/Roll sensor for 0 is not available - best alternative device 1 is being used."
Solution URL:	"SolutionsSolution 4007.htm"
ID:	4008
Default Severity:	High
Summary:	"0 has 1 2's watch circle"
Description:	" The target object 0 has 1 the watch circle surrounding 2 "
Solution URL:	"SolutionsSolution 4008.htm"
ID:	4009
Default Severity:	High
Summary:	"BOP to Riser angle has exceeded critical angle of 0. Its value is 1."
Description:	"BOP to Riser angle has exceeded the critical threshold of 0. Its value is 1."
Solution URL:	"SolutionsSolution 4009.htm"
ID:	4010
Default Severity:	High
Summary:	"0 does not support Wideband 2."

Table G–4 Alarm Details - Tracker (continued)

Description:	"0 does not support Wideband 2, support for this feature has been disabled. Any beacon with a Wideband 2 address will not be used for navigation."
Solution URL:	"SolutionsSolution 4010.htm"
ID:	4011
Default Severity:	High
Summary:	"MRAMS telemetry from Beacon 0 was not received"
Description:	"The system has requested the attitude of Beacon 0 but no reply was received or the reply was corrupted."
Solution URL:	"SolutionsSolution 4011.htm"
ID:	4012
Default Severity:	High
Summary:	"Riser Profiling telemetry from Beacon 0 was not received"
Description:	"The system has requested the Riser Profiling data from Beacon 0 but no reply was received or the reply was corrupted."
Solution URL:	"SolutionsSolution 4012.htm"
ID:	4014
Default Severity:	High
Summary:	"Riser angle at beacon 0 has exceeded 1"
Description:	"Riser angle at beacon 0 has exceeded the threshold of 1."
Solution URL:	"SolutionsSolution 4014.htm"
ID:	4015
Default Severity:	High
Summary:	"Beacon 0 has returned no data"
Description:	" Beacon 0 returned no data from at least 1 sensor."
Solution URL:	"SolutionsSolution 4015.htm"
ID:	4016
Default Severity:	High
Summary:	"0 does not support HPR 300 Channels."
Description:	"0 is a 6G device and does not support navigation using HPR300 channels, these beacons will be taken offline."
Solution URL:	"SolutionsSolution 4016.htm"
ID:	4017
Default Severity:	High

Table G–4 Alarm Details - Tracker (continued)

Summary:	"No Pitch/Roll data for 0 - using 0.0"
Description:	"0 has a USBL Transceiver but does not have any Pitch/Roll Data - 0.0 will be used - this could result in degraded tracking. Solution: Add a Pitch/Roll Device to this vehicle, or fix a Pitch/Roll device which is not working."
Solution URL:	"SolutionsSolution 4017.htm"
ID:	4018
Default Severity:	High
Summary:	"Beacon 0's tilt has exceeded the delta angle 1. It is currently 2"
Description:	"Beacon 0's tilt has exceeded the Beacon Sensor Monitoring delta angle of 1. It is currently 2"
Solution URL:	"SolutionsSolution 4018.htm"
ID:	4019
Default Severity:	High
Summary:	"Beacon 0's depth has exceeded the delta depth 1. It is currently 2"
Description:	"Beacon 0's depth has exceeded the Beacon Sensor Monitoring delta depth of 1. It is currently 2"
Solution URL:	"SolutionsSolution 4019.htm"
ID:	4020
Default Severity:	High
Summary:	"Beacon 0's temperature has exceeded the delta temperature 1. It is currently 2"
Description:	"Beacon 0's temperature has exceeded the Beacon Sensor Monitoring delta temperature of 1. It is currently 2"
Solution URL:	"SolutionsSolution 4020.htm"
ID:	4021
Default Severity:	High
Summary:	"Beacon 0's sound speed has exceeded the delta sound speed 1. It is currently 2"
Description:	"Beacon 0's speed has exceeded the Beacon Sensor Monitoring delta sound speed of 1. It is currently 2"
Solution URL:	"SolutionsSolution 4021.htm"
ID:	4022
Default Severity:	High
Summary:	"Beacon Sensor Monitoring telemetry from Beacon 0 was not received"
Description:	"The system has requested the Beacon Sensor Monitoring data from Beacon 0 but no reply was received or the reply was corrupted."
Solution URL:	"SolutionsSolution 4022.htm"

Table G–4 Alarm Details - Tracker (continued)

ID:	4024
Default Severity:	Low
Summary:	"No Heading data for 0 - using Computed Heading"
Description:	"0 has a USBL Transceiver but does not have any Heading Data - As there are 2 or more reference beacons, the Heading will be Computed"
Solution URL:	"SolutionsSolution 4024.htm"
ID:	4025
Default Severity:	High
Summary:	"BOP to Riser angle has exceeded warning angle of 0. Its value is 1."
Description:	"BOP to Riser angle has exceeded the warning threshold of 0. Its value is 1."
Solution URL:	"SolutionsSolution 4025.htm"
ID:	4026
Default Severity:	Low
Summary:	"Environmental settings: No GNSS available for latitude"
Description:	"Pressure to Depth: The option "Use GNSS" in the Toolwindow requires an operational GNSS in the job."
Solution URL:	"SolutionsSolution 4026.htm"
ID:	4027
Default Severity:	Low
Summary:	"GyroCompatt 0 is not enabled for Sensor Monitoring"
Description:	"GyroCompatt 0 is not enabled for Sensor Monitoring. Sensor measurements should be enabled as heading sensor observations are required for vehicle tracking."
Solution URL:	"SolutionsSolution 4027.htm"
ID:	4999
Default Severity:	Critical
Summary:	"Dummy Alarm to silence all lesser alarms"
Description:	"None"
Solution URL:	"http://www.sonardyne.co.uk"

G.1.5 Alarm Details - Logger

Table G–5 Alarm Details - Logger

ID:	5000
Default Severity:	Low
Summary:	"Available disk space is less than minimum threshold (0)"

Table G–5 Alarm Details - Logger (continued)

Description:	"Monitored disk drive 0 has been detected at time 1, to have less space than the minimum threshold (2). It is recommended to perform any manual housekeeping activities on drive 0 to free any disk space."
Solution URL:	"SolutionsSolution 5000.htm"
ID:	5001
Default Severity:	High
Summary:	"Available disk space is less than warning threshold (0)"
Description:	"Monitored disk drive 0 has been detected at time 1, to have less space than the warning threshold (2). The system will attempt to perform adhoc automated housekeeping on drive 0, to free some disk space. Any additional housekeeping activities that can be performed on drive 0 to free any disk space are recommended."
Solution URL:	"SolutionsSolution 5001.htm"
ID:	5002
Default Severity:	Critical
Summary:	"Available disk space is less than critical threshold (0)"
Description:	"Monitored disk drive 0 has been detected at time 1, to have less space than the critical threshold (2). The system will attempt to perform adhoc automated housekeeping on drive 0, to free some disk space, however will no longer log any Data until this alarm has been cleared. Any additional housekeeping activities that can be performed on drive 0 to free any disk space are recommended."
Solution URL:	"SolutionsSolution 5002.htm"
ID:	5003
Default Severity:	Critical
Summary:	"Log File Update Failed"
Description:	"Error occurred updating current Active log file 0. It is recommended to save the job and then shutdown the system, and then restart. If the problem persists, then try creating a new job should resolve the issue."
Solution URL:	"SolutionsSolution 5003.htm"
ID:	5004
Default Severity:	Critical
Summary:	"Initialising Logger Failed"
Description:	"Error occurred initialising Logger using current Active log file 0. It is recommended to save the job and then shutdown the system, and then to restart the application. If the problem persists, then try recreating a new job should resolve the issue."
Solution URL:	"SolutionsSolution 5004.htm"
ID:	5005

Table G–5 Alarm Details - Logger (continued)

Default Severity:	Critical
Summary:	"Log File Connection Failed"
Description:	"Error occurred connecting to current Active log file 0, using connection string 1. It is recommended that you verify that the Server name in the Options Logger setting is correct, and that SQL Server service is running. After making any changes shutdown the system, and then restart. If the problem persists, then try recreating a new job should resolve the issue."
Solution URL:	"SolutionsSolution 5005.htm"
ID:	5006
Default Severity:	Critical
Summary:	"Creating New Log Repository File Failed"
Description:	"Error occurred during creating new Log repository 0, using connection string 1. It is recommended that you use the Logging UI found under menus Tools->Maintenance, to create a new repository, and select to use this for logging."
Solution URL:	"SolutionsSolution 5006.htm"
ID:	5007
Default Severity:	Critical
Summary:	"Attempting to Log 0 with invalid SourceUID"
Description:	"Attempting to log 0 data with an unset SourceUID, which is invalid and will cause a batch update exception to occur. To prevent this exception, this value is being set to zero. This error should only be seen by development systems, and it's recommended that the developer logging this data needs to be informed, that the SourceUID value is set correctly."
Solution URL:	"SolutionsSolution 5007.htm"
ID:	5008
Default Severity:	High
Summary:	"0 Log File Batch Update Failed"
Description:	"Error occurred updating current Active log file 0, with invalid data in batch update of table 1. This will not prevent the system from tracking, however it is recommended that you export a Sonardyne support file, and send this to support@sonardyne.com."
Solution URL:	"SolutionsSolution 5008.htm"
ID:	5009
Default Severity:	High
Summary:	"0 Log data bounds check failed"
Description:	"Bounds checking error occurred with invalid data found for table 0, the variables failing bounds checking being 1. This will not prevent the system from tracking or logging, however it is recommended that you export a Sonardyne support file, and send this to support@sonardyne.com."

Table G–5 Alarm Details - Logger (continued)

Solution URL:	"SolutionsSolution 5009.htm"
ID:	5010
Default Severity:	High
Summary:	"Job file Logging failed"
Description:	"A problem was experienced when the system attempted to log the Job file. Further information: 0. This may not prevent the system from tracking, however it is recommended that you export a Sonardyne support file, and send this to support@sonardyne.com should you be having a logging problem."
Solution URL:	"SolutionsSolution 5010.htm"
ID:	5011
Default Severity:	Critical
Summary:	"Stopped Logging Data"
Description:	"The system has stopped logging data, after passing the critical disk space threshold on the monitored disk drive 0. The system will no longer log any Data until this alarm has been cleared. Please perform manual housekeeping to free as much disk space on drive 0 as possible, including emptying the Recycle Bin, to increase the free disk space above the disk space thresholds."
Solution URL:	"SolutionsSolution 5011.htm"

G.1.6 Alarm Details - Main UI

Table G–6 Alarm Details - Main UI

ID:	6000
Default Severity:	Critical
Summary:	"Unable to start the MainUI system"
Description:	"An unknown failure occurred at time 0, when trying to start the MainUI System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 6000.htm"
ID:	6001
Default Severity:	Critical
Summary:	"Unable to stop the MainUI system"
Description:	"An unknown failure occurred at time 0, when trying to stop the MainUI System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 6001.htm"

G.1.7 Alarm Details - Application Main

Table G-7 Alarm Details - Application Main

ID:	7000
Default Severity:	Critical
Summary:	"Unable to start the ApplicationMain system"
Description:	"An unknown failure occurred at time 0, when trying to start the ApplicationMain System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 7000.htm"
ID:	7001
Default Severity:	Critical
Summary:	"Unable to stop the ApplicationMain system"
Description:	"An unknown failure occurred at time 0, when trying to stop the ApplicationMain System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 7001.htm"
ID:	7999
Default Severity:	Critical
Summary:	"Dummy Alarm to silence all lesser alarms"
Description:	"None"
Solution URL:	"http://www.sonardyne.co.uk"

G.1.8 Alarm Details – Main UI

Table G-8 Alarm Details – Main UI

ID:	8000
Default Severity:	Critical
Summary:	"Unable to start the Remote Control system"
Description:	"An unknown failure occurred at time 0, when trying to start the Remote Control System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 8000.htm"
ID:	8001
Default Severity:	Critical
Summary:	"Unable to stop the Remote Control system"
Description:	"An unknown failure occurred at time 0, when trying to stop the Remote Control System. Please verify that the application was installed correctly using the installer, and if not please re-install the Software."
Solution URL:	"SolutionsSolution 8001.htm"

G.2 Events

G.2.1 System Manager

Table G–9 Event Details - System Manager

ID:	10000
Type:	SystemInformation
Msg:	"All system components started."
Show In MiniView:	"True"
ID:	10001
Type:	DebugTrace
Msg:	"0 successfully started."
ID:	10002
Type:	SystemInformation
Msg:	"0 no longer available."
ID:	10003
Type:	UserTransaction
Msg:	"Last job not loaded because user held CONTROL+SHIFT keys down."
ID:	10004
Type:	UserTransaction
Msg:	"Job not automatically saved during shutdown because user held CONTROL+SHIFT keys down."
ID:	10005
Type:	SystemInformation
Msg:	"Automatically loaded last used job: 0"
ID:	10006
Type:	SystemWarning
Msg:	"Unable to save the job due to a problem in component: 0"
Show In MiniView:	"True"
ID:	10007
Type:	SystemWarning
Msg:	"Unable to access Security Key - Please restart system"
Show In MiniView:	"True"

Table G–9 Event Details - System Manager (continued)

ID:	10008
Type:	SystemInformation
Msg:	"Created new job 0 from current template"
ID:	10009
Type:	SystemInformation
Msg:	"Saved job template data"
ID:	10010
Type:	SystemInformation
Msg:	"Job 0 Closed"
ID:	10011
Type:	SystemInformation
Msg:	"Created new blank job 0"
ID:	10012
Type:	SystemInformation
Msg:	"Loaded Job 0 and updated with job template settings"
ID:	10013
Type:	SystemWarning
Msg:	"Job file : 0 is corrupted. No backup found."
Show In MiniView:	"True"
ID:	10014
Type:	SystemWarning
Msg:	"Job file : 0 is corrupted. The backup job was loaded instead."
Show In MiniView:	"True"
ID:	10015
Type:	SystemWarning
Msg:	"Job file : 0 is corrupted. No backup found."
Show In MiniView:	"True"
ID:	10016
Type:	SystemWarning
Msg:	"Job file : 0 is corrupted. Replaced with backup job."

