NOAA FORM 76-35A

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE

DATA ACQUISITION AND PROCESSING REPORT

Type of Survey Hydrographic

Field No. OPR-N395-KR-09

Registry No. H12053

LOCALITY

State Washington

General Locality Approaches to Puget Sound

Sublocality Cultus Bay

2009

CHIEF OF PARTY

Donald L. Brouillette

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NOAA FORM 77-28
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U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

REGISTRY No H12053

HYDROGRAPHIC TITLE SHEET

INSTRUCTIONS – The Hydrographic Sheet should be accompanied by this form, filled in as completely as possible, when the sheet is forwarded to the Office.

FIELD No.

State Washington

General Locality Approaches to Puget Sound

Sub-Locality Cultus Bay

Scale N/A **Date of Survey** 09/19/09 - 10/06/09

Instructions dated June 26, 2009 **Project No.** OPR-N395-KR-09

Vessel M/V Defender IV (1154554) M/V Beaver (1054456)

Chief of party Donald L. Brouillette

Surveyed by B. Bunge, B. Heather, K. Fankhauser, C. Pinero, R. White, J. Deming, D. Moore, T. Jamison

Soundings by echo sounder, hand lead, pole Reson SEABAT 8101(Defender IV) Kongsberg EM3002(Beaver)

Graphic record scaled by N/A

Graphic record checked by N/A **Automated Plot** N/A

Verification by Pacific Hydrographic Branch

Soundings in fathoms feet at MLW MLLW Meters at MLLW

REMARKS: The purpose of this work is to provide NOAA with modern and accurate hydrographic survey data for the area in the central Puget Sound.

All times are in UTC.

Projection is UTM Zone 10 N.

NOAA FORM 77-28 SUPERSEDES FORM C&GS-537

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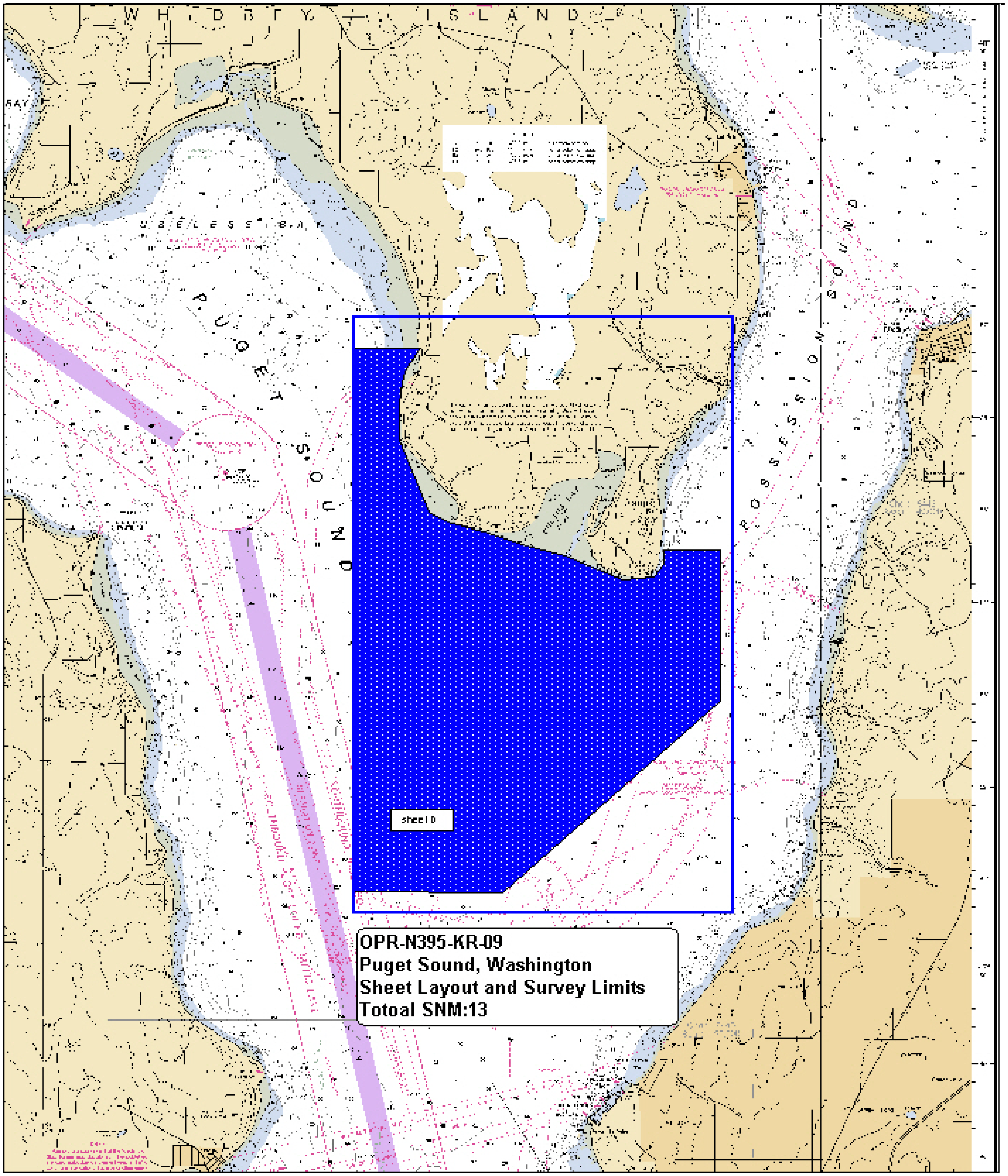

Figure 1: OPR-N395-KR-09

A. Equipment

A1. VESSELS

A1.a Defender IV

The Defender IV is an aluminum catamaran built by Kvichak Marine Industries. It is 54 feet in length with a 20 foot beam. It has a large aft deck with an A-Frame and Davit. Defender IV can accommodate six crew members. *(Appendix A)*

A1.b M/V Beaver

The M/V beaver is a 30 foot vessel with a 10 foot beam. Powering the Beaver is a 300 HP Cummins 6BTA 5.9 Marine Diesel Engine. There is a large aft deck and room in the cabin for two sonar operators and the captain. The Beaver has a top speed of 26 kts and a service speed up to 22 Kts.
(Appendix B)

A2. SOUNDING EQUIPMENT

The Kvichak Defender IV was equipped with a pole mounted Reson SeaBat 8101 multibeam system during the OPR-N360-KR-09 project. The Reson 8101 system operates at a frequency of 240 kHz. It has 101 horizontal beams centered 1.5º apart and an along-track beam width of 1.5 º. This multibeam system has a maximum swath width of 150º (Appendix C). The extended range receiver was used which allowed for a maximum range of 450 meters. The range scale, gain, power level, and ping rates, were a function of water depth and data quality. These parameters were noted in the survey line logs at the start of each line.