Table G–9 Event Details - System Manager (continued)

Show In MiniView:	"True"
ID:	10017
Type:	DebugTrace
Msg:	"Adhoc dongle check initiated"
ID:	10018
Type:	DebugTrace
Msg:	"Initiated adhoc dongle check - found a 0 dongle."
ID:	10019
Type:	DebugTrace
Msg:	"Periodic dongle check initiated"
ID:	10020
Type:	DebugTrace
Msg:	"Initiated periodic dongle check - found a 0 dongle"
ID:	10021
Type:	SystemInformation
Msg:	"Found uninitialised 0 1 security key has been activated."
ID:	10022
Type:	SystemInformation
Msg:	"User: 0 selected Become Master"
ID:	10023
Type:	SystemInformation
Msg:	"Received "Become Master" request from Slave system (0)."
Show In MiniView:	"True"
ID:	10024
Type:	SystemInformation
Msg:	"Remote System (0): Master-Slave state changed from 1 to 2."
Show In MiniView:	"True"
ID:	10025
Type:	SystemInformation

Table G–9 Event Details - System Manager (continued)

Msg:	"Local System (0) Master-Slave state changed from 1 to 2."
Show In MiniView:	"True"
ID:	10026
Type:	DebugTrace
Msg:	"Job Save failure, with exception: 0."
ID:	10027
Type:	DebugTrace
Msg:	"Failure to set security of Job file after save, with exception: 0."
ID:	10029
Type:	DebugTrace
Msg:	"Job Saved Successfully to 0"

G.2.2 Event Details - Device Manager

Table G–10 Event Details - Device Manager

ID:	20000
Type:	DebugTrace
Msg:	"0 Device UID:1 has been created ok"
ID:	20002
Type:	SystemWarning
Msg:	"0 2Hz data rate is below minimum of 1Hz."
Show In MiniView:	"True"
ID:	20004
Type:	DebugTrace
Msg:	"0 Initialisation ok"
ID:	20005
Type:	SystemWarning
Msg:	"0 Baud rate change failed"
Show In MiniView:	"True"
ID:	20006
Type:	SystemWarning
Msg:	"0 Calibration command failed"

Table G–10 Event Details - Device Manager (continued)

Show In MiniView:	"True"
ID:	20007
Type:	DebugTrace
Msg:	"0 Calibration command ok for frequency 1Hz"
ID:	20009
Type:	DebugTrace
Msg:	"0 Attitude command failed"
Show In MiniView:	"True"
ID:	20010
Type:	DebugTrace
Msg:	"0 Noise monitor command failed"
Show In MiniView:	"True"
ID:	20011
Type:	DebugTrace
Msg:	"0 Unable to send command"
ID:	20012
Type:	DebugTrace
Msg:	"0 Not initialised. Unable to send command"
Show In MiniView:	"True"
ID:	20013
Type:	DebugTrace
Msg:	"0 Phase calibration out of range"
Show In MiniView:	"True"
ID:	20014
Type:	DebugTrace
Msg:	"0 Failed to send telemetry"
Show In MiniView:	"True"
ID:	20015
Type:	DebugTrace
Msg:	"0 Getting serial number"

Table G–10 Event Details - Device Manager (continued)

Show In MiniView:	"True"
ID:	20016
Type:	DebugTrace
Msg:	"0 Setting address to 1"
Show In MiniView:	"True"
ID:	20017
Type:	DebugTrace
Msg:	"0 Address command ok"
ID:	20018
Type:	DebugTrace
Msg:	"0 Address command failed"
Show In MiniView:	"True"
ID:	20019
Type:	DebugTrace
Msg:	"0 Authenticating"
ID:	20020
Type:	DebugTrace
Msg:	"0 Authentication ok"
ID:	20021
Type:	DebugTrace
Msg:	"0 Authentication failed"
Show In MiniView:	"True"
ID:	20022
Type:	DebugTrace
Msg:	"0 Setting Baud rate to 1"
Show In MiniView:	"True"
ID:	20024
Type:	DebugTrace
Msg:	"0 Device has connected ok"

Table G–10 Event Details - Device Manager (continued)

ID:	20025
Type:	SystemWarning
Msg:	"0 HDOP value of 1 indicates low quality"
Show In MiniView:	"True"
ID:	20026
Type:	SystemWarning
Msg:	"0 Quality indicator changed from: 1 to 2"
Show In MiniView:	"True"
ID:	20028
Type:	SystemWarning
Msg:	"0 Is currently aided by 1"
Show In MiniView:	"True"
ID:	20030
Type:	DebugTrace
Msg:	"0 Auto gain initialising to maximum."
ID:	20031
Type:	DebugTrace
Msg:	"0 Beacon 1 no signal, increasing gain to 2"
ID:	20032
Type:	DebugTrace
Msg:	"0 Beacon 1 signal 2dBV, auto setting gain to 3"
ID:	20033
Type:	DebugTrace
Msg:	"0 Cannot connect. No security key found."
Show In MiniView:	"True"
ID:	20034
Type:	AcousticInformation
Msg:	"0 [Signal Diags] Total RMS noise calculated at 1dB."
ID:	20036
Type:	DebugTrace

Table G–10 Event Details - Device Manager (continued)

Msg:	"0 Status flag changed to 1"
ID:	20037
Type:	DebugTrace
Msg:	"0 Pre-emption time less than 50ms [Current = 1][Requested = 2]"
ID:	20038
Type:	DebugTrace
Msg:	"0 Pulse Position Pitch is 1 Roll is 2"
ID:	20039
Type:	DebugTrace
Msg:	"0 Phase calibration data span > 1 degrees."
Show In MiniView:	"True"
ID:	20040
Type:	DebugTrace
Msg:	"0 HPT Transceiver Baud rate change ok: 1 to 2."
ID:	20041
Type:	DebugTrace
Msg:	"0 HPT Transceiver Baud rate change failed: 1 to 2."
Show In MiniView:	"True"
ID:	20042
Type:	DebugTrace
Msg:	"0 Pulse Position depth calculated as 1m."
ID:	20043
Type:	DebugTrace
Msg:	"0 Pulse Position depth not received or negative."
Show In MiniView:	"True"
ID:	20044
Type:	DebugTrace
Msg:	"0 Broadcast event ID not found."
ID:	20045

Table G–10 Event Details - Device Manager (continued)

Type:	DebugTrace
Msg:	"0 Range rejected RT value of 1 ` acceptance level of 2"
Show In MiniView:	"True"
ID:	20046
Type:	DebugTrace
Msg:	"0 Range is being set to invalid"
Show In MiniView:	"True"
ID:	20047
Type:	DebugTrace
Msg:	"0 Direction information set to invalid"
Show In MiniView:	"True"
ID:	20049
Type:	SystemInformation
Msg:	"0 Failed to get battery type"
Show In MiniView:	"True"
ID:	20050
Type:	DebugTrace
Msg:	"0 Cannot Transmit, must be a Slave"
ID:	20051
Type:	DebugTrace
Msg:	"0 DiagnosticCommand: 1"
ID:	20052
Type:	DebugTrace
Msg:	"0 Rx attenuation 1dB not supported. Maximum value is 2dB"
ID:	20053
Type:	DebugTrace
Msg:	"0 Range rejected 1 samples 2 or more required."
Show In MiniView:	"True"
ID:	20054
Type:	DebugTrace

Table G–10 Event Details - Device Manager (continued)

Msg:	"0 Range set to invalid."
Show In MiniView:	"True"
ID:	20055
Type:	DebugTrace
Msg:	"0 Setting direction information to invalid."
ID:	20056
Type:	DebugTrace
Msg:	"0 MasterAcoustics : 1"
ID:	20057
Type:	DebugTrace
Msg:	"0 TransceiverLPT : 1"
ID:	20058
Type:	DebugTrace
Msg:	"0 Unknown HPT protocol version"
ID:	20059
Type:	DebugTrace
Msg:	"0 Range recovery failed"
Show In MiniView:	"True"
ID:	20060
Type:	DebugTrace
Msg:	"0 Range reply failed"
Show In MiniView:	"True"
ID:	20061
Type:	DebugTrace
Msg:	"0 Checksum failure on command 1"
Show In MiniView:	"True"
ID:	20063
Type:	DebugTrace
Msg:	"0 TransceiverGDT 1"

Table G–10 Event Details - Device Manager (continued)

ID:	20064
Type:	DebugTrace
Msg:	"0 TransceiverHPT 1"
ID:	20065
Type:	DebugTrace
Msg:	"0 Lodestar AHRS is settling"
Show In MiniView:	"True"
ID:	20066
Type:	DebugTrace
Msg:	"0 Lodestar AHRS is settled"
Show In MiniView:	"True"
ID:	20067
Type:	DebugTrace
Msg:	"0 1 command timed out "
Show In MiniView:	"True"
ID:	20068
Type:	DebugTrace
Msg:	"0 Command decode failure"
Show In MiniView:	"True"
ID:	20069
Type:	DebugTrace
Msg:	"0 No reply"
Show In MiniView:	"True"
ID:	20070
Type:	DebugTrace
Msg:	"0 Telemetry errors in 0"
Show In MiniView:	"True"
ID:	20071
Type:	DebugTrace
Msg:	"0 Not initialised!"
Show In MiniView:	"True"

Table G–10 Event Details - Device Manager (continued)

ID:	20072
Type:	SystemInformation
Msg:	"0 Retrying command"
Show In MiniView:	"True"
ID:	20073
Type:	SystemInformation
Msg:	"0 is 1"
Show In MiniView:	"True"
ID:	20074
Type:	SystemInformation
Msg:	"0 Covert mode is 1"
Show In MiniView:	"True"
ID:	22527
Type:	SystemWarning
Msg:	"The PSU on 0 has failed at 48v 1"
ID:	22528
Type:	SystemWarning
Msg:	"The PSU on 0 has failed at 24v 1"
ID:	22529
Type:	SystemWarning
Msg:	"The PSU on 0 has failed at 5v 1"
ID:	22530
Type:	SystemWarning
Msg:	"The PSU on 0 has failed at 3v3 1"
ID:	22531
Type:	SystemWarning
Msg:	"0 has overheated 1"
ID:	22536
Type:	SystemWarning

Table G–10 Event Details - Device Manager (continued)

Msg:	"0 has failed to send power through transceiver card 3 1"
ID:	22537
Type:	SystemWarning
Msg:	"0 has failed to send power through transceiver card 4 1"
ID:	22538
Type:	SystemWarning
Msg:	"0 has failed to send power through transceiver card 5 1"
ID:	24000
Type:	SystemInformation
Msg:	"0 1"
ID:	24001
Type:	SystemInformation
Msg:	"0 Setting individual interrogate mode"
Show In MiniView:	"True"
ID:	24002
Type:	SystemInformation
Msg:	"0 Setting TAT to 1:F1ms"
Show In MiniView:	"True"
ID:	24003
Type:	SystemInformation
Msg:	"0 Setting range power to 1"
Show In MiniView:	"True"
ID:	24004
Type:	SystemInformation
Msg:	"0 Setting receive gain to 1"
Show In MiniView:	"True"
ID:	24005
Type:	SystemInformation
Msg:	"0 Setting responder mode On"
Show In MiniView:	"True"

Table G–10 Event Details - Device Manager (continued)

ID:	24006
Type:	SystemInformation
Msg:	"0 Setting responder mode Off"
Show In MiniView:	"True"
ID:	24007
Type:	SystemInformation
Msg:	"0 Setting Pulse Position Depth On"
Show In MiniView:	"True"
ID:	24008
Type:	SystemInformation
Msg:	"0 Setting Pulse Position Angles On"
Show In MiniView:	"True"
ID:	24009
Type:	SystemInformation
Msg:	"0 Setting Pulse Position mode Off"
Show In MiniView:	"True"
ID:	24010
Type:	SystemInformation
Msg:	"0 Setting telemetry wait to 1 seconds"
Show In MiniView:	"True"
ID:	24011
Type:	SystemInformation
Msg:	"0 Setting telemetry gain to 1"
Show In MiniView:	"True"
ID:	24012
Type:	SystemInformation
Msg:	"0 Setting telemetry power to 1"
Show In MiniView:	"True"
ID:	24013
Type:	SystemInformation

Table G–10 Event Details - Device Manager (continued)

Msg:	"0 Getting battery status"
Show In MiniView:	"True"
ID:	24014
Type:	SystemInformation
Msg:	"0 Getting fixed status"
Show In MiniView:	"True"
ID:	24015
Type:	SystemInformation
Msg:	"0 Setting release mode"
Show In MiniView:	"True"
ID:	24016
Type:	SystemInformation
Msg:	"0 Getting depth "
Show In MiniView:	"True"
ID:	24017
Type:	SystemInformation
Msg:	"0 Getting sound speed "
Show In MiniView:	"True"
ID:	24018
Type:	SystemInformation
Msg:	"0 Getting temperature "
Show In MiniView:	"True"
ID:	24019
Type:	SystemInformation
Msg:	"0 Setting blocking period to 1ms"
Show In MiniView:	"True"
ID:	24020
Type:	SystemInformation
Msg:	"0 Disabling"
Show In MiniView:	"True"

Table G–10 Event Details - Device Manager (continued)

ID:	24021
Type:	SystemInformation
Msg:	"0 Setting Common Interrogate mode"
Show In MiniView:	"True"
ID:	24022
Type:	SystemInformation
Msg:	"0 Setting TX telemetry to Fast"
Show In MiniView:	"True"
ID:	24023
Type:	SystemInformation
Msg:	"0 Setting TX telemetry to Normal"
Show In MiniView:	"True"
ID:	24024
Type:	SystemInformation
Msg:	"0 Setting TX telemetry to Slow"
Show In MiniView:	"True"
ID:	24025
Type:	SystemInformation
Msg:	"0 Setting TX telemetry to Wideband"
Show In MiniView:	"True"
ID:	24026
Type:	SystemInformation
Msg:	"0 Setting Individual Interrogate mode On"
Show In MiniView:	"True"
ID:	24027
Type:	SystemInformation
Msg:	"0 Setting HPR mode On"
Show In MiniView:	"True"
ID:	24028
Type:	SystemInformation
Msg:	"0 Setting wideband receiver On"

Table G–10 Event Details - Device Manager (continued)