The M/V Beaver was equipped with a hull mounted Kongsberg EM 3002. The EM 3002 operates at a frequency of 300 kHz. It has 160 beams and a maximum swath width of 130 º. It has an operating range of less than 1 meter to greater than 200 meters. It was operated in high density, equidistant mode, producing 254 beams. (Appendix D)

A3. POSITIONING and ORIENTATION EQUIPMENT

The Kvichak Defender IV was equipped with an IXSEA Octans surface gyrocompass and motion sensor. The Octans has a heading accuracy of 0.1º secant latitude (0.1 x 1/COS Latitude), and a resolution of 0.01º. Heave, surge and sway measurements are accurate to 5 cm or 5%. The dynamic roll and pitch accuracy is 0.01º with a resolution of 0.001º. Position was determined in real time using a Trimble Zephyr Model 2 GPS antenna connected to a Trimble SPS851. Coast Guard corrections were received by a Hemisphere MBX-4 DGPS beacon receiver. More information on the MBX-4 beacon receiver can be found in appendix E.

The Beaver was equipped with a Coda Octopus F180 for positioning and motion reference. The

F180 has a pitch and roll accuracy of less than 0.025º. Using DGPS, there was a CEP positioning accuracy of 0.5 – 4.0 meters. The two GPS antennas were mounted athwartship along a bar above the cabin with a 2 meter baseline, which gives a true heading accuracy of 0.05º. The F-180 has a heave accuracy of 5% of heave amplitude or 5 cm. Coast Guard corrections were received through a Hemisphere GBX PRO beacon receiver. (Appendix F)

Both vessels monitored real-time QC displays in QINSy throughout the survey to ensure that the positional accuracies specified in the NOS Hydrographic Surveys Specifications and Deliverables were achieved.

A4. SOFTWARE

A4.a Acquisition

Two computers were online aboard the Defender IV. One acting as an acquisition machine, the other as a navigation computer. The data were collected and stored using QINSy on the acquisition computer. The QINSY navigation computer also logged data as a backup. Both QINSy computers operated on a 2.86 GHz Intel core 2 Quad processor PC running Windows XP service pack 3. Multibeam data was stored in the native QINSy .db format before being exported as an XTF. The XTF files contain all uncorrected multibeam bathymetry, position, attitude, heading and UTC time stamp data required by CARIS to process the soundings. All motion and offsets were corrected for during post processing in CARIS.

The Beaver had two online computers as well. One was running QINSy for navigation while the other used SIS (Seafloor Information System) for acquisition. The .all files from SIS contain all needed information for post processing in CARIS. The computer running SIS version 3.6.0 for multibeam acquisition used an AMD Athlon dual core 5050e processor with 2GB memory, 200 GB HD, Nvidia GeForce 8800GT video card, and Windows XP service pack 3. The navigation computer running QINSy used a 2.86 GHz Intel core 2 Quad processor PC running Windows XP service pack 3.

Two log files were maintained daily aboard the Defender IV. The acquisition log, maintained by the sonar operator, contains recorded sonar settings that correlate with each survey line that was run. The same log sheet was used to record Defender IV status updates about the daily operations and weather. The Navigation log on the Defender was used to record information on each line that was run, navigation information about where the Defender was at what time, daily waterline measurements, and a log of all sound velocity profiles taken. The Beaver maintained two logs as well. One which contained line information and navigation information while the other contained waterline measurements and a sound velocity log.

A4.b Processing

All Soundings were processed using CARIS (Computer Aided Resource Information System) HIPS (Hydrographic Information Processing System) v6.1.

IVS Fledermaus 6.7 was used to generate CUBE surfaces for data cleaning and filtering.

A complete list of software and Hardware used on this project is included in Appendix G and H.

B. Quality Control

B1. Processing Routine

In the CARIS Vessel Configuration File (HVF) for both the M/V Beaver and M/V Defender IV, error estimates for all survey sensors were entered. These error estimates were used in CARIS to calculate the Total Propagated Uncertainty (TPU) at the 95% confidence interval for the horizontal and vertical components for each individual sounding. The values that were input in the CARIS VCF file for the survey sensors are the specified manufacturer accuracy values and were downloaded from the CARIS website http://www.caris.com/tpu/ in August 2009.

The calculated vertical and horizontal uncertainty or TPU values were then used to:

E. Build and edit CUBE surfaces in IVS Fledermaus
F. Filter the data to IHO order 1 (<100m) and 2 (>100m) specifications depending on depth.

G. Create finalized BASE surfaces that used only soundings meeting or exceeding IHO Order 1 and 2 standards and have been CUBE filtered in Fledermaus.

An overview of the data processing flow follows:

In order for the XTF and SIMRAD files to be used by CARIS, they must be converted to HDCS format using the CARIS conversion wizard. Prior to the conversion the vessel offsets, patch test calibration values, TPU values, delta draft, and static draft were entered into the VCF.

Once converted, the tide data was loaded into each line and then the line was SVP corrected and merged in CARIS HIPS. The TPE was then computed for each sounding and the attitude, navigation and bathymetry data for each individual line were examined for noise, as well as to ensure the completeness and correctness of the data set.

After each individual line was examined and cleaned in CARIS HIPS, the HDCS files were then used to build Combined Uncertainty Bathymetry Estimator (CUBE) surfaces in IVS Fledermaus using PFM Direct. The CUBE surfaces were created at varying resolutions depending on the depth range. The following depth thresholds were used on this project for cleaning purposes.

- Depth Threshold: 0 to 20 meters resolution = 1 m

- Depth Threshold: 20 + meters resolution = 2 m

Deviations from these thresholds, if any, are detailed in the appropriate DR.

The data was then cleaned in Fledermaus by flagging and rejecting individual soundings or correcting the CUBE surface. The sounds were then filtered to IHO Order 1 or 2 standards off the CUBE surface; in some specific cases user defined filters were used ranging between IHO Order 1 and IHO Order 2 in shallow water. This was done to avoid cropping out valid data or possible DTONs in areas with high concentrations of SAV.

Sounding data that was CUBE filtered and passed the required quality assurance checks were used in the final BASE uncertainty surfaces.

B2. Uncertainty Values

As seen in the uncertainty surface, uncertainty is generally lowest near the sonar nadir beams and increases toward the outside of each swath. This is expected and primarily a result of sound velocity error uncertainty.

Oscillations from port to starboard along lines in the uncertainty surface are due to higher uncertainty computed due to vessel roll, again prevalent mostly in the outer beams.

Higher uncertainty is apparent in areas of steep or rapidly changing bottom topography and areas where outer beams were left to contribute to the surface. However, despite high uncertainty in these areas, data matchup is good and the data acceptable for nautical charting purposes.

Small patches of higher uncertainty are evident in the uncertainty surface coinciding with infill lines run at later dates. This is most likely due to tidal and current fluctuations that cannot be accounted for as accurately as they are in areas that are less dynamic. These offsets are only vertical and average out around 10cm reaching a max value of about 40 cm. For specific details concerning these offsets within each sheet, please refer to the corresponding DR, under a separate cover.

B3. Designated Soundings

While examining the data in subset mode soundings were designated wherever the CUBE surface did not adequately depict the shoalest point of a feature. Designations were initially assigned to soundings in IVS Fledermaus, then were double checked and added to in CARIS. Soundings were designated when they met or exceeded the criteria for designation set forth in the HSSD (April 2008) to ensure they were carried through to the finalized BASE surfaces.

C. Corrections to Soundings

C1. Sound Velocity Profiles

Sound velocity casts were taken approximately every three hours, or when the data appeared to need a new one. Seabird CTDs were used aboard both the Beaver and the Defender. The CTD aboard the Defender was a SBE 19+, while the one on the Beaver was a SBE 19. For each cast, the probes were held at the surface for 1-2 minutes to allow time for the unit to turn on and reach temperature equilibrium. The probes were then lowered and raised at an approximate rate of 1 m/s. The Seabirds were set to sample the water at a rate of 2 Hz. Only the downcast were used for post processing. The Sea Bird probes were rinsed out with freshwater to minimize salt-corrosion and in some cases to rinse out sediment. Comparison casts (confidence checks) were completed every week in compliance with the HSSD (April 2008), section 5.1.3.3.

The beaver used a Valeport SVP650 for sound speed at the head of the EM3002.

C2. SQUAT & SETTLEMENT

The squat and settlement test for the M/V Defender was conducted due east of Pt. Fosdick, WA, August 10th, 2009 (Julian Day 283).
The squat and settlement test for the M/V Beaver was conducted in Lake Union due north of downtown Seattle, WA, August 20th, 2009 (Julian Day 232).

The squat settlement tests were performed by first establishing a 1000 meter line in the direction of the current. The line was then run heading north at a speed of 1 kt and then the same line run south at 1 kt. The line was then run 3 more times in the same pattern at incrementing vessel speeds collecting data at way points; one on each end and one at the center. This data was then compared at each way point (see squat and settlement spread sheets) by sampling soundings in the subset editor in CARIS. Average depth and speed were computed for each line at each way point. The difference in depth averages were computed and correlated with the appropriate speeds to plot overall Squat and Settlement for both vessels.

All measurements were corrected for pitch, roll, and reduced to the vessel's common reference point (CRP) in the CARIS vessel configuration file, VCF. Heave was removed so that the long-period heave would not produce bias in the dynamic draft calculations (Procedures taken from Settlement and Squat Procedures Using the Multibeam Echosounder Method, see below for charted and table results)

Figure 2 – M/V Defender IV Settlement Curve

The results of the squat settlement test for the Reson 8101 are shown below.

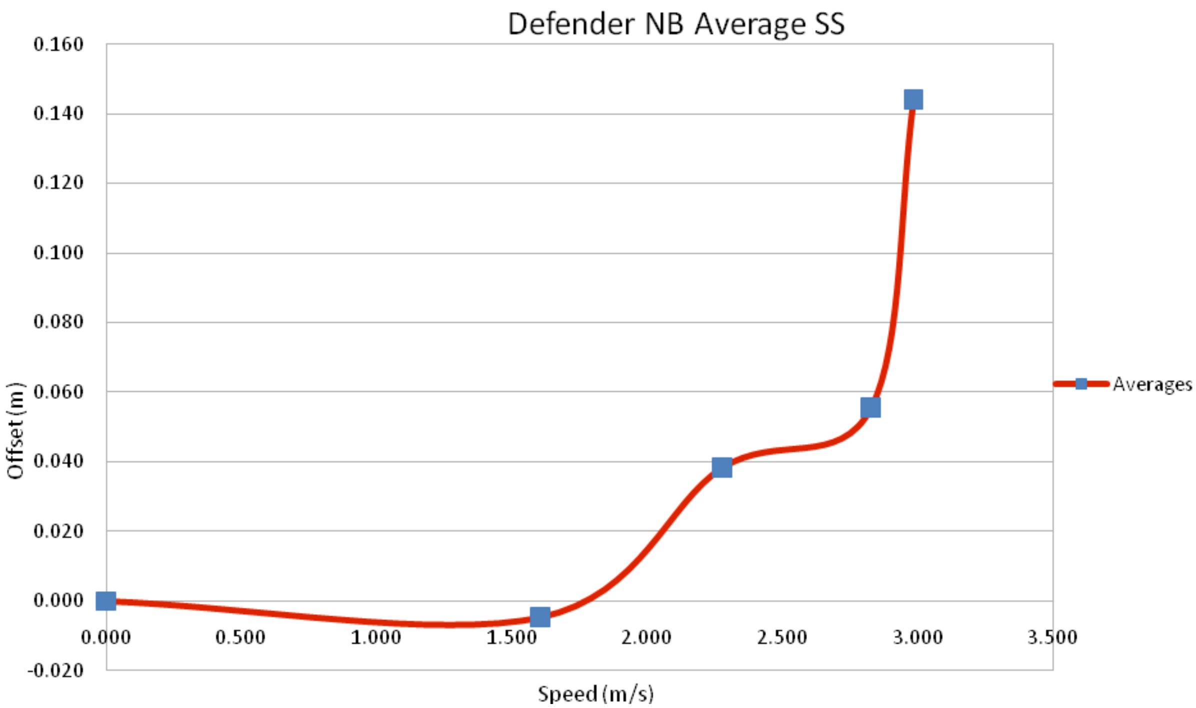

Table 1 – M/V Defender IV Settlement Results

M/V Defender IV-8101 CALCULATED SETTLEMENT	
Speed (kts)	Settlement
0.000	0.000
1.605	-0.005
2.275	0.038
2.825	0.055
2.983	0.144

Figure 3 - M/V Beaver Settlement Curve

The results of the squat settlement test for the EM 3002 are shown below.