Show In MiniView:	"True"
ID:	24029
Type:	SystemInformation
Msg:	"0 Getting sensor measurement"
Show In MiniView:	"True"
ID:	24030
Type:	SystemInformation
Msg:	"0 Setting Individual Interrogate mode"
Show In MiniView:	"True"
ID:	24031
Type:	SystemInformation
Msg:	"0 Setting battery override"
Show In MiniView:	"True"
ID:	24032
Type:	SystemInformation
Msg:	"0 Resetting to defaults"
Show In MiniView:	"True"
ID:	24033
Type:	SystemInformation
Msg:	"0 Getting beacon configuration"
Show In MiniView:	"True"
ID:	24034
Type:	SystemInformation
Msg:	"0 Getting user defaults"
Show In MiniView:	"True"
ID:	24035
Type:	SystemInformation
Msg:	"0 Setting user defaults"
Show In MiniView:	"True"
ID:	24036

Table G–10 Event Details - Device Manager (continued)

Type:	SystemInformation
Msg:	"0 Setting protocol reply format"
Show In MiniView:	"True"
ID:	24037
Type:	SystemInformation
Msg:	"0 Setting LBL wait to 1 seconds"
Show In MiniView:	"True"
ID:	24038
Type:	SystemInformation
Msg:	"0 Authentication phase 1"
Show In MiniView:	"True"
ID:	24039
Type:	SystemInformation
Msg:	"0 Authentication phase 2"
Show In MiniView:	"True"
ID:	24040
Type:	SystemInformation
Msg:	"0 Preparing navigation cycle"
Show In MiniView:	"True"
ID:	24041
Type:	SystemInformation
Msg:	"0 Starting navigation cycle"
Show In MiniView:	"True"
ID:	24042
Type:	SystemInformation
Msg:	"0 Setting TX telemetry to 1"
Show In MiniView:	"True"
ID:	24043
Type:	SystemInformation
Msg:	"0 Calibrating 1Hz"
Show In MiniView:	"True"

Table G–10 Event Details - Device Manager (continued)

ID:	24044
Type:	SystemInformation
Msg:	"0 Getting firmware version"
Show In MiniView:	"True"
ID:	24045
Type:	SystemInformation
Msg:	"0 Setting RX config for event 1"
Show In MiniView:	"True"
ID:	24046
Type:	SystemInformation
Msg:	"0 Setting TX config for event 1"
Show In MiniView:	"True"
ID:	24047
Type:	SystemInformation
Msg:	"0 Setting diagnostic mode On"
Show In MiniView:	"True"
ID:	24048
Type:	SystemInformation
Msg:	"0 Setting diagnostic mode Off"
Show In MiniView:	"True"
ID:	24049
Type:	SystemInformation
Msg:	"0 Getting noise measurement"
Show In MiniView:	"True"
ID:	24050
Type:	SystemInformation
Msg:	"0 Setting TX telemetry to Pulse Position"
Show In MiniView:	"True"
ID:	24051
Type:	SystemInformation

Table G–10 Event Details - Device Manager (continued)

Msg:	"0 Getting protocol version"
Show In MiniView:	"True"
ID:	24052
Type:	SystemInformation
Msg:	"0 Setting range reply mode to LBL"
Show In MiniView:	"True"
ID:	24053
Type:	SystemInformation
Msg:	"0 Setting range reply mode to USBL"
Show In MiniView:	"True"
ID:	24054
Type:	SystemInformation
Msg:	"0 Setting internal range calculation"
Show In MiniView:	"True"
ID:	24055
Type:	SystemInformation
Msg:	"0 Setting external range calculation"
Show In MiniView:	"True"
ID:	24056
Type:	SystemInformation
Msg:	"0 Reset communications link"
Show In MiniView:	"True"
ID:	24057
Type:	SystemInformation
Msg:	"0 Setting RX telemetry to 1"
Show In MiniView:	"True"
ID:	24058
Type:	SystemInformation
Msg:	"0 Release 1"
Show In MiniView:	"True"

Table G–10 Event Details - Device Manager (continued)

ID:	24059
Type:	SystemInformation
Msg:	"0 Getting sensor measurement"
Show In MiniView:	"True"
ID:	24060
Type:	SystemInformation
Msg:	"0 Setting common interrogate mode on 1"
Show In MiniView:	"True"
ID:	24061
Type:	SystemInformation
Msg:	"0 Release armed"
Show In MiniView:	"True"
ID:	24062
Type:	SystemInformation
Msg:	"0 Release activated"
Show In MiniView:	"True"
ID:	24063
Type:	SystemWarning
Msg:	"PTP offset of 0s has exceeded 1s limit"
Show In MiniView:	"True"
ID:	24064
Type:	SystemWarning
Msg:	"0 Discovering beacons"
Show In MiniView:	"True"
ID:	24065
Type:	SystemInformation
Msg:	"0 No release mechanism found!"
Show In MiniView:	"True"
ID:	24066
Type:	SystemInformation
Msg:	"0 Getting configuration"

Table G–10 Event Details - Device Manager (continued)

Show In MiniView:	"True"
ID:	24067
Type:	SystemInformation
Msg:	"0 Getting subscription configuration"
Show In MiniView:	"True"
ID:	24068
Type:	SystemInformation
Msg:	"0 Setting subscription configuration"
Show In MiniView:	"True"
ID:	24069
Type:	SystemInformation
Msg:	"0 Setting interrogation to navigation channel 1"
Show In MiniView:	"True"
ID:	24070
Type:	SystemInformation
Msg:	"0 Setting reply to navigation channel 1"
Show In MiniView:	"True"
ID:	24071
Type:	SystemInformation
Msg:	"0 sending 1 to 2"
Show In MiniView:	"True"
ID:	24072
Type:	SystemInformation
Msg:	"0 receiving 1 from 2"
Show In MiniView:	"True"
ID:	24073
Type:	SystemWarning
Msg:	"0 Failed changing to 1 "
Show In MiniView:	"True"
ID:	24074

Table G–10 Event Details - Device Manager (continued)

Type:	SystemInformation
Msg:	"0 Recovered reassigning beacons"
Show In MiniView:	"True"
ID:	25000
Type:	SystemInformation
Msg:	"0 1"
Show In MiniView:	"True"
ID:	25001
Type:	SystemWarning
Msg:	"0 1"
Show In MiniView:	"True"
ID:	27000
Type:	AcousticInformation
Msg:	"0 Starting acoustic event 1 at 2"
ID:	27008
Type:	AcousticInformation
Msg:	"0 Acoustic Diagnostics 1"
ID:	27009
Type:	SystemWarning
Msg:	"0 Lodestar sample count limit not achieved for beacon 1."
ID:	27010
Type:	SystemWarning
Msg:	"0 Lodestar is rejecting acoustics for beacon 1."
ID:	27011
Type:	SystemWarning
Msg:	"0 Lodestar QJSum limit exceeded for beacon 1."
ID:	27012
Type:	SystemWarning
Msg:	"0 Lodestar minimum SNR limit not achieved for beacon 1."

Table G–10 Event Details - Device Manager (continued)

ID:	27013
Type:	SystemWarning
Msg:	"0 Lodestar minimum signal level not achieved for beacon 1."
ID:	27014
Type:	SystemWarning
Msg:	"0 Lodestar was provided invalid Jx/Jy values for beacon 1."
ID:	27015
Type:	SystemWarning
Msg:	"0 Lodestar failed Kalman filter Sigma test for beacon 1."
ID:	27016
Type:	SystemWarning
Msg:	"0 Lodestar did not pass observation to Kalman filter for beacon 1"
ID:	27017
Type:	SystemWarning
Msg:	"0 Resetting after 1 phase calibrations with span > 30 degrees."
Show In MiniView:	"True"
ID:	27018
Type:	SystemWarning
Msg:	"0 No range received from 1"
Show In MiniView:	"True"
ID:	27019
Type:	SystemWarning
Msg:	"0 Getting time"
Show In MiniView:	"True"
ID:	28000
Type:	DebugTrace
Msg:	"DeviceManager requesting Job Save."

G.2.3 Event Details - Scheduler

Table G–11 Event Details - Scheduler

ID:	30000
------------	--------------

Table G–11 Event Details - Scheduler (continued)

Type:	SystemWarning
Msg:	"Failed to measure range between 0 and 1"
Show In MiniView:	"True"
ID:	30001
Type:	DebugTrace
Msg:	"Scheduler aborted acoustic cycle 0 (timed out on DeviceManager)"
ID:	30002
Type:	AcousticInformation
Msg:	"Valid Direct (0) TT:1 Kx:2 Ky:3 4 Signal"
ID:	30003
Type:	AcousticInformation
Msg:	"Invalid Direct (0) TT:1 Kx:2 Ky:3 4 Signal"
ID:	30004
Type:	AcousticInformation
Msg:	"Valid Indirect (0) TT:1 Kx:2 Ky:3 4 Signal"
ID:	30005
Type:	AcousticInformation
Msg:	"Invalid Indirect (0) TT:1 Kx:2 Ky:3 4 Signal"
ID:	30006
Type:	AcousticInformation
Msg:	"Invalid unknown (0) TT:1 Kx:2 Ky:3 4 Signal"
ID:	30007
Type:	SystemInformation
Msg:	"The scheduler is discarding the prediction to 0"
Show In MiniView:	"True"
ID:	30008
Type:	SystemWarning
Msg:	"There have been 0 consecutive no replies to Beacon 1."
Show In MiniView:	"True"

Table G–11 Event Details - Scheduler (continued)

ID:	30009
Type:	SystemWarning
Msg:	"Simulation has started."
ID:	30010
Type:	SystemWarning
Msg:	"Simulation has ended."
ID:	30011
Type:	DebugTrace
Msg:	"Acoustic cycle complete."
ID:	30012
Type:	SystemInformation
Msg:	"Too many beacons are on Common Interrogate Signal 0"
Show In MiniView:	"True"

G.2.4 Event Details - Tracker

Table G–12 Event Details - Tracker

ID:	40000
Type:	DebugTrace
Msg:	"Tracker failed to solve - Kalman Filter:0"
ID:	40001
Type:	DebugTrace
Msg:	"Kalman failed Chi-Squared Test - 0 : 1"
ID:	40002
Type:	DebugTrace
Msg:	"Tracker 0 Observation Rejected - Kalman Filter"
ID:	40003
Type:	DebugTrace
Msg:	"Tracker failed to solve - Least Squares Filter:0"
ID:	40004
Type:	SystemWarning
Msg:	"Range Rejected - Negative Range - 0"

Table G–12 Event Details - Tracker (continued)

Show In MiniView:	"True"
ID:	40005
Type:	DebugTrace
Msg:	"Least Squares failed to converge after 0 iterations"
ID:	40006
Type:	SystemInformation
Msg:	"Beacon 0 changed from 1 to 2"
ID:	40007
Type:	DebugTrace
Msg:	"Tracker Reseeded due to divergence - Kalman Filter:0 RF:1"
ID:	40008
Type:	DebugTrace
Msg:	"Tracker Reseeded due to Stability Period - Kalman Filter:0"
ID:	40009
Type:	DebugTrace
Msg:	"Tracker Reseeded due to Speed Threshold - Kalman Filter:0 RF:1"
ID:	40010
Type:	SystemWarning
Msg:	"Sensor Monitoring- No status received"
Show In MiniView:	"True"
ID:	40011
Type:	SystemWarning
Msg:	"Sensor Monitoring - Telemetry from beacon 0 to be retried."
Show In MiniView:	"True"
ID:	40012
Type:	SystemWarning
Msg:	"Sensor Monitoring - Sensor Error: 0 : 1 Observation Invalid or Old"
ID:	40013
Type:	AcousticInformation

Table G–12 Event Details - Tracker (continued)

Msg:	"Sensor Monitoring- Good Reply: 0"
ID:	40014
Type:	SystemWarning
Msg:	"Range Rejected - too few good samples - received: 0 good samples"
Show In MiniView:	"True"
ID:	40015
Type:	DebugTrace
Msg:	"Least Squares Reset - 0 Filter: 1"
ID:	40016
Type:	DebugTrace
Msg:	"0 Reseeded due to Unreasonable Values - 1 States:2"
ID:	40017
Type:	SystemWarning
Msg:	"0 taken offline, due to completion of array calibration"
Show In MiniView:	"True"
ID:	40018
Type:	DebugTrace
Msg:	"Tracker EnvironmentManager requesting Job Save."
ID:	40019
Type:	DebugTrace
Msg:	"Tracker ReferenceFrameManager requesting Job Save."
ID:	40020
Type:	SystemWarning
Msg:	"Output Telegram automatically disabled for 0. Beacon is fixed."
Show In MiniView:	"True"

G.2.5 Event Details - Logger

Table G–13 Event Details - Logger

ID:	50000
Type:	DebugTrace
Msg:	"Logger successfully started monitoring disk drive 0"

Table G–13 Event Details - Logger (continued)

ID:	50001
Type:	DebugTrace
Msg:	"Logger failed to start monitoring disk drive 0"
ID:	50002
Type:	DebugTrace
Msg:	"Logger successfully stopped monitoring disk drive 0"
ID:	50003
Type:	DebugTrace
Msg:	"Logger failed to stop monitoring disk drive 0"
ID:	50004
Type:	DebugTrace
Msg:	"Logger successfully started monitoring log repository 0"
ID:	50005
Type:	DebugTrace
Msg:	"Logger failed to start monitoring log repository 0"
ID:	50006
Type:	DebugTrace
Msg:	"Logger successfully stopped monitoring log repository 0"
ID:	50007
Type:	DebugTrace
Msg:	"Logger failed to stop monitoring log repository 0"
ID:	50008
Type:	DebugTrace
Msg:	"Logger created new log repository 0"
ID:	50009
Type:	DebugTrace
Msg:	"Logger failed to created new log repository"
ID:	50010

Table G–13 Event Details - Logger (continued)

Type:	DebugTrace
Msg:	"Logger started using new log repository 0"
ID:	50011
Type:	DebugTrace
Msg:	"Logger failed to start using new log repository 0"
ID:	50012
Type:	DebugTrace
Msg:	"Critical House keeping session started on drive 0"
ID:	50013
Type:	SystemWarning
Msg:	"Critical House keeping session completed on drive 0"
ID:	50014
Type:	DebugTrace
Msg:	"Adhoc House keeping session started"
ID:	50015
Type:	DebugTrace
Msg:	"Adhoc House keeping session completed"
ID:	50016
Type:	DebugTrace
Msg:	"Warning House keeping session started on drive 0"
ID:	50017
Type:	SystemWarning
Msg:	"Warning House keeping session completed on drive 0"
ID:	50018
Type:	DebugTrace
Msg:	"Manual house keeping required on drive 0 (drives free space < Minimum disk space threshold)"
ID:	50019
Type:	DebugTrace