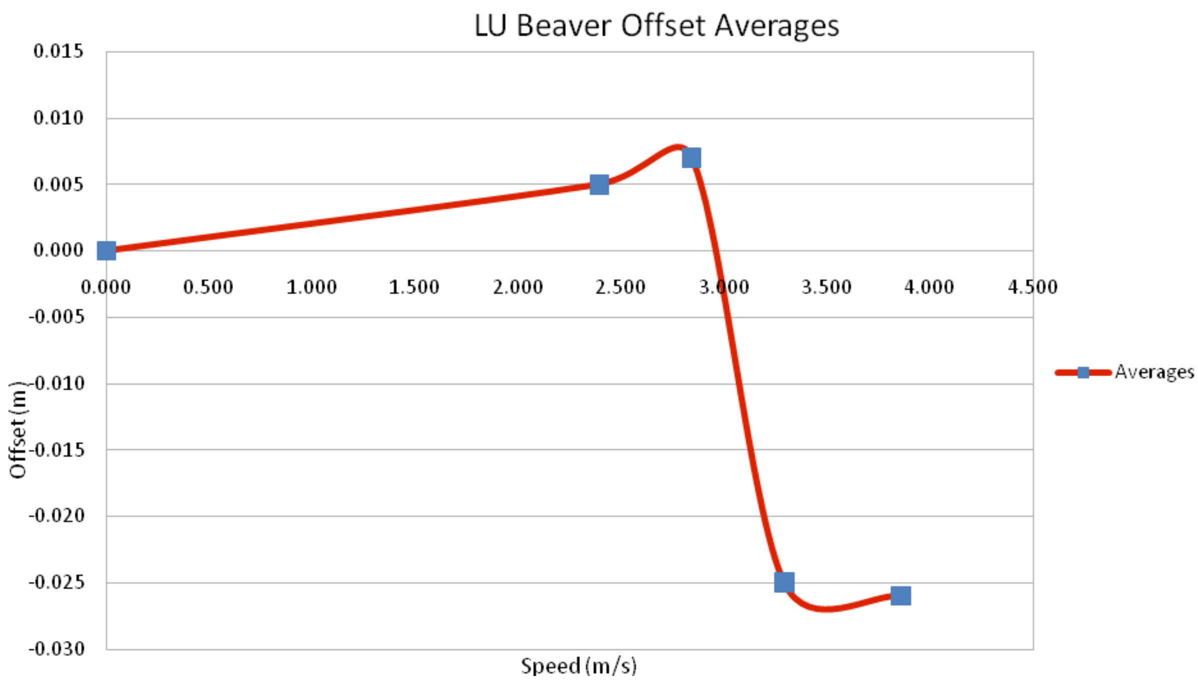

Table 2 – M/V Beaver Settlement Results

M/V Defender IV-8101 CALCULATED SETTLEMENT	
Speed (kts)	Settlement
0.000	0.000
2.393	0.005
2.843	0.007
3.293	-0.025
3.858	-0.026

Note: Vessel speed was noted on the survey line logs, and the settlement values were entered into the CARIS HVF so HIPS could perform the correction automatically during merge.

C3. STATIC DRAFT

Static draft was measured immediately prior and post of daily survey operations. These were measured from the port side deck on both the M/V Beaver and M/V Defender IV, and then the correction to the common reference point was applied. Refer to tables 3 & 4 below for draft values.

Table 3: M/V Beaver

Date	Time	Draft (m)	Date	Time	Draft (m)
2009-231	12:00:00 AM	0.69	2009-260	03:30:00 PM	0.65
2009-233	04:10:00 PM	0.69	2009-261	02:00:00 AM	0.66
2009-234	01:30:00 AM	0.71	2009-261	08:50:00 PM	0.64
2009-234	06:00:00 PM	0.69	2009-262	02:00:00 AM	0.65
2009-235	12:18:00 AM	0.72	2009-262	02:55:00 PM	0.66
2009-236	03:41:00 PM	0.67	2009-262	04:25:00 PM	0.66
2009-237	12:36:00 AM	0.69	2009-262	07:10:00 PM	0.66
2009-238	04:00:00 PM	0.68	2009-263	01:15:00 AM	0.67
2009-239	12:30:00 AM	0.71	2009-263	04:40:00 PM	0.67
2009-240	03:35:00 PM	0.67	2009-264	12:13:00 AM	0.68
2009-241	12:10:00 AM	0.71	2009-264	03:10:00 PM	0.65
2009-241	03:05:00 PM	0.68	2009-264	11:59:00 PM	0.66
2009-242	12:30:00 AM	0.7	2009-268	08:10:00 PM	0.65
2009-242	03:15:00 PM	0.69	2009-269	01:43:00 AM	0.66
2009-243	12:35:00 AM	0.71	2009-269	03:00:00 PM	0.66
2009-243	03:30:00 PM	0.68	2009-270	01:00:00 AM	0.66
2009-243	10:35:00 PM	0.69	2009-270	02:45:00 PM	0.66
2009-244	12:30:00 AM	0.7	2009-271	01:00:00 AM	0.66
2009-244	03:45:00 PM	0.67	2009-271	04:15:00 PM	0.65
2009-245	12:18:00 AM	0.7	2009-272	04:15:00 PM	0.65
2009-245	03:35:00 PM	0.63	2009-274	06:50:00 PM	0.65
2009-246	12:10:00 AM	0.65	2009-275	03:30:00 PM	0.65
2009-247	03:30:00 PM	0.65	2009-276	01:15:00 AM	0.65
2009-248	12:30:00 AM	0.66	2009-276	02:45:00 PM	0.66
2009-248	02:45:00 PM	0.64	2009-276	10:30:00 PM	0.66
2009-248	07:21:00 PM	0.64	2009-278	02:35:00 PM	0.66
2009-252	08:30:00 PM	0.63	2009-279	01:30:00 AM	0.66
2009-253	12:38:00 AM	0.65	2009-279	05:45:00 PM	0.64
2009-253	04:30:00 PM	0.76	2009-280	01:00:00 AM	0.64
2009-253	07:07:00 PM	0.76	2009-280	04:00:00 PM	0.65
2009-253	08:15:00 PM	0.62	2009-280	05:45:00 PM	0.65
2009-254	12:30:00 AM	0.65	2009-280	11:30:00 PM	0.65
2009-254	03:45:00 PM	0.64	2009-281	12:30:00 AM	0.64
2009-254	10:50:00 PM	0.66	2009-281	03:00:00 PM	0.65
2009-255	03:00:00 PM	0.64	2009-282	12:09:00 AM	0.65
2009-256	12:00:00 AM	0.63	2009-282	04:51:00 PM	0.64
2009-256	06:00:00 PM	0.66	2009-282	07:00:00 PM	0.64
2009-256	10:20:00 PM	0.66	2009-282	07:25:00 PM	0.64
2009-258	03:00:00 PM	0.61	2009-282	07:30:00 PM	0.64
2009-259	12:34:00 AM	0.67	2009-282	08:00:00 PM	0.64
2009-259	04:40:00 PM	0.67	2009-282	10:30:00 PM	0.64
2009-260	12:40:00 AM	0.67			

Table 4: M/V Defender IV

Date	Time	Draft (m)	Date	Time	Draft (m)
2009-224	12:00:00 AM	0.87	2009-247	12:51:00 AM	0.9
2009-226	12:00:00 AM	0.87	2009-247	07:02:00 PM	0.87
2009-226	11:59:00 PM	0.87	2009-248	01:11:00 AM	0.89
2009-227	03:06:00 PM	0.87	2009-248	03:20:00 PM	0.86
2009-228	12:54:00 AM	0.86	2009-249	01:05:00 AM	0.9
2009-228	03:30:00 PM	0.88	2009-249	03:15:00 PM	0.9
2009-229	12:22:00 AM	0.91	2009-250	12:38:00 AM	0.9
2009-229	03:30:00 PM	0.81	2009-262	02:55:00 PM	0.83
2009-230	12:50:00 AM	0.91	2009-263	12:54:00 AM	0.81
2009-230	03:45:00 PM	0.92	2009-263	02:56:00 PM	0.83
2009-231	01:11:00 AM	0.81	2009-264	01:54:00 AM	0.86
2009-231	09:35:00 PM	0.84	2009-264	02:25:00 PM	0.85
2009-232	01:12:00 AM	0.85	2009-265	01:18:00 AM	0.85
2009-232	02:15:00 PM	0.85	2009-265	02:20:00 PM	0.86
2009-233	12:59:00 AM	0.86	2009-266	01:35:00 AM	0.87
2009-233	04:26:00 PM	0.85	2009-266	02:20:00 PM	0.87
2009-234	12:55:00 AM	0.88	2009-267	02:20:00 PM	0.89
2009-234	03:36:00 PM	0.87	2009-267	02:35:00 PM	0.88
2009-235	12:30:00 AM	0.9	2009-268	01:27:00 AM	0.89
2009-236	04:00:00 PM	0.89	2009-268	02:37:00 PM	0.87
2009-237	01:11:00 AM	0.9	2009-269	01:33:00 AM	0.89
2009-237	08:34:00 PM	0.86	2009-269	02:42:00 PM	0.88
2009-238	01:46:00 AM	0.86	2009-270	01:41:00 AM	0.89
2009-238	03:44:00 PM	0.86	2009-270	02:31:00 PM	0.88
2009-239	12:29:00 AM	0.88	2009-271	01:49:00 AM	0.89
2009-239	03:33:00 PM	0.87	2009-271	05:00:00 PM	0.85
2009-240	12:50:00 AM	0.88	2009-272	02:27:00 PM	0.85
2009-240	03:54:00 PM	0.88	2009-272	07:55:00 PM	0.86
2009-241	12:35:00 AM	0.87	2009-273	02:40:00 PM	0.87
2009-241	03:27:00 PM	0.88	2009-274	01:55:00 AM	0.87
2009-242	12:48:00 AM	0.89	2009-274	02:40:00 PM	0.88
2009-242	03:15:00 PM	0.91	2009-274	07:45:00 PM	0.87
2009-243	12:03:00 AM	0.92	2009-275	02:30:00 PM	0.86
2009-243	03:27:00 PM	0.84	2009-276	01:30:00 AM	0.89
2009-244	12:10:00 AM	0.86	2009-276	02:57:00 PM	0.88
2009-244	03:22:00 PM	0.86	2009-277	01:50:00 AM	0.9
2009-245	12:44:00 AM	0.86	2009-278	02:44:00 PM	0.9
2009-245	03:46:00 PM	0.87	2009-279	01:42:00 AM	0.89
2009-246	12:41:00 AM	0.89	2009-279	02:15:00 PM	0.9
2009-246	03:45:00 PM	0.9	2009-279	09:45:00 PM	0.89

C4. TIDES

All sounding data were initially adjusted to MLLW using predicted tidal data from the Seattle tide station (9447130). Predicted tides were used for preliminary processing only. Verified tides were downloaded from the NOAA database for the Seattle tidal gauge on October 28th. Verified tidal data were used for all final base surfaces.

For more detail concerning the tidal zones, see the Horizontal and Vertical Control report.

C5. VESSEL ATTITUDE

The Defender's heading and dynamic motion were measured by the IXSEA Octans III (IMU). The system calculated heading and motion using its fiber optic gyroscope and motion sensor. The Octans was installed in the port engine compartment of the Defender as close to the center of gravity as possible. The operational accuracy specifications for this system can be found in appendix I.

The Beaver used a Coda Octopus F180 for positioning and motion reference. The F180 uses a pair of GPS antennas to determine heading. The two GPS antennas were mounted along the port side of the cabin with a 2 meter baseline. Heave, pitch, and roll were measured with the F180's MRU which was mounted just forward of the EM 3002 and directly above. For operational accuracy specifications see appendix J.

C6. CALIBRATIONS

Multibeam

Multibeam patch tests were conducted prior to the survey in Lake Union just north of downtown Seattle. The M/V Defenders patch test was conducted on JD 224. M/V Beavers patch test was conducted on JD 231.

Offsets from the M/V Beaver calibration were changed 4 times after the initial calibration. Each alteration coincided with a patch test. These were performed because the M/V Beaver was dry docked periodically due to Sound Velocity Sensors malfunctions at the EM 3002 sonar head. Re-installation of sound velocity sensors at the transducer head required the removal and re-installation of the transducer itself. Calibrations were completed after every dry docking and prior to any sonar acquisition in the survey areas. The dates for these calibrations are (JD): 238, 243, 247 (Yaw Offset patch test using outfall pipes off Steilacoom) and 274.

Roll offsets for the M/V Defender proved to be an issue due to the configuration of the Reson 8101 transducer mounting pole. Each day the mounting pole was winched tightly in place to where the winch cable was marked. Even though no visible difference between days could be observed on deck it became apparent in the data that we were getting a fraction of a degree in roll offset variation, the standard deviation of which was 0.21 degrees (average of -1.47 deg) over the course of the entire survey. These variations were accounted for by running two parallel lines half a swath distance apart each day for calibration purposes. The end result shows no significant errors in roll.

All calibration lines and vessel files (HVF) are included in the digital data deliverables. Please see Appendix K for the calibration report and procedures.

D - Approval Sheet

REGISTRY NUMBER H12053

This report and the accompanying digital data are respectfully submitted.

Field operations contributing to the accomplishment of project H12053 were conducted under my direct supervision with frequent personal checks of progress and adequacy. This report and smooth sheet have been closely reviewed and are considered complete and adequate as per the Statement of Work.

WILLIAMSON AND ASSOCIATES, INCORPORATED

Digitally signed by Donald L. Brouillette
DN: cn=Donald L. Brouillette, o=Williamson and Associates, ou=Survey, email=dbrouillette@wassoc.com, c=US
Date: 2010.02.18 22:13:43 -08'00'

Donald L. Brouillette

Hydrographer

Williamson & Associates, Incorporated

18 February 2010

KMI Leasing Co., LLC

Defender Class

KMI Leasing offers four state-of-the-art, all-aluminum catamarans for Lease or Charter

469 NW Bowdoin Place ⌘ Seattle, WA 98107 Phone: (206) 353-7441 ⌘ E-mail: garyb@kvichak.com

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DEFENDER CLASS

Fast-response, versatile catamarans for a wide range of applications

▪ Research ▪ Security
▪ Dive ▪ Crew Assist

▪ ROV & AUV
▪ Sonar
(side-scan, towed, pole-mounted)