Table G–13 Event Details - Logger (continued)

Msg:	"Free disk space on drive 0 is now greater than minimum disk space threshold"
ID:	50020
Type:	DebugTrace
Msg:	"House keeping required on drive 0 (drives free space < Warning disk space threshold)"
ID:	50021
Type:	DebugTrace
Msg:	"Free disk space on drive 0 is now greater than warning disk space threshold"
ID:	50022
Type:	DebugTrace
Msg:	"House keeping required on drive 0 (drives free space < Critical disk space threshold)"
ID:	50023
Type:	DebugTrace
Msg:	"Free disk space on drive 0 is now greater than critical disk space threshold"
ID:	50024
Type:	DebugTrace
Msg:	"Log file 0 is approaching enforced maximum size and is requesting a new log to be created."
ID:	50025
Type:	DebugTrace
Msg:	"Log file 0 has reached enforced maximum size and is requesting to switch to the new log file."
ID:	50026
Type:	DebugTrace
Msg:	"0 house keeping session has deleted 1 log files. (Deleted log files are 2)."
ID:	50027
Type:	DebugTrace
Msg:	"0 house keeping session has not offlined or deleted any log files."
ID:	50028
Type:	DebugTrace

Table G–13 Event Details - Logger (continued)

Msg:	"Closing job file and detaching log repository files."
ID:	50029
Type:	SystemWarning
Msg:	"Job '0' has been modified with its log files folder setting being updated. This may occur if the job has been copied or moved."
ID:	50030
Type:	SystemWarning
Msg:	"Unable to find log files 0 and 1 in folder 2."
ID:	50031
Type:	DebugTrace
Msg:	"Logger compressed closed log repository 0."
ID:	50032
Type:	DebugTrace
Msg:	"Logger successfully cancelled thread '0'."
ID:	50033
Type:	DebugTrace
Msg:	"Logger failed to cancel thread '0' within specified time."
ID:	50034
Type:	SystemWarning
Msg:	"Casius export timed-out whilst retrieving data leg (0 to 1)."
ID:	50035
Type:	DebugTrace
Msg:	"Next Repository Log file 0 cannot be found attached to server 1 - switching to next log file has been delayed."
ID:	50036
Type:	SystemWarning
Msg:	"Unable to find log file 0 in folder 1."
ID:	50037
Type:	DebugTrace

Table G–13 Event Details - Logger (continued)

Msg:	"Successfully deleted log file 0 in folder 1."
ID:	50038
Type:	DebugTrace
Msg:	"Unable to delete log file 0 in folder 1."
ID:	50039
Type:	DebugTrace
Msg:	"Starting to check for orphaned repositories left on the server."
ID:	50040
Type:	DebugTrace
Msg:	"Successfully detached orphaned repository 0 from server 1."
ID:	50041
Type:	DebugTrace
Msg:	"Unable to detach orphaned repository 0 from server 1."
ID:	50042
Type:	DebugTrace
Msg:	"Finished checking for orphaned repositories left on the server. (Removed 0 repositories)."
ID:	50043
Type:	DebugTrace
Msg:	"Timed 0 house keeping session started"
ID:	50044
Type:	DebugTrace
Msg:	"Timed 0 house keeping session completed"
ID:	50045
Type:	DebugTrace
Msg:	"No active data repository found in the job - logger will attempt to create it."
ID:	50046
Type:	DebugTrace
Msg:	"No active event repository found in the job therefore - logger will attempt to create it."

Table G–13 Event Details - Logger (continued)

ID:	50047
Type:	DebugTrace
Msg:	"No active calibration event repository found in the job - logger will attempt to create it."
ID:	50048
Type:	DebugTrace
Msg:	"Active repository found using old schema (0) - a new repository will be created (1)."
ID:	50049
Type:	SystemWarning
Msg:	"The logger has encountered a possible corrupted job file which it will attempt to recover from."
ID:	50050
Type:	SystemWarning
Msg:	"Unable to attach static repository(s) (0) to Server (1). Verify server is running, repositories exist, and are not compressed."
ID:	50051
Type:	SystemWarning
Msg:	"Unable to attach active repository(s) (0) to Server (1). Verify server is running, repositories exist, and are not compressed."
ID:	50052
Type:	SystemWarning
Msg:	"Unable to find active repository (0) - requesting new repository to be created."
ID:	50053
Type:	DebugTrace
Msg:	"0 House keeping session has offlined 1 log files. (Offlined log files are 2)."
ID:	50054
Type:	DebugTrace
Msg:	"Successfully offlined log file 0 in folder 1."
ID:	50055
Type:	DebugTrace
Msg:	"Unable to offline log file 0 in folder 1."

Table G–13 Event Details - Logger (continued)

ID:	50056
Type:	SystemWarning
Msg:	"Batched update of 0 data buffer failed, 1. To protect the system, buffered data has been deleted."
ID:	50057
Type:	DebugTrace
Msg:	"Successfully detached offlined log file 0 in folder 1."
ID:	50058
Type:	DebugTrace
Msg:	"Unable to detach offline log file 0 in folder 1."
ID:	50059
Type:	DebugTrace
Msg:	"0 House keeping session has detached 1 offline log files. (Detached offlined log files are 2)."
ID:	50060
Type:	DebugTrace
Msg:	"Offline repository(s) (0) unexpectedly found attached to Server (1). This may occur should a system be forcibly closed before a successful job save."
ID:	50061
Type:	DebugTrace
Msg:	"Exception caught in 0. Further Info: 1. Please check the debug event log for more information."
ID:	50062
Type:	DebugTrace
Msg:	"Asked to log an empty job file. Please check the debug event log for more information."
ID:	50063
Type:	DebugTrace
Msg:	"Logger Housekeeping requesting Job Save."
ID:	50064
Type:	DebugTrace

Table G–13 Event Details - Logger (continued)

Msg:	"Logger Admin requesting Job Save post creating new 0 repository."
ID:	50065
Type:	DebugTrace
Msg:	"Logger Admin requesting Job Save post switching to use new repository."
ID:	50066
Type:	DebugTrace
Msg:	"Logger Admin requesting Job Save post deleting repository 0."
ID:	50067
Type:	DebugTrace
Msg:	"Logger Admin requesting Job Save post offlining repository 0."
ID:	50068
Type:	DebugTrace
Msg:	"Logger Admin requesting Job Save post job load."
ID:	50069
Type:	DebugTrace
Msg:	"Logger Admin requesting Job Save post New Job finished load."
ID:	50070
Type:	DebugTrace
Msg:	"Logger Admin requesting Job Save post Job SaveAs."
ID:	50071
Type:	SystemWarning
Msg:	"Logging stopped due to Critical Disk Space Threshold has being passed on disk 0."
ID:	50072
Type:	SystemInformation
Msg:	"Logging restarted due to Critical Disk Space Theshold being cleared on disk 0."
ID:	50073
Type:	SystemWarning
Msg:	"Cannot create new 0 log repository because Logging has stopped due to Critical Disk Space Threshold alarm."

G.2.6 Event Details - Main UI

Table G–14 Event Details - Main UI

ID:	60000
Type:	SystemInformation
Msg:	"The MainUI system successfully started at time 0"
ID:	60001
Type:	SystemInformation
Msg:	"The MainUI system successfully stopped at time 0"
ID:	60002
Type:	UserTransaction
Msg:	""0" Object="1" OldValue="2" NewValue="3""
ID:	60003
Type:	UserTransaction
Msg:	""0" Object="1" Value="2""
ID:	60004
Type:	UserTransaction
Msg:	""0" Object="1""
ID:	60005
Type:	UserTransaction
Msg:	""0""

G.2.7 Event Details - Application Main

Table G–15 Event Details - Application Main

ID:	70000
Type:	SystemInformation
Msg:	"The ApplicationMain system successfully started at time 0"
ID:	70001
Type:	SystemInformation
Msg:	"The ApplicationMain system successfully stopped at time 0"

G.2.8 Event Details - Main UI

Table G–16 Event Details - Main UI

ID:	80000
Type:	SystemInformation
Msg:	"The Remote Control system successfully started at time 0"
ID:	80001
Type:	SystemInformation
Msg:	"The Remote Control system successfully stopped at time 0"
ID:	80002
Type:	UserTransaction
Msg:	"0"

Appendix H – Acoustic Positioning Methods

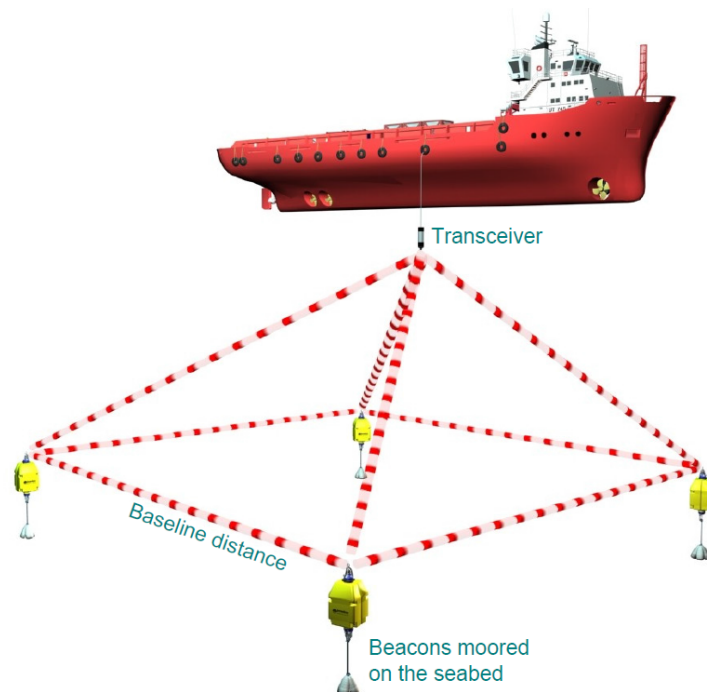
H.1 Long Baseline (LBL)

H.1.1 Hardware

A long baseline system has two parts or segments:

The first segment comprises a number of acoustic transponder beacons in an array moored in fixed positions on the seabed. The positions of the beacons are described in a co-ordinate frame fixed to the seabed. The straight-line distances between them form the ‘baselines’ used by the system.

Figure H–1 Typical LBL System



The second segment comprises an underwater acoustic transducer on a transceiver. The transceiver is usually installed on the vessel either in an over-the-side arrangement as shown in *Figure H–1*, or in a fixed through-the-hull arrangement. It can also be installed on a towfish if necessary.

H.1.2 Principles

The distance from the transducer to a transponder beacon can be measured by causing the transducer to transmit a short acoustic signal to which the transponder beacon responds.

The transceiver makes an accurate measurement of the interval between the instant when it transmits and the instant when it receives the transponder's response. Because the sound velocity in water is known at the location, it is possible to develop a good estimate of the range between the transceiver and the transponder beacon.

This measurement process is repeated for all the beacons in the array, and the position of the transceiver is then calculated or estimated relative to the array.

H.1.3 Beacon Numbers

In principle, navigation can be achieved using just two transponder beacons fixed to the seabed. However, with only two transponders, there would be ambiguity in the navigation solution because it

would not be possible to determine from the measurements which side of the baseline was the correct transceiver position.

Also, when using only two beacons, the depth of the transceiver (equivalent to the transceiver's 'height' above the beacons) must be assumed.

For these reasons, three beacons is the minimum that can be used to produce unambiguous results in three dimensions. The use of five beacons provides sufficient redundancy to allow erroneous measurements to be identified, and is useful for making checks on the quality of navigation.

H.1.4 Baseline Distance

The term 'long baseline' is used because, generally, the baseline distances are much greater for LBL than for short baseline (SBL), and it is certainly much longer than for ultra-short baseline (USBL).

The longer baselines used by LBL systems mean that LBL is more accurate than SBL and USBL. LBL also has the advantage of being able to position the vessel, or any other object, directly using a 'fixed' frame of reference. This removes most of the problems associated with vessel motion.

H.1.5 Calibration

It is necessary to calibrate the array of beacons on the seabed, and there are several techniques available for doing this. The most appropriate method to use depends on the specific requirements of the operation and on the available hardware.

With the continuing integration of LBL, SBL and USBL systems, intelligent transponder beacons that can measure baselines directly, and satellite navigation systems, the calibration of seabed arrays has become a quick and simple operation, completed automatically in some cases.

H.2 Short Baseline (SBL)

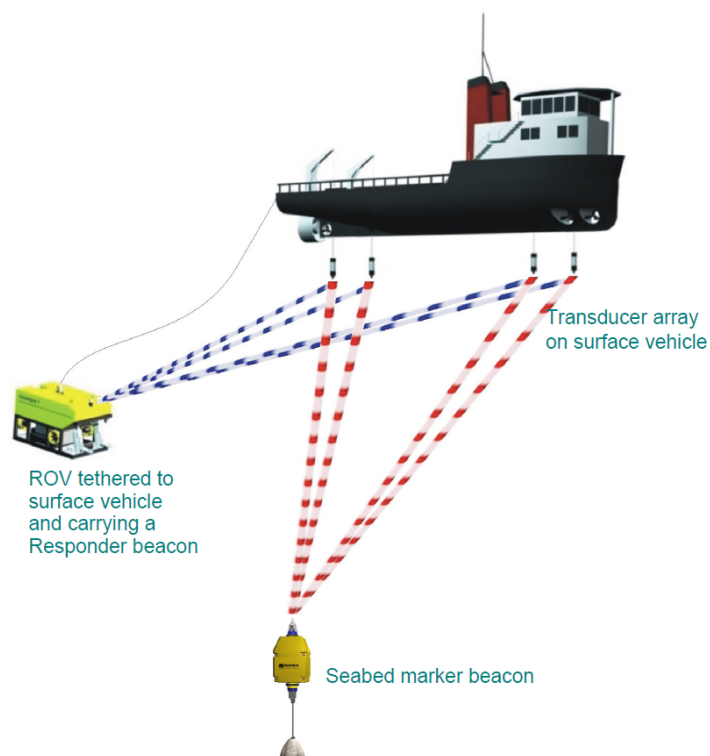
H.2.1 Hardware

Short baseline (SBL) acoustic position systems are usually fitted to a vessel such as a barge, a semi-submersible, or a large drilling vessel.