SPECIFICATIONS

54' Length x 20' Beam Twin Caterpillar 3196 engines

300 gal. fresh water capacity Crew accommodations for six

1200 gallon fuel capacity Top speed ~30 knots

A-Frame & Davit Full Galley

For additional information & rates contact: Gary Buholm
Phone: (206) 353-7441 garyb@kvichak.com

M/V Beaver 30' Sea Ark Survey Vessel

Length	30'
Beam	9'8"
Draft	30"
Propulsion	Cummins 6 BTA 5.9 300 HP
Gear Boxes	Twin Disc 506 2:1
Cooling	Furmstrum
Shafts	1 3/8 Aquamet A19
Propellers	22 x22 non slip
Service Speed	22 Kts
Top Speed	26 Kts.
Transducer Hi	200khz 3.5 deg
Transducer Low	24 khz 33 deg
GPS	AG 132
GPS II	AG 112
Sounder	Innerspace 456
Tide Gauge	Lyman Burke & Assoc

SeaBat 8101

Multibeam Echosounder

The SeaBat 8101 Multibeam Echosounder measures discrete depths, enabling complex underwater features to be mapped with precision. Dense coverage is achieved utilizing up to 4,000 soundings per second for a swath up to 600 meters in width, even as the survey vessel travels at speeds in excess of 12 knots.

With high accuracy and a measurement rate of up to 40 profiles per second, the SeaBat 8101 enables surveys to be completed faster and in greater detail than previously realized.

The SeaBat 8101 transducer is available for operating depths of 120, 300, 1500, and 3,000 meters. Small and lightweight, it can be mounted on underwater vehicles (ROV or towed) and transported to locations where accurate measurements are required.

- **Phase and amplitude bottom detection**
- **150° swath coverage (upgradeable to 210°)**
- **240kHz frequency**
- **Up to 600m swath width**

SeaBat 8101

Multibeam Echosounder

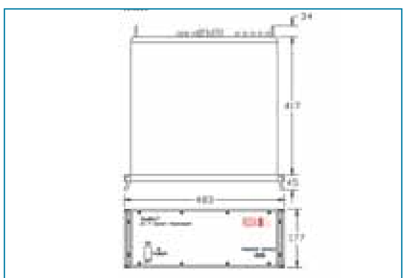
SYSTEM PERFORMANCE		
Operating Frequency:	240kHz (nominal)	
Swath Coverage:	150°	(upgradeable to 210°)
Max Range:	300m	
	450m max range available with ER option	
Number of Beams:	101, beamspacing 1.5°	
Along-Track Beamwidth:	1.5° (nominal)	
Across-Track Beamwidth:	1.5° (nominal)	
Max. Update Rate:	40	
Operational Speed:	Up to 18 knots	

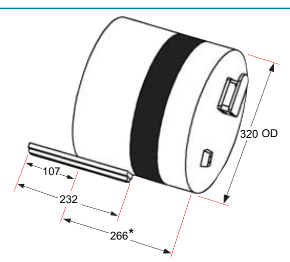
PROCESSOR SPECIFICATIONS		
Power Required:	100/240VAC, 47/63Hz, 100W maximum	
Data Uplink:	High-speed digital coax with fiber-optic option	
Computer Interface:	10MB Ethernet and RS232C	
Data Downlink:	Serial, 19.2k baud	
Display Video Out:	SVGA: 800 x 600;	
	Refresh Rate:	~72Hz
Graphics Colors:	Sonar Image:	256 Colors
	Other Graphics:	8-bit RGB
Input Device:	3-Button Trackball	
Dimensions (HWD):	177 x 483 x 417mm	
Mounting:	19in. rack mountable	
Temperature:	Operating:	0° to +40°C
	Storage:	-30° to +55°C
Weight:	20kg (44 lbs.)	

DISPLAY SPECIFICATIONS	
Screen Size:	14” diagonal
Display:	SVGA High-Resolution, Color Monitor
Power Consumption:	80W
Weight:	11.2kg (24.6lbs.)

SONARHEAD SPECIFICATIONS		
Power Requirements:	24VDC, 2 amps max. (Power available from Processor.)	
Operating Depth:	120m (300,1500, and 3000m available)	
Dimensions:	266 x 320mm (W / D) excluding projector	
Temperature:	Operating:	-5° to +40°C
	Storage	-30° to +55°C
Weight (aluminum):	Dry:	26.8kg (59lbs.)
	Wet:	4.8kg (10.6lbs.)
Weight (titanium):	Dry:	40kg (88lbs.)
	Wet:	18kg (39.6lbs.)

OPTIONS	
Sidescan ugrade	Mounting plate assembly
Fairings	Spares kit
Titanium housing	210° swath
Extended-Range (ER) projector	Coax to fiber optic interface unit
Increase sonar head depth rating	





*Option 049: 274mm

For Acoustical Measurement Accuracy please refer to www.reson.com or contact sales.

RESON A/S
Denmark
Tel: +45 4738 0022
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The Netherlands
Tel: +31 (0)10 245 1500
E-mail: info@reson.nl