In an SBL system there are at least three, and typically four, acoustic transducers fitted in a triangular or rectangular array on the lower part of the vessel. The distances between transducers (the 'baselines') are made as large as practical on the vessel, and are typically at least 10 metres long.

The position of each transducer within a co-ordinate frame fixed to the vessel is determined by conventional survey techniques, or from the 'as built' survey of the vessel.

Figure H-2 Typical SBL System



H.2.2 Baseline Distances

The term 'short' is used as a comparison against long baseline techniques, where the baseline length usually exceeds 100 metres and can exceed 1000 metres.

If the distances from the transducers to an acoustic beacon are measured using the techniques described for LBL, then the beacon's position within the vessel's co-ordinate frame can be computed. Furthermore, if redundant measurements are made, a best estimated can be determined, which is statistically more accurate than the basic position calculation.

H.2.3 Principles

SBL systems transmit from one but receive on all transducers. The result is one distance (or range) measurement and a number of range (or time) differences.

With an SBL system the co-ordinate frame is fixed to the vessel, and is therefore subject to the rotational motions of roll, pitch and yaw. This apparent disadvantage can be overcome by using additional VRU and gyrocompass instruments, external to the SBL system, to supply measurements of roll, pitch and heading. The additional measurements allow the co-ordinates of the beacon to be transformed mathematically to remove the effects of these rotational motions.

If the requirement is to estimate the position of the vessel in some fixed or 'inertial' frame, such as one fixed to the seabed, then at least one beacon must be placed in a fixed position on the seabed and used as a reference point. This is the principle used for dynamic positioning vessels.

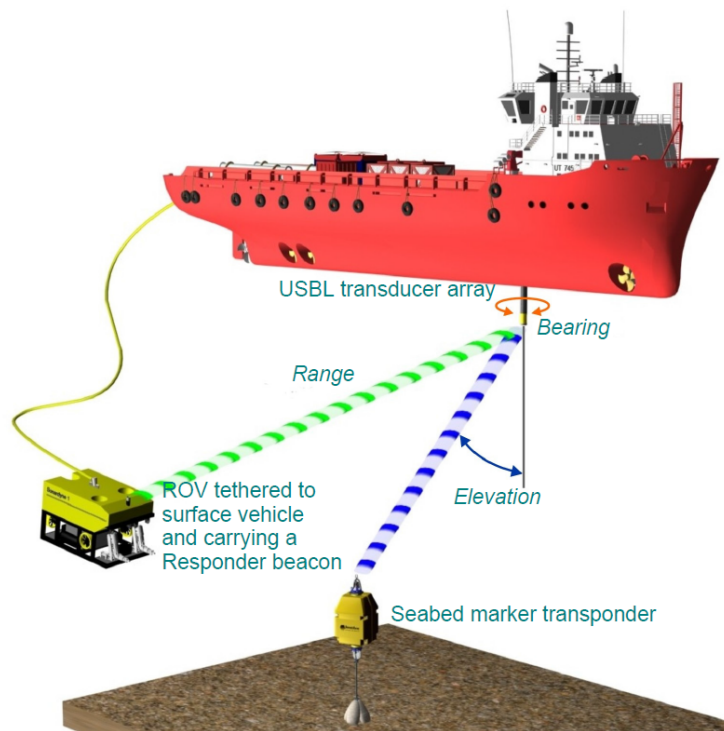
Figure H-2 shows an example of a system that has a transponder beacon fixed to the seabed and a responder beacon located on an ROV. In this case the system can calculate the position of the vessel and of the ROV within a reference frame fixed to the seabed.

H.3 Ultra-short Baseline (USBL)

H.3.1 Hardware

The principles of ultra-short baseline (USBL) position measurement are very similar to those of an SBL system already described. However, instead of the transducers being deployed at widely-spaced locations on the vessel, they are built into a single transceiver assembly.

Figure H-3 Typical USBL System



H.3.2 Principles

The distance or range measurement principles used in a USBL system are the same as those used for SBL, but the time differences between signal reception at the difference transducers are significantly less than for an SBL system.

Systems that use sinusoidal signals measure the time-phase of the signal received by each transducer element in the transceiver, and compare them with a reference signal generated in the receiver. These time-phase differences between transducer elements are computed by subtraction, and then the system is equivalent to an SBL system in the calculation of range and bearing.

Another practical difference is that the transducer elements of a USBL system are in a transceiver assembly that is installed at some convenient location in the vessel co-ordinate frame.

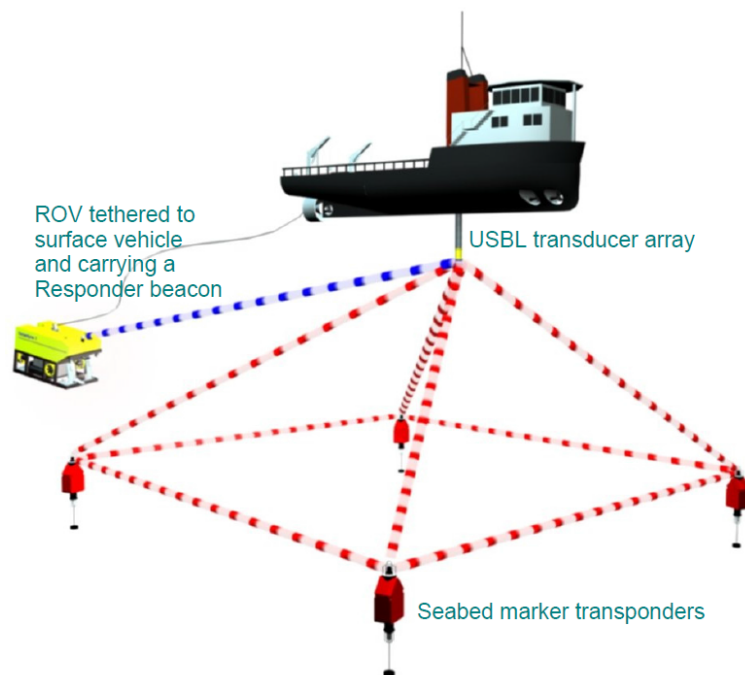
It is important to recognise that, whereas an SBL system calculates beacon positions in the vessel frame, a USBL system calculates beacon positions in a frame fixed to the transceiver assembly. To transform these positions into the vessel's co-ordinate frame requires the transceiver's attitude with respect to the vessel frame to be measured during installation.

H.4 Long / Ultra-short Baseline (L/USBL)

H.4.1 Hardware

The long / ultra-short baseline (L/USBL) system is a special case of the USBL system. It uses USBL hardware in a configuration similar to the one described for the LBL system.

Figure H-4 Typical L/USBL system



H.4.2 Principles

An L/USBL system follows the same methods for calculating range and bearing measurements as the basic USBL system. However, because there are more beacons deployed on the seabed, a considerable improvement in accuracy can be achieved by the L/USBL system.

Non-Critical Operations

If a basic L/USBL system is not to be used for highly accurate survey work, a system such as the one shown in *Figure H-4* will perform a top-down calibration automatically as soon as it is placed in Navigation mode with the beacons declared as References.

This calibration technique, described in *I.4 "Simple Array Calibration"*, relies on multiple range and time-phase difference measurements between the USBL transducer and each transponder on the seabed in turn. Provided an accurate measurement of sound velocity is used, over a period of time the system calculates repeatable positions for the seabed array relative to the USBL transducer.

Critical Operations

If the L/USBL system is to be used for survey work where accuracy is critical, the seabed array must be calibrated separately or by using baseline measurements. If a DGPS input is available to the L/USBL system it is feasible to locate each beacon on the seabed directly in a geographical frame of reference to an accuracy determined by that of the DGPS measurements.

Similarly, if COMPATT beacons are used for the seabed array, the L/USBL system can command them to self-calibrate. Using COMPATT beacons has the additional advantage of giving the system significantly more flexibility, in that they can be commanded to respond on any of a variety of

frequencies and with any desired turn-around delay time. This means that a COMPATT version of the system becomes simpler and faster to set up and use.

H.4.3 Dual Operation

Two complete sets of L/USBL equipment can be operated in tandem to provide dual redundancy. When used in this way, the two systems are linked in such a way that, following failure of any major element, the system can continue to operate without the need for operator intervention. Operation of a dual-redundant system is identical to that of a standard version.

In dual redundancy, one system operates as the 'master' and the other operates as the 'slave'. The slave system monitors the functions and performance of the master, and takes over system operations if it detects any failure.

H.5 Long-short USBL (LSUSBL)

H.5.1 Hardware

In a LSUSBL system, four or more transceivers are deployed below the vessel, and four or more beacons are deployed on the seabed.

H.5.2 Principles

LSUSBL mode is a combination of USBL, LBL and SBL modes. The reference array is interrogated from one transceiver, and the replies from all the beacons are collected at all the transceivers. All the resulting measurements are used to derive a single solution of the vessel's position.

This single solution comprises SBL, USBL and LBL components:

- Ranges to each beacon are collected at all the transceivers, giving an SBL component to the solution.
- The LBL component arises from the ranges three or more beacons having been collected.
- The USBL component arises from both range and direction calculations derived from the multiple transducers of a single transceiver.

LSUSBL uses the same equipment and configuration as LUSBL, but uses data from more transceivers. It is not specifically described in this manual. If operating in LSUSBL mode, use the description for L/USBL but enter the additional transceivers.

Appendix I – System Calibration

I.1 Introduction

This section explains how certain factors external to the system can have an impact on system performance.

By following appropriate calibration methods it is possible to take control of these external factors by quantifying their effects, and then compensating for them in software.

I.2 Sound Velocity

An accurate knowledge of sound velocity, and of the way that the sound velocity varies with water depth, are both very important factors in making an estimation of acoustic range underwater.

I.2.1 Background

The system estimates ranges from a knowledge of the elapsed time between the transmission of an interrogation signal and the reception of a reply. To convert this time measurement to a range estimate, the system requires an accurate knowledge of sound velocity:

$$\text{range} = \frac{\text{elapsed time} \times \text{sound velocity}}{2}$$

Note

 The divide-by-two element of this calculation allows for the two-way acoustic path — from the interrogating transceiver to the transponder and then back to the transceiver again.

Because of the linear relationship between sound velocity and estimated range, a 1% error in the measurement of sound velocity causes a 1% error in the range estimate.

For L/USBL applications, the **Through the Water Column** sound velocity value is usually the most important.

Note

 Provided the sound velocity is set to the average sound velocity in water between the transceiver and the working depth, the USBL software compensates automatically for ray refraction.

Checks on Sound Velocity

You should make regular checks on the sound velocity during an operation. The frequency with which you make these checks depends on circumstances. You should make the checks more frequently in areas where you suspect the temperature profile with depth may change significantly during the operation.

Update the software whenever you note any changes in the value of sound velocity. Depending on circumstances, these changes can occur over the course of a full day, or can occur more rapidly.

It is possible to make a simple check on the **Through the Water Column** sound velocity by observing the vessel's depth value shown on the **Chart** display. If this is not zero, then it is likely that the 'through water' sound velocity requires correction.

If there is no other method available to measure the sound velocity, it is possible to use the value of the vessel's apparent depth, indicated on the **Chart** display, together with a knowledge of the beacon's depth in water to calculate a new value for sound velocity as follows:

$$NSV = OSV \times \left[\frac{WD + SD}{WD} \right]$$

where:

NSV=new value for Through the Water Column sound velocity

OSV=old sound velocity value

WD=water depth to beacon

SD=apparent depth for the vessel

Save the new value for sound velocity and, having done this, check that the apparent depth of the vessel is now zero.

I.2.2 Measurement of Sound Velocity

You can use a sound velocity profiler to measure sound velocity directly. Alternatively, you can read the acoustic range from a beacon directly below the transceiver and compare the indicated value with the known water depth. Adjust the sound velocity value to make the two measurements equal.

There are a number of velocimeter instruments available for measuring the speed of sound directly. These devices use the 'sing-around' principle where high-frequency acoustic pulses emitted by a transducer reflect back from a target at a known distance from the transducer.

By knowing the round-trip distance and measuring the round-trip time to great accuracy, these devices are capable of delivering direct sound speed measurements to an accuracy of ± 0.1 m/s or better.

I.3 Transceiver Alignment Calibration

If absolute position accuracy is important (as distinct from good position repeatability), it is necessary to determine what corrections must be applied to the vessel's attitude sensors so that the system can calculate the correct L/USBL directions.

Note



The system uses measurements from an external vertical reference unit and gyrocompass to apply corrections to its directional and positional calculations. For these corrections to be accurate, the misalignment between the vessel's vertical reference unit (VRU) and the system's transceivers must be known.

Before accurate and reliable measurements can be taken from the system it is important to measure and compensate for any misalignment that exists between the transceiver's frames of reference and the VRU's frame of reference.

I.4 Simple Array Calibration

I.4.1 Top-down Calibration

The USBL capability of the integrated system allows the position of each reference beacon to be determined relative to other beacons in the array by using a 'top-down' calibration technique, without the need to take baseline measurements between them.

In this method, the system measures the slant range and direction to each beacon from the vessel, and uses this information to determine the position of each reference beacon with respect to the vessel's L/USBL position.

The accuracy of this calibration is affected by random and systematic error sources, including the accuracy of transceiver measurement, errors in sound velocity measurement, and the accuracy of transceiver alignment with the vessel's VRU and gyrocompass.

The calibrated beacon positions produced by the top-down method are the best estimates in the presence of these errors. More importantly, it gives the positions of the reference beacons as seen by the USBL transceivers.

This array calibration method provides the most stable position for DP operations on deep-water drilling vessels, because it is used only to maintain a fixed position for the vessel, which means that the acoustic measurements do not change.

Typically, the top-down calibration technique takes approximately one hour to complete. It has the important advantage of providing an uninterrupted supply of acoustic position information to a vessel's DP system throughout the calibration. This can be from arrival on station and deployment of the first beacon, through the array calibration process, and then during the long-term maintenance of the array.

On vessels where there are multiple transceivers in use, all transceivers should be selected and configured for L/USBL operation during the top-down calibration process.

Because the integrated system supports operation in a WGS84 earth frame, the 'absolute' geodetic co-ordinates for each reference beacon can be determined in WGS84 UTM co-ordinates if necessary. Because this does not require measurement of the seabed baselines, it represents a significant advantage when working in areas where there is a rugged bottom topography.