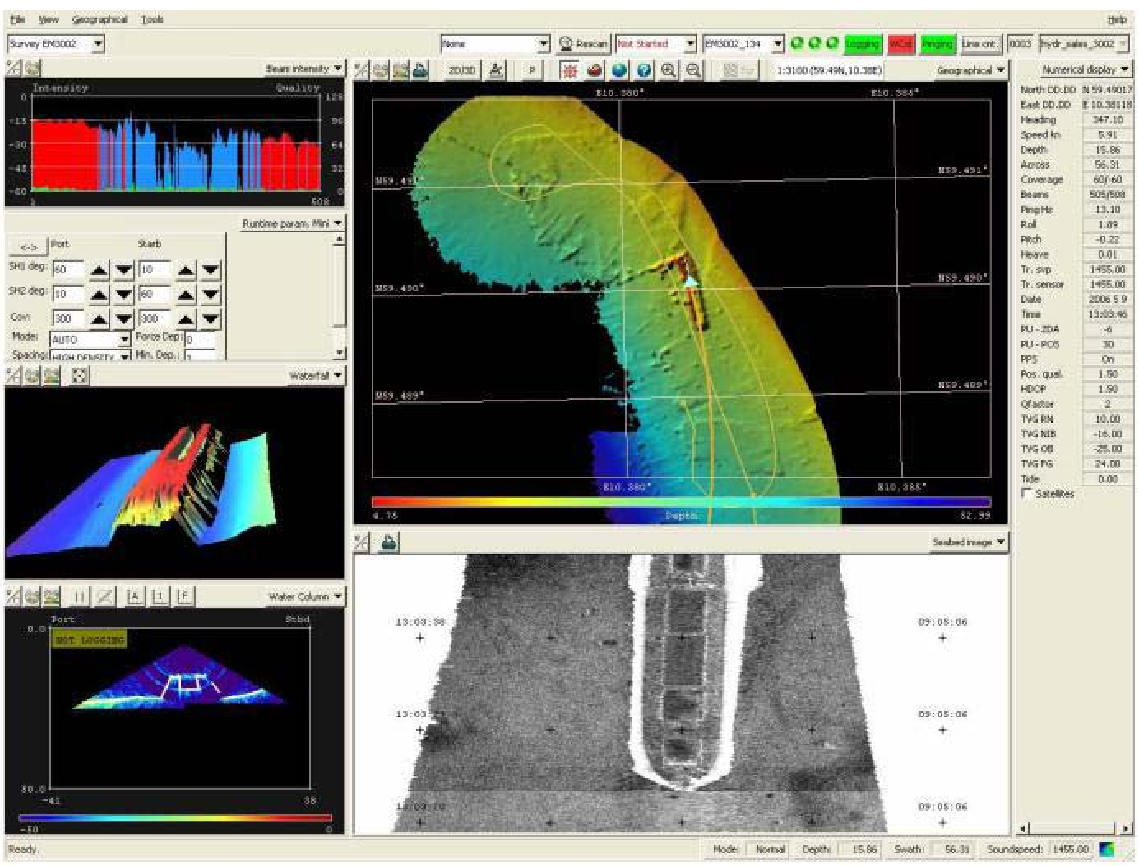
Version: B007 0705

EM 3002

KONGSBERG

Multibeam echo sounder

The new generation high performance shallow water multibeam



(855-164771 / Rev.E / 20.06.2006)

System description

Key facts

The **EM 3002** is a new advanced multibeam echo sounder with extremely high resolution and dynamically focused beams. It is very well suited for detailed seafloor mapping and inspection with water depths from less than 1 meter up to typically 200 meters in cold oceanic conditions. Maximum depth capability is strongly dependant on water temperature and salinity - up to 300 meters is possible under favorable conditions. Due to its electronic pitch compensation system and roll stabilized beams, the system performance is stable also in foul weather conditions.

The spacing between soundings as well as the acoustic footprints can be set nearly constant over the swath in order to provide a uniform and high detection and mapping performance. Dynamic focusing of all receive beams optimizes the system performance and resolution for short range applications such as underwater inspections.

Typical applications

- Mapping of harbours, inland waterways and shipping channels with critical keel clearance
- Inspection of underwater infrastructure
- Detection and mapping of debris and other underwater objects
- Detailed surveys related to underwater construction work or dredging
- Environmental seabed and habitat mapping
- Mapping of biomass in the water column

Features

The EM 3002 system uses frequencies in the 300 kHz band. This is an ideal frequency for shallow water applications, as the high frequency ensures narrow beams with small physical dimensions. At the same time, 300 kHz secures a high maximum range capability and robustness under conditions with high contents of particles in the water.

EM 3002 uses a powerful sonar processor unit in combination with 1 or 2 compact sonar heads. The high computing power of the EM 3002 sonar processor makes it possible to apply sophisticated and exact signal processing algorithms for beamforming, beam stabilisation, and bottom detection. In High Density processing mode the system has close to uniform acoustic footprints and resolution over the whole swath width, and therefore a much improved capability to detect objects and other details on the bottom.

EM 3002 will in addition to bathymetric soundings, produce an acoustic image of the seabed. The image is obtained by combining the acoustic return signals inside each beam, thus improving signal to noise ratio considerably, as well as eliminating several artifacts related to conventional sidescan sonars. The acoustic image is compensated for the transmission source level, receiver sensitivity and signal attenuation in the water column, so that reliable bottom backscatter levels in dB are obtained. The image is also compensated for acoustic ray bending, and thus completely geo-referenced, so that preparation of a sonar mosaic for a survey area based upon data from several survey lines is easy. Objects observed on the seabed image are correctly located and their positions can be readily derived.

List of options

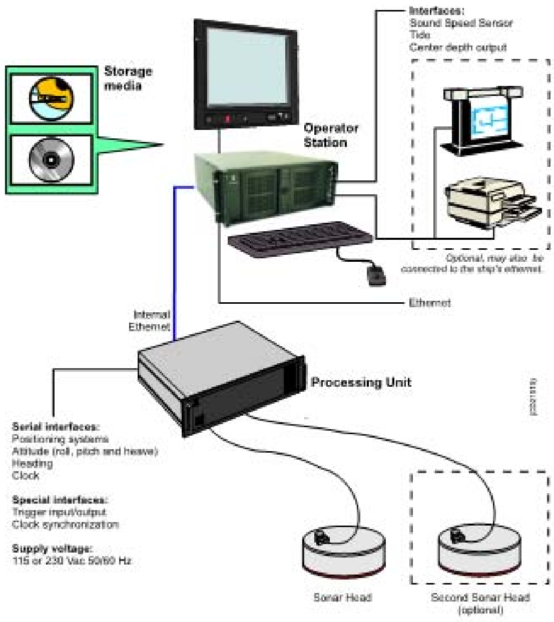
- Dual sonar heads - EM 3002D
- Logging of water column data
- Software for Automatic Calibration
- CUBE terrain modeling SW
- Extended depth raiting for transducer(s): 1500 m
- Extended length of transducer cable: 30 or 45 m
- Bracket for portable mounting of sonar head(s)
- Flight case for safe transportation of 1 sonar head w/cable
- Flight case for processing unit and operators workstation

- Full swath width accuracy to the latest IHO standard
- Swath width up to 10 x water depth (EM 3002D) or 200 m (cold oceanic water)
- Depth range from < 1 meter to > 200 meters
- Bottom detection by phase or amplitude
- 100% bottom coverage even at more than 10 knots vessel speed
- Real-time ray bending and attitude compensation
- Seabed image (sidescan) data output
- Sonar heads for 500 or 1500 meters depth rating
- Water column data display window + logging (optional)

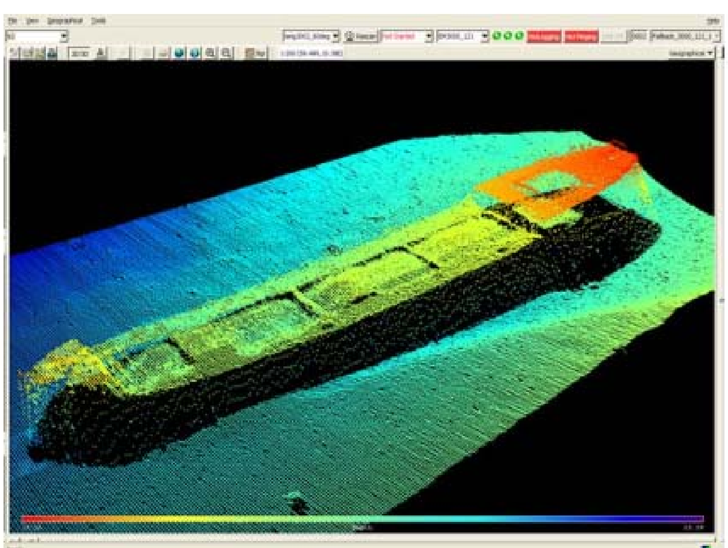
Operator Station

The Operator Station is a rugged zed PC workstation running on either Linux® or Microsoft Windows XP®. The Operator Station software, SIS, has extensive functionality such as 3D graphics, real-time data cleaning and electronic map background.

The EM 3002 can be set up to use other operational software than SIS, for example "QINCy®" or Costal Oceanographics "HYPACK® Max", and is also supported by software from Triton Elics International, EIVA and others.



Typical system configuration with desktop Operator Station, Processing Unit and one or two Sonar Heads.



The image of a sunken wreck at 20 m depth.

Note that Kongsberg Maritime AS does not take any responsibility for system malfunction caused by third-party software.

Advanced functions

- Bottom detection uses a combination of amplitude and phase processing in order to provide a high sounding accuracy over the whole swath width.
- All beams are stabilized for pitch and roll movements of the survey vessel, by electronically steering the transmit beam as well as the receive beams.
- Dynamic focusing of the receive beams is applied in order to obtain improved resolution inside the acoustic near-field of the transducer.
- Swath coverage with one sonar head reaches 130 degrees, but can be manually limited while still maintaining all beams inside the active swath. For deeper waters the swath width will be reduced due to reduced signal-to-noise margin. The system will automatically re-locate all beams to be within the active swath.
- With two sonar heads the swath width will reach 200 degrees to allow for inspection of constructions up to the water surface, as well as for efficient mapping of beaches, rivers and canals. On a flat shallow seabed the swath-width can be about 10 x depth.
- Operator controlled equidistant or equiangular beam spacing.

Technical specifications

Operational specifications

Frequencies .... 293, 300, 307 kHz
Number of soundings per ping:
  Single sonar head .... Max 254
  Dual sonar heads .... Max 508
Maximum ping rate .... 40 Hz
Maximum angular coverage:
  Single sonar head .... 130 degrees
  Dual sonar heads .... 200 degrees
Pitch stabilisation .... Yes
Roll stabilisation .... Yes
Heave compensation .... Yes
Pulse length .... 150 µs
Range sampling rate .... 14, 14.3, 14.6 kHz
Depth resolution .... 1 cm
Transducer geometry .... Mills cross
Beam spacing .... Equidistant or equiangular
Beamforming:
- Time delay with shading
- Dynamically focused receive beams

Seabed image data

- Composed from beamformed signal amplitudes
- Range resolution 5 cm.
- Compensated for source level and receiver sensitivity, as well as attenuation and spherical spreading in the water column.
- Amplitude resolution: 0.5 dB.

External sensors

- Position
- Heading
- Motion sensor (Pitch, roll and heave)
- Sound velocity profile
- Sound velocity at transducer.
- Clock synchronisation (1 PPS)

Environmental and EMC specifications

The system meets all requirements of the IACS E10 specification.The Operator Station, LCD monitor and Processing Unit are all IP22 rated.

Dimensions and weights

Sonar head:
  Shape .... Cylindrical
  Housing material .... Titanium
  Diameter .... 332 mm
  Height .... 119 mm
  Weight .... 25 kg in air, 15 kg in water
  Pressure rating .... 500 m (1500 m option)
  transducer cable length .... 15 m

Sonar Processing Unit:
  Width .... 427 mm
  Depth .... 392 mm
  Height .... 177 mm
  Weight .... 14.5 kg

Operator Station:
  Width .... 427 mm
  Depth .... 480 mm
  Height .... 127 mm
  Weight .... 20 kg

19" industrial LCD monitor:
  Width 483mm
  Depth .... 68 mm
  Height .... 444 mm
  Weight .... 12 kg
  Resolution .... 1280 x 1024 pixels

All surface units are rack mountable. Dimensions exclude handles and brackets.

Kongsberg Maritime is engaged in continuous development of its products, and reserves the right to alter the specifications without further notice.

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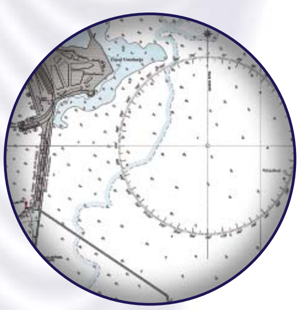
E-mail: subsea@kongsberg.com

KONGSBERG

Hemisphere GPS

MBX-4

Reliable Auto-Tracking Differential Beacon Receiver



Provide a reliable source of free differential corrections with the MBX-4 Differential Beacon Receiver that augments a separate GPS receiver with free accuracy-improving correction data from networks of beacon stations located throughout the world. With automatic dual-channel tracking, the MBX-4 ensures the best beacon station is always being decoded. Beacon stations are automatically tracked based on signal strength or station distance and can also be manually selected.

Hemisphere GPS' MBX-4 has been optimized for high performance reception and proves reliable even in noisy environments. It outputs the industry standard RTCM SC-104 format accepted by differential-ready GPS receivers and can be configured and monitored with NMEA 0183 protocol. Hemisphere GPS' MBX-4 receiver kit includes an integrated GPS and beacon antenna.

Key MBX-4 Advantages

- Supplements GPS systems with free beacon differential corrections, capable of sub-meter accuracy (depending on GPS receiver quality)
- Dual-channel design allows strongest signal or closest station selection
- Integrated signal splitter outputs GPS signal from combined GPS / differential antenna
- Simple to monitor and configure through menu system and display
- Patented ceramic filter blocks out-of-band signals, optimizing reception

Hemisphere GPS

MBX-4 Beacon Receiver

Receiver Specifications

Channels:	2-channel, parallel tracking
Channel Spacing:	500 Hz
Frequency Range:	283.5 to 325.0 Hz
MSK Bit Rates:	50, 100, 200 bps
Operating Modes:	Manual, Automatic and Database
Cold Start Time:	<1 min
Warm Start Time:	<2 seconds
Demodulation:	Minimum Shift Keying (MSK)
Sensitivity:	2.5 µV/m for 6 dB SNR
Dynamic Range:	100 dB
Frequency Offset:	±8 Hz (27 ppm)
Adjacent Channel Rejection:	61 dB @ ± 400 Hz
Correction Output Protocol:	RTCM SC-104
Input Status Protocol:	NMEA 0183

Communications

Interface:	RS-232C or RS-422
Baud Rates:	2400, 4800, 9600

Environmental Specifications

Operating Temperature:	-30°C to +70°C (-22°F to 158°F)
Storage Temperature:	-40°C to +80°C (-40°F to 176°F)
Humidity:	95% non-condensing
EMC:	CISPR22 EN 61000-6-1 CE

Power Specifications

Input Voltage Range:	9 to 40 VDC
Nominal Power:	2.5 W
Nominal Current:	210 mA @ 12 VDC
Antenna Voltage Output:	10 VDC (5 VDC