I.4.2 DP-Ref Waypoint

Calibration creates a special waypoint called DP_Ref located at the origin of the array. Certain DP telegrams indicate vessel position relative to the DP_Ref location.

In common with all waypoints, DP_Ref has its own reference frame so that the system can display positions relative to DP_Ref.

Appendix J – CASIUS Data Collection Methods

Note



See Section A.10.3 "CASIUS" for information about the software interface for CASIUS.

J.1 Manoeuvring Guidelines

There are no specific manoeuvres required, but data collected should conform to the following guidelines:

- Some of the data must be taken with the vessel above or nearly above the beacon, so as to maximize the effects of any pitch and roll offsets.
- Some of the data must be taken with the vessel at some distance from the beacon so as to maximize the effects of any gyrocompass offset.
- Data must be taken at opposite headings so as to maximize information used to determine any antenna offsets.
- Ideally, data should be taken through the full range of azimuth directions.
- Data should be collected at a horizontal distance from the beacon that is no greater than the water depth at the beacon position, or a maximum of 500 metres from the beacon's position, whichever is the smaller.
- Ideally, the manoeuvres done while collecting data should reflect the way the vessel is used operationally.

If the vessel is expected to be largely stationary during operation then it should be stationary for each data collection phase. Similarly if the vessel is expected to be moving past the beacon operationally then the data should be collected while moving.

If the vessel is not capable of dynamic positioning, then it will be difficult to keep the vessel stationary, so the latter method will almost inevitably be used.

- Heading changes are known to cause some VRU units to misread. Refer to the VRU documentation for details of how long the VRU takes to settle down after various rates of turn.

Because of this effect, and because data is needed at more than one heading, the vessel manoeuvring may need to be broken up into a series of data collection passes or phases, each at a constant heading. A constant heading should be maintained for a short time prior to and during each pass.

- An important decision to be made is whether the data will be collected while moving or stationary. It is preferable to be stationary if possible as this minimises any DGPS lag problems. If the vessel has no DP capability then this will not be a realistic option and in this case data should be collected during a series of straight run lines over and to the side of the beacon.

J.2 Data Collection – DP Vessel

A dynamic positioning vessel is able to move in any direction while maintaining a constant heading. - Sonardyne suggests that you use the manoeuvring pattern shown in *Figure J-1* below, pausing at each of the cardinal points and also directly above the beacon.

Note



CASIUS data is collected while stationary.

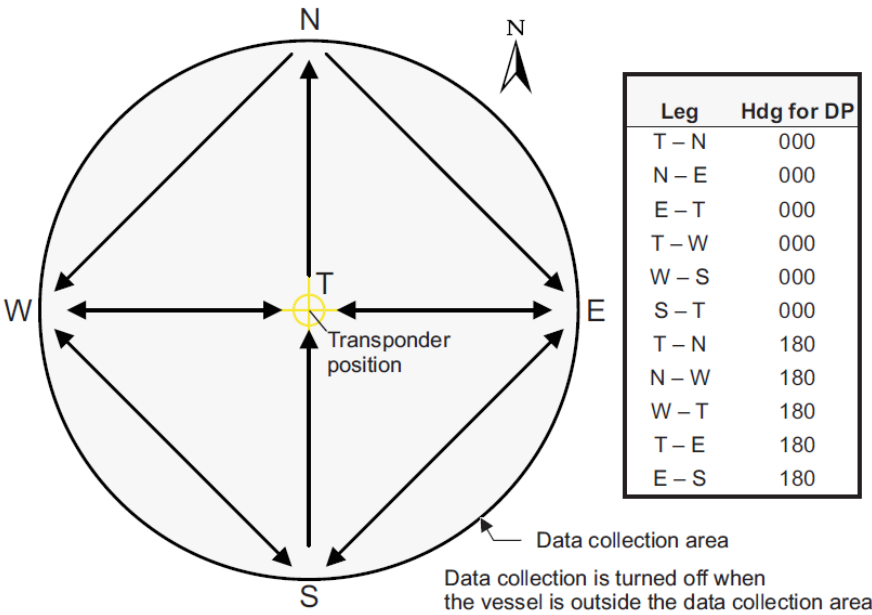
Sonardyne suggests that you collect an equal amount of data at each cardinal point to avoid skewing the data.

Note that a reciprocal heading is used for the second half of the data collection.

The radius of the circle centred on the beacon defines the data collection area. This would normally be equal to one third of the water depth at the beacon, or a maximum of 500 metres. The data collection points are then at 90 degrees to one another at equal distance from the beacon, as well as immediately above the beacon.

The pattern may be rotated in any direction to accommodate wind or currents.

Figure J-1 Manoeuvring Pattern for a DP Vessel

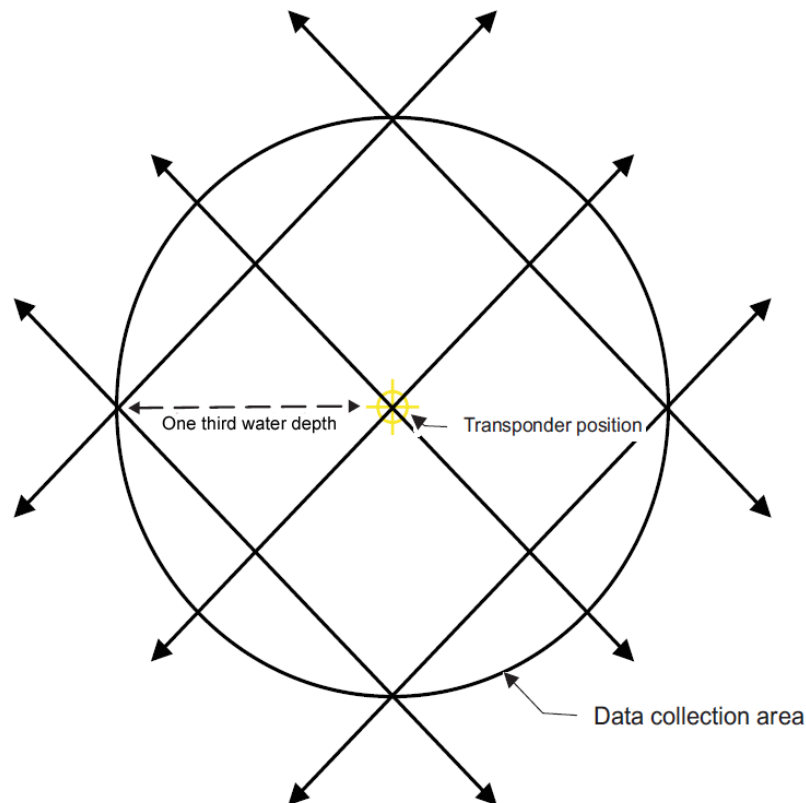


J.3 Data Collection – Constantly Moving Vessel

This data collection method is very similar to the one outlined in *Section J.2 "Data Collection – DP Vessel"* for stationary collection of data, except that the vessel is not expected to stop at the cardinal points to log the data but only to collect data on the transits between cardinal points whilst maintaining good heading.

This method requires the vessel to run 12 lines, with eight transits between adjacent cardinal points (in both directions). The pattern includes a run line in both directions passing directly over the beacon, as shown in *Figure J-2*.

Figure J-2 Manoeuvring Pattern – Constantly Moving Vessel



As before, the pattern can be rotated to allow for current and wind directions where required. The length of the run lines for data collection depend on the water depth as before for the stationary data collection example.

The radius of the circle centred on the beacon defines the data collection area. This would normally be equal to half of the water depth, or a maximum of 500 metres.

Sonardyne suggests that you extend these lines by an appropriated distance to ensure the vessel has a chance to stabilize its heading before beginning data collection within the area, as shown in the example.

To keep the lines straight in the data collection area, the vessel should move outside the data collection area before making a turn for the next run line. Also, the heading should be stable for a period before starting to collect data (the length of this period depends on the VRU's characteristics and on the rate of heading change prior to achieving a stable heading).

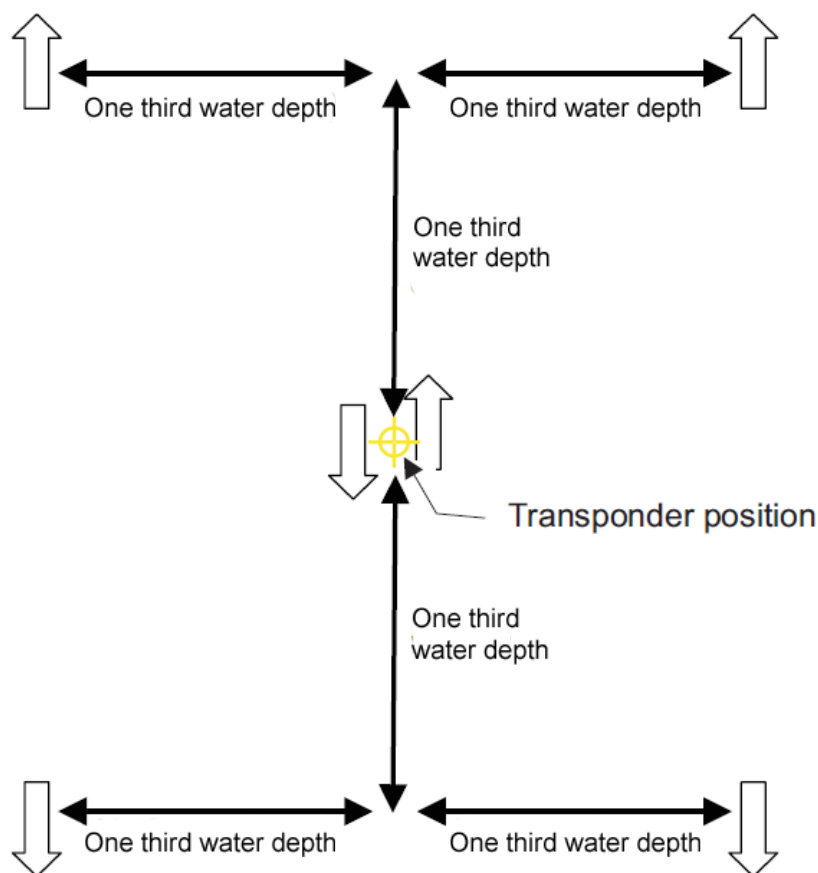
The vessel should reduce speed while passing over the beacon, to acquire more readings there. The vessel's speed should be maintained at the outer ends of the run lines.

J.4 Data Collection – DP Vessel with Tilted Transceiver

The data collection process is the same as for a non-tilted transceiver, except the points where the data is collected must be moved by 30° when collecting data with a tilted transceiver.

Figure J-3 shows a suggested data collection pattern and the heading of the vessel at each position, (assuming the transceiver is tilted backwards).

Figure J-3 Manoeuvring pattern – Tilted Transceiver



J.5 USBL Transceiver Alignment Calibration Check

After you have applied the alignment corrections you should perform more manoeuvres to confirm the correct operation of the system. Commonly these manoeuvres involve using the same seabed beacon used for the CASIUS calibration but they can be repeated using any seabed beacon to verify that the alignment corrections are still valid at any time.

J.5.1 Before You Begin

Check that:

- the VRU and heading sensors that were used in the CASIUS calibration are selected as the active sensors in the vessel properties dialog box.
- the GNSS is enabled for use in tracking.
- the alignment corrections from the CASIUS are correctly entered in the USBL transceiver's offsets dialog box.
- the correct average through-water sound speed is set, or a current sound speed profile has been imported into the system.

J.5.2 Alignment Check

1. Manoeuvre the vessel so that the USBL transceiver is as close as possible over the top of the nominated beacon on the seabed.

2. Allow the beacon to track as a mobile for several minutes, and then place a waypoint as near as possible to the centre of the cloud of positions.

If this beacon has just been used for the CASIUS calibration, then the position of the waypoint can be edited in the system setup tree to match the box-in co-ordinate of the beacon, otherwise, the position derived directly over the beacon can be used.

3. Rotate the vessel slowly around the beacon, attempting to keep the transceiver as near as possible over the top of the beacon.

As a percentage of water depth, the computed position of the beacon should not deviate from the waypoint by more than the 1 Drms 'After CASIUS (% depth)' figure given in the CASIUS report.

4. Starting with the transceiver as close as possible over the top of the beacon, move the vessel by a distance of twice the water depth, or 1000 metres (whichever is less) away from the beacon. The beacon should not deviate significantly from the waypoint position.

If the system passes both of these checks, this confirms that the USBL transceiver is correctly aligned to the selected attitude and heading sensors.

If the system has other sensors interfaced, Sonardyne recommends that you align them to the sensors used in the CASIUS calibration by using the tool provided in the **Tools** menu.

Appendix K – Frames of Reference

K.1 Introduction

When studying the relative positions and movements between two of more bodies, it is important to set and follow rules that define the references to be used for the resulting measurements. In considering these relationships for the system there are several definitions that apply:

- geographical co-ordinate frame
- local grid co-ordinate frame
- vessel body frame
- VRU or attitude sensor body frame
- gyrocompass or heading sensor body frame, and
- body frames of the system's transceivers.

In a practical, well-surveyed navigation installation, the body frames of the vessel, the gyrocompass and the VRU will align with each other, and we can consider them as being the same.

This appendix explains each of the reference frames (also called co-ordinate frames) mentioned in this manual.

K.2 Geographical (World) Co-ordinate Frame

The geographical co-ordinate frame is fixed with respect to the earth's surface and aligns with the north–south, east–west and up–down directions.

Absolute positions can be defined within this co-ordinate frame by using conventional latitude, longitude and depth notations. Positions can also be defined relative to another fixed location either in Cartesian co-ordinates (through eastings and northings) or in polar co-ordinates (as an offset distance, bearing and depth relative to the reference point).

K.2.1 Seabed Frame

A frame with its z axis vertical and stationary with respect to the seabed is known as a seabed frame or an inertial frame. Normally, and for convenience in this reference frame, the x,y plane where $z = 0$ is at or just below the lowest point on the seabed in the area. Positions above this plane have a positive z co-ordinate or height. Depth is considered as negative height and is measured from the sea-surface or from a height close to it.

K.3 Local Grid Co-ordinate Frame

A local grid co-ordinate frame is also fixed with respect to the earth's surface, but it does not need to align with it, and can have its origin at any convenient location.

Again, it is possible to express positions within the local frame by using Cartesian co-ordinates or polar co-ordinates, with respect to a fixed location within the frame.

When using this type of reference frame, it is necessary to define the frame's origin (co-ordinate 0, 0, 0) and its orientation with respect to the geographical co-ordinate frame before it is possible to translate positions measured in the local frame into geographical co-ordinates.

K.4 Vessel, VRU and Gyrocompass Body Frames

These reference frames are fixed relative to the body to which they refer. They move and rotate relative to the geographical co-ordinate frame as the body moves.

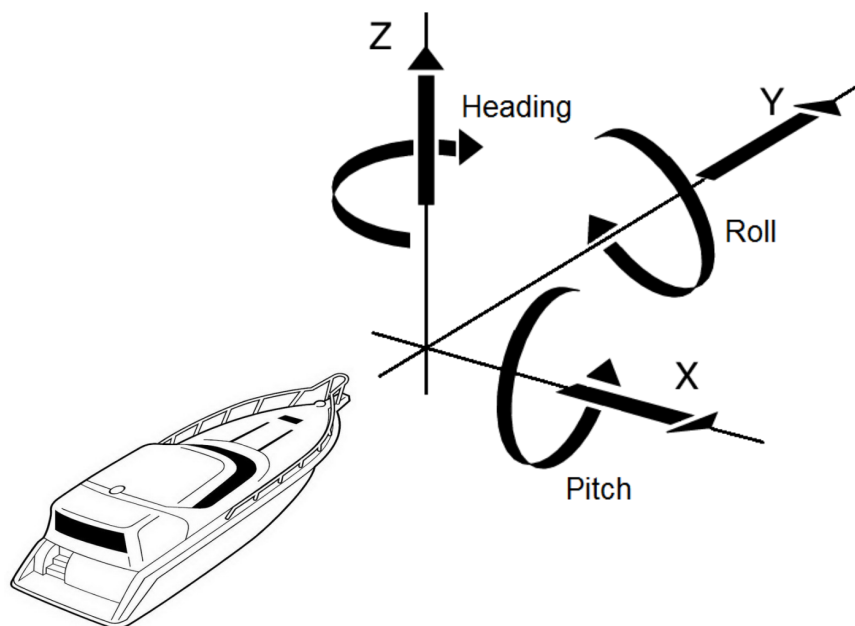
Note

 In this explanation the term 'vessel body frame' could refer equally to a surface vessel, an ROV, or any other body.

There are different conventions available to define the various body frames in use, and all are equally valid. Differences exist particularly among the manufactures of vertical reference units. These differences should have been addressed during installation so that they can be ignored for the purposes of normal system operation, but you should make yourself aware of the differences so that you can identify problems arising from incorrect corrections if they occur.

Also, during installation the various attitude and heading instruments should have been aligned with the vessel, so that their measurements are valid for the vessel and for all the various sensors installed on it. Residual misalignment between the instruments can usually be compensated for in software.

The figure below shows the convention used by Sonardyne to define the vessel body frame.



In this convention:

- The X axis aligns with the vessel's port-starboard direction, with positive co-ordinates being to starboard of the axis origin.
- The Y axis aligns with the vessel's fore-aft direction, with positive co-ordinates being forward of the axis origin.
- The Z axis aligns with the vessel's vertical, with positive co-ordinates being above the axis origin.
- Under positive Pitch rotation the Y axis rotates towards the current +Z direction.
- Under positive Roll rotation the Z axis rotates towards the current +X direction.
- Under positive Heading rotation the Y axis rotates towards the current +X direction.

K.4.1 Origins

The origin of a co-ordinate frame is the point where the X, Y and Z offsets are all zero (0, 0, 0).

The origin of the vessel frame is called the vessel's common reference point (CRP). The position of the vessel's CRP is arbitrary and can be at any convenient location on the vessel.

The origin of the vertical reference unit is usually at the centre of the internal inclinometer, at a location inside the VRU defined by the VRU manufacturer.

The origin of the gyrocompass is at the centre of the gyro, with the fore–aft direction defined by the compass lubber line.

K.4.2 Compensated frame

An RPH (Roll, Pitch and Heading) compensated vessel frame is a frame sharing the same origin as the vessel frame but with the z-axis vertical and the y-axis parallel with a meridian passing through the origin (points true north).

K.5 Transceiver Co-ordinate Frame

The system's transceiver co-ordinate frames follow the same convention described above for the vessel frame. The origin is at the centre of the transducer.

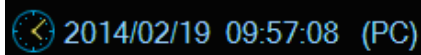
K.6 Corrections Between Co-ordinate Frames

Corrections between the transceiver and the vessel body frame are estimated by the CASIUS calibration tool. This tool uses simultaneous observations of position from GNSS, attitude from the VRU, and heading from the gyro, combined with acoustic observations from a beacon on the seabed, to estimate the alignment angles of the transceiver and its position relative to the GNSS antenna.

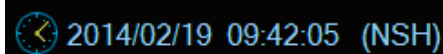
Appendix L – Time System

All time keeping and time stamping uses System (common) Time.

On start-up, time is started from Windows time (which itself starts from the PC's real-time clock (RTC)), but always shows UTC, which is independent of the time zone. The software user interface shows PC at the bottom right-hand corner.

A screenshot of a software interface showing a clock icon, the date and time "2014/02/19 09:57:08", and the text "(PC)" in parentheses, indicating the time source is the PC.

After an NSH is connected, the system synchronizes its machine time with the NSH clock, which is significantly more stable than the PC's clock. After this has occurred, the user interface shows NSH as the time source.

A screenshot of a software interface showing a clock icon, the date and time "2014/02/19 09:42:05", and the text "(NSH)" in parentheses, indicating the time source is the NSH.

Whenever time synchronization is really important, for example in multi-system operations, a TOD device is added to the system. This takes UTC or ZDA strings and a PPS signal from a GNSS into the NSH. This allows the NSH time to synchronize with UTC. The PPS signal flashes and the received time changes on the TOD device dialog. The user interface shows EXT as the time source.

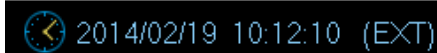
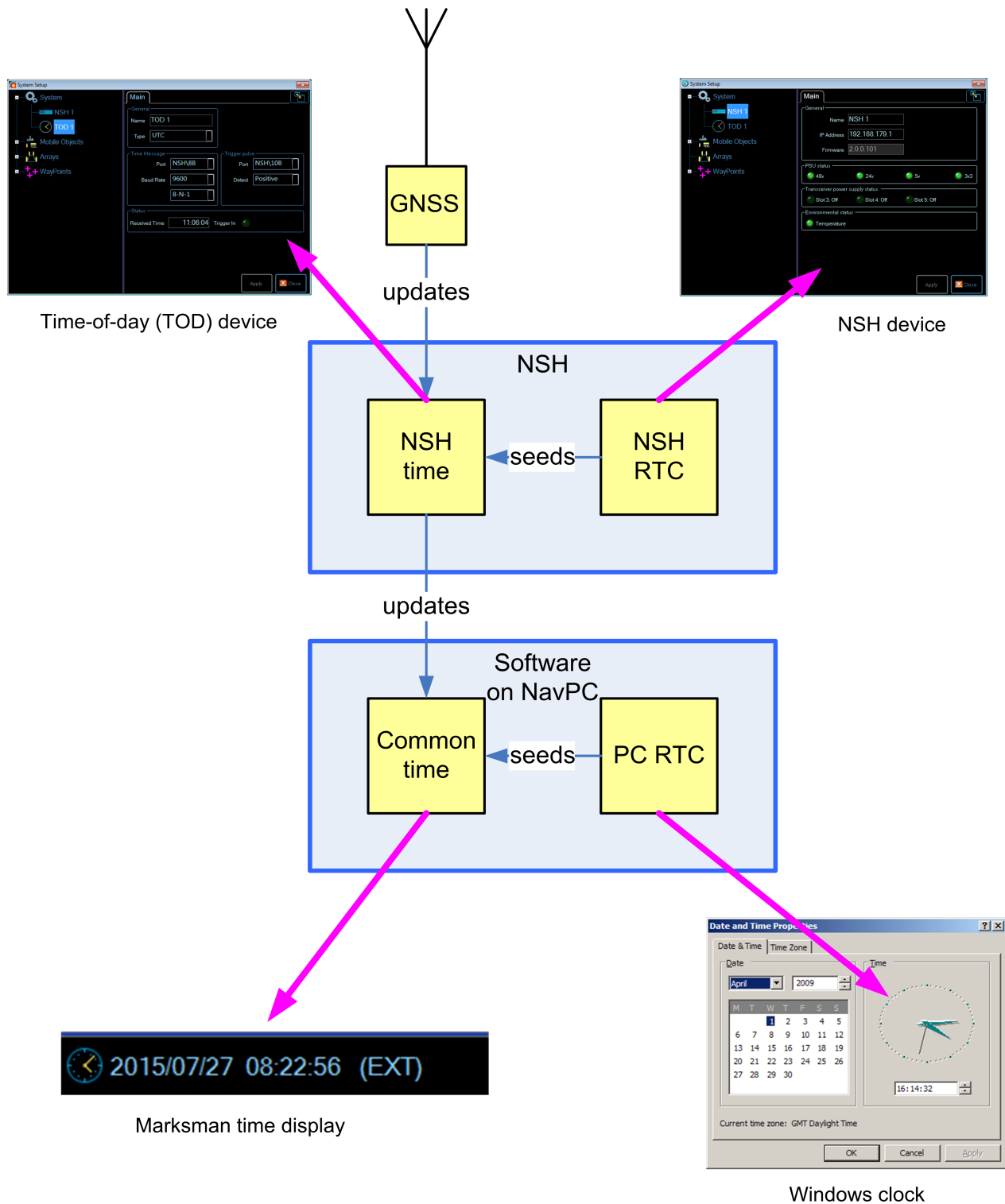
A screenshot of a software interface showing a clock icon, the date and time "2014/02/19 10:12:10", and the text "(EXT)" in parentheses, indicating the time source is the EXT device. There are also small status icons in the bottom right corner.

Figure L-1 Time System



Appendix M – Third Party and Open Source Software Licence Notices and Terms

The following third party and open source software is used with Marksman, Ranger 2 Pro, Ranger 2 Survey and Ranger 2 DP software.

M.1 Third Party Software

M.1.1 SE46 AB

Powered by SE46 AB

M.2 Open Source Software

M.2.1 Gios PDF Library

© 2005 Paolo Gios

This software application makes use of the Gios PDF Library, which is distributed in accordance with the GNU LESSER GENERAL PUBLIC LICENSE version 3.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.

M.2.2 PTPd V1.0

This application makes use of PTPd software.

Copyright © 2005-2008 Kendall Correll, Aidan Williams.

Permission to use, copy, modify, and/or distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED “AS IS” AND THE AUTHOR DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF OR IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

M.2.3 Tera Term V4.8

Copyright (c) T.Teranishi.

Copyright (c) TeraTerm Project.

All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

3. The name of the author may not be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE AUTHOR "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES,

INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

M.2.4 Filezilla V3.7.3 FTP Software

Copyright (C) 2004-2013 Tim Kosse

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License V2 as published by the Free Software Foundation.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

Sonardyne International Ltd., hereby disclaims all copyright interest in the program 'Filezilla'.

Definitions

The following tables are included in this section:

Table No	Title
Table 1	Abbreviations used in this Manual
Table 2	User Operator Terms
Table 3	Signal Processing and Communication Terms

Abbreviations

Acronym	Definition
6G	Sonardyne's sixth generation technology hardware platform
AHRS	Attitude and Heading Reference System
BOP	Blow-Out Preventer
CIS	Common Interrogate Signal
CPN	Component Part Number
CRP	Common Reference Point
CRS	Common Reply Signal
DB or DBV	Signal level relative to full scale voltage in dBs
DGPS	Differential Global Positioning System
DP	Dynamic Positioning
DWG	Drawing
ENC	Electro-Magnetic Compatibility
GNSS	Global Navigation Satellite System
HPT	High Performance Transceiver
IIS	Individual Interrogate Signal
IL	Interference Level
INS	Inertial Navigation System
IRS	Individual Reply Signal
LBL	Long Baseline
NSH	Navigation Sensor Hub
PAN	Programmable Acoustic Navigator
ROV	Remotely Operated Vehicle
Rx	Receive
SBL	Short Baseline
SN or SNR	Signal to Noise Ratio
TAT	A beacon's Turn Around Time
TOD	Time of Day
Tx	Transmit
UID	A beacon's Unique Identification

Abbreviations (continued)

Acronym	Definition
USBL	Ultra-Short Baseline
VRU	Vertical Reference Unit
WSM 6+	Wideband Sub-Mini 6 Plus
XC	Cross-Correlation

User Operator Terms

Term	Definition
Acoustic Beacon	An instrument that emits acoustic signals. It is used to mark a point on the seabed or is fixed to a mobile target so that the target can be tracked or positioned in space. The major types of beacon are described in this glossary, but some beacons can be configured as several or any of the types. The major beacon types are: • Transponder Beacon • Responder Beacon • Pinger Beacon
Acoustic Signal	A message carried by sound pressure waves through the water. In the Sonardyne case, the message has finite length in time.
Common Reference Point	The location on a body from which all offset distances are measured. This point has the x, y, z co-ordinates 0, 0, 0 in the body's co-ordinate reference frame.
COMPATT	COMPUting And Telemetry Transponder. A range of COMPATTs is available from Sonardyne to perform a variety of tasks.
Co-ordinate Frame	A system that is used to define the position of a body in space. The system used is a right-handed Rectangular Cartesian co-ordinate system in three dimensions, where the three axes used are orthogonal. Co-ordinate frames are also called 'reference frames'.
Database	A body of data stored in a computer memory or on magnetic disk media.
DP (Dynamic Positioning)	A system that automatically maintains a vessel on a constant heading and in a fixed position in an inertial frame or with respect to a mobile target. It avoids the need to anchor a vessel and provides greater flexibility in operation. Normally such a system uses a number of position inputs such as GNSS receivers, taut wire sensors, LBL, SBL or USBL acoustic positioning sensors, wind speed indicators and so on. The system controls thrusters on the vessel to maintain position and attitude in yaw.
DP Reference	The acoustic positioning system reports the position of a reference point on the seabed, or that of a mobile target in the vessel's frame, or that of a stabilised vessel's frame regardless of what else the system is doing. This is to maintain compatibility with earlier systems and to provide a standard interface regardless of the type of system used (LBL, SBL, USBL, LSBL, L/USBL) and the manner in which it is being used (for example LSBL in SBL or LBL mode).
DP Telegram	The Telegram an acoustic positioning system sends to a DP system over a serial interface.

User Operator Terms (continued)

Term	Definition
Dual-Redundant L/USBL System	Two complete sets of L/USBL equipment working in tandem on a master/slave basis. The two sub-systems are cross-linked in such a way that, in the event of a failure of any major element, system operation continues without the need for operator intervention. From the operator's point of view, operation of the dual-redundant version is essentially identical to that of the standard version.
Geodetic Co-ordinates	The earth is modelled by a reference spheroid (of which there is a large selection). The position of any point on or near the earth surface is defined by an angle of latitude and an angle of longitude. For a point on the spheroid P: • Latitude is defined as the angle between the normal at P and the plane of the spheroidal equator. • Longitude is defined as the angle between the meridian plane through P and the arbitrarily defined zero meridian plane or the 'Greenwich' plane. (See <i>Geodesy, fourth edition, Bomford, Oxford, sections 2.03 and 4.10(d) for more precise definitions.</i>) Note: This co-ordinate system is not the same as the astronomical co-ordinate system.
Global Navigation Satellite System (GNSS)	A multi-user, 24-hour, worldwide radio navigation system using the NAVSTAR constellation of satellites. GNSS receivers are capable of tracking and decoding data from the satellites and using it to compute the position and velocity of a vehicle. The L/USBL system uses the WGS 84 Geodetic Co-ordinate system.
GNSS attitude sensor	A system based on a GNSS receiver using three or more antennas with known baselines. It is able to compute the instantaneous attitude of a vessel about the roll, pitch and yaw axes.
Gyrocompass	A north-seeking gyroscope uses the properties of a gyroscope when its spin axis is maintained horizontal. The gyroscope senses the spin axis of the earth and will align itself with true north. Precision gyrocompasses, such as that in the -Sonardyne Lodestar Attitude and Heading Reference System (AHRS) use ring laser gyros, which have no moving parts.
Heading (Yaw)	Twisting or oscillation of a moving ship about a vertical axis.
Inclinometer	An analogue device, usually fitted into a COMPATT, which measures the angle of the transponder in which it is mounted with respect to the local vertical. These are generally less accurate than a dedicated vertical reference unit (VRU).
Intelligent Transponder Beacon	A particular type of transponder beacon that is managed by a micro-controller. It is commonly referred to as a COMPATT. It can decode acoustic telemetered commands from a transceiver and can send telemetered data to the transceiver. It can measure the distance between itself and other transponder beacons and can then telemeter the data to a transceiver. Usually the instrument is capable of measuring its depth and the temperature of the water, and can be commanded to telemeter its own internal state back to the surface. It can also be used to measure a variety of underwater parameters and telemeter these back to the surface. It is used, for example, as an intelligent angle-measuring device in a Riser Angle Monitoring System. Very often is fitted with a release mechanism enabling it to be returned, on command, back to the surface at the end of a mission (or if battery power is low). The intelligent beacon can be developed to the state where it becomes a remotely operated transceiver.

User Operator Terms (continued)

Term	Definition
L/USBL system	A hybrid of an LBL and a USBL system. It uses USBL equipment in an LBL configuration.
Long Baseline (LBL) System	A system where there are two or more (typically four) transponders on the seabed. The positions of the transponders are established by a calibration process in a seabed frame. The distances from a transducer to each transponder are measured using a transceiver. The position of the transducer can be computed in the seabed frame. It takes its name from the 'baselines' joining each Transponder. It is sometimes referred to as a range-range system.
LSBL System	A hybrid version of an LBL system and an SBL system.
Mobile	A body that is free to move relative to the seabed through the space between the sea surface and the seabed.
Monitor / Keypad	An instrument that contains a colour graphics display monitor and has a keypad in close proximity suitable for operator input to the system. Sonardyne systems are designed for rack mounting.
Navigation Sensor Hub (NSH)	An instrument that: • Provides communication interfaces to connect to gyro, VRU, GNSS, transceiver • Provides power to transceiver • Timestamps all messages
Navigation Processor	A rack-mounted set of chassis equipment that: • Acts as the system controller. • Accepts operator input from the keypad. • Generates the display signals for the monitor. • Processes data from the transceiver into a form suitable for display to the operator and output to a DP system. • Interfaces to various 'attitude' sensors and other navigation systems.
Pinger Beacon	A particular type of beacon that emits signals regularly without an interrogating signal. A Synchronous pinger is one that can be synchronised to an external master signal. A Precision pinger is one with an accurate internal time standard.
RAMS (riser angle monitoring system) or marine riser angle monitoring system (MRAMS)	A system used for measuring the differential angle between a BOP (Blow-Out Preventer) on the seabed and the Riser, connecting the BOP to the rig. Comprises a COMPATT type Transponder, which is normally mounted rigidly to the BOP, and an external inclinometer unit normally mounted on the Riser and connected by cable to the COMPATT. On command, the system measures the angle of the BOP with respect to the local vertical and reports this back to the surface. It can then repeat this process for the Riser using the external inclinometer.
Responder Beacon	A particular type of beacon that emits an acoustic signal in response to an electrical signal carried to it by cable.
ROV (Remotely Operated Vehicle)	A vehicle controlled and powered over a cable connection so that it can travel in the space between the sea surface and the seabed.
Seabed	The surface of the earth covered by water or sea. The seabed is considered stationary.
Short Baseline (SBL) System	A system where three or more transducers are fixed to a vessel and connected to a single transceiver. The position of each transducer is measured and co-ordinated in the vessel frame. By measuring the time of arrival of the signal from a beacon at each transducer the position of the beacon in the vessel frame can be computed.

User Operator Terms (continued)

Term	Definition
Sonardyne	Sonardyne International Limited and its affiliates.
Sonardyne Wideband®2	6G® transponders and transceivers use Sonardyne Wideband® 2 ultra-wide bandwidth signals giving a faster and robust transmission of data, more precise ranging and mitigation from multipath in shallow water and amongst steel structures in deep-water.
Sound Velocity	The speed with which sound pressure waves propagate through water. Sound velocity varies with properties such as water temperature, salinity and pressure. This is a core parameter in the accurate operation of acoustic positioning systems.
Sound Velocity Profile	Variations of sound velocity with water depth caused by varying temperature, salinity and pressure. In practice the depth cannot be measured directly. Therefore pressure measurements are made, and depth computed, using a knowledge of density. Derivation of density requires a knowledge of temperature and salinity. Salinity is measured indirectly through a measurement of water conductivity. Therefore a popular method of measuring the sound velocity profile is from a profile of pressure, temperature and conductivity and the use of empirically derived formulae to compute depth and sound velocity. Sound velocity can be measured directly using a dedicated and calibrated instrument called a sound velocimeter, although it is still necessary to have the relevant depth measurements available.
Submersible	A vehicle that operates below the sea surface and can carry a pilot and other personnel in a one atmosphere environment. It carries a supply of air for life support, and power for propulsion and other demands. It is capable of operating autonomously away from its support vessel for a limited time.
Target	Object to be tracked by an acoustic system.
Transceiver	An instrument that can generate electrical signals suitable for conversion to acoustic signals by a transducer. It can detect received signals and extract information from them. Some transceivers can measure the time it takes a signal to travel from a transducer to a transponder and return. Some can encode and send data in a message and extract digital data from a message (a process called Acoustic Telemetry).
Transducer	A device that converts electrical signals into acoustic signals and vice versa. A hydrophone is a device used to convert acoustic signals into electrical signals only. Note: The term is often applied to a complete instrument that contains pre-amplifiers, matching networks and so on.
Transponder Beacon	A particular type of beacon that emits an acoustic signal when it detects an interrogating acoustic signal.
True North	The direction of the shortest line that can be drawn, across the surface of the earth, from the observer to the North Pole.
Ultra-Short Baseline (USBL) System	A system similar in principle to an SBL system except the system uses three or more elements in a single transducer array. The measurements it makes are the differences in 'time-phase' of the signals from each element. The co-ordinate frame is fixed to the transducer array, which must be oriented in the vessel frame to be equivalent to the SBL system.

User Operator Terms (continued)

Term	Definition
UTM (Universal Transverse Mercator)	A Projection system that is used to transform geodetic co-ordinates into an orthogonal two-dimensional system suitable for representation on a plane such as a chart. Normally the co-ordinates are called eastings and northings, which are equivalent to x and y respectively. The UTM system is a worldwide system. Each projection covers 6 degrees of longitude with the central meridian at 3, 9 degrees etc. east of Greenwich and from 84 degrees north to 80 degrees south. The scale factor on a central meridian is 0.9996 (with some exceptions). The projection is orthomorphic, which means that at a point the scale in all directions is the same and there is no local distortion. However it should be noted that the scale factor changes with distance from the central meridian. For points away from the central meridian grid north and true north diverge. The difference is called the convergence, and is positive when grid north is east of true north. Usually, the point where the central meridian meets the spheroid equator is given a false easting of 500000 m. Many countries' mapping systems are based on the same system but use a particular reference spheroid, non-standard central meridians, scale factors and different false eastings and northings. The polar regions are covered by two Zenithal orthomorphic projections.
Vessel	A body floating in the sea with at least part of it penetrating the surface. It is free to move and rotate relative to the seabed.
VRG (Vertical Reference Gyroscope)	A gyroscopically stabilised VRU.
VRU (Vertical Reference Unit)	An instrument that measures the instantaneous roll and pitch of a vessel.
Yaw (Heading)	Twisting or oscillation of a moving ship about a vertical axis.

Signal Processing and Communication Terms

Term	Definition
Bore-Sight	The axis about which a transducer's maximum power gain is being directed.
Capture Area	The effective aperture size of the array. It is directly related to the array gain.
Carrier-to-Noise Density	The ratio of the signal power (C) to noise power (No) in unit bandwidth (C/No); generally quoted in dBHz.
Directivity Index	The ratio of the radiation intensity in the direction of interest compared with an isotropic radiator.
False Alarm	Occurs when an invalid signal has satisfied all of the detection criteria and the detection process incorrectly declares the presence of a valid signal.
False Alarm Number	Prediction of the average number of possible decisions between false alarms.
False Alarm Probability	The resultant probability of all the false alert probabilities.
False Alarm Rate	Prediction of the number of false alarms that will occur in a specified time.

Signal Processing and Communication Terms (continued)

Term	Definition
False Alert	Occurs when an invalid signal has satisfied one detection criterion and the detection process incorrectly declares the presence of a valid signal.
False Alert Rate	Prediction of the number of false alerts that will occur in a specified time.
Front-to-Back Ratio (for a transducer)	The ratio of power transmitted in the forward hemisphere of the transducer's polar diagram to that transmitted in the reverse hemisphere of the polar diagram.
Kalman Filter	An adaptive filter that provides optimum filtering of a signal that has been subjected to a non-stationary environment (that is, when the data is changing significantly during the filter convergence time).
Least Squares (LSQ)	Used to generate a raw estimate of position based on a single set of measurements. The solution computed minimises the sum of the squares of the differences between the measurements and their estimates based on the solution. Each solution is independent of those that were computed from previous sets of measurements, and so is vulnerable to the effect of undetected errors in the current set of measurements.
Middleton Noise	This noise is impulsive in nature and is described by a Middleton probability density function. The three classes of noise description are A, B and C: Class A: Typically narrower spectrally than the receiver bandwidth in question and, as such, generates ignorable transients in the receiver's front end (initial linear stages) when source emission terminates. Class B: The bandwidth of the incoming noise is larger than that of the receiver's front end stages, so that transient effects occur both in the build up and in the decay; the latter predominates. To varying degrees, the receiver is 'shock excited', particularly for inputs of very short duration; the receiver is said to 'ring'. Class C: The sum of Class A and Class B interference.
Rayleigh Fading Channel	The fading characteristics of the propagating channel are in accordance with a Rayleigh Probability Density function. Such a channel does not support constant signals. The phase of the signal is uniformly distributed between 0 and 2 radians.
Rayleigh Probability Density Function	A Rayleigh Probability Density function is the instantaneous vectorial addition of two independent zero mean-time variant Gaussian processes. The phase of the resultant vector is uniformly distributed between 0 and 2 radians.
Rician Fading Channel	The fading characteristics of the propagating channel are in accordance with a Rician Probability Density function. Such a channel does support a constant signal level. Associated with this signal is a non-coherent Gaussian signal of lower strength.
Rician Probability Density Function	A Rician Probability Density function is the instantaneous vectorial addition of two independent zero mean-time variant Gaussian processes where one of the designated signal vectors is not only consistently larger than the other but remains so during the observation time.
Translinear Mode	The system operates in linear mode for signals within specified dynamic range. Once the input signal level is larger than the upper limit set by the input dynamic range, hard limiting occurs.

Global Headquarters, UK

Blackbushe Business Park
Yateley
Hampshire
GU46 6GD, UK

T. +44 (0)1252 872288
F. +44 (0) 1252 876100
sales@sonardyne.com

Rio das Ostras, Brasil

Av. Zen lotes 05 e 06
Quadra D
Zen, Rio das Ostras – RJ
CEP 28.890-000, Brasil

T. +55 22 2123 4950
F. +55 22 2123 4951
brasil.sales@sonardyne.com

Singapore, Asia

34 Loyang Crescent
Block B
Singapore
508993

T. +65 6542 1911
F. +65 6542 6937
asia.sales@sonardyne.com

Houston, USA

8280 Willow Place Drive North
Suite 130
Houston, Texas
77070, USA

T. +1 281 890 2120
F. +1 281 890 7047
usa.sales@sonardyne.com

Aberdeen, UK

Units 12–13,
The Technology Centre
Claymore Drive
Bridge of Don, Aberdeen
AB23 8GD, UK

T. +44 (0) 1224 707875
F. +44 (0) 1224 707876
sales@sonardyne.com

24/7 Emergency Helpline

T. +44 (0) 01252 877600

Email Support

support@sonardyne.com

Website

www.sonardyne.com

Twitter

[@sonardyne](https://twitter.com/sonardyne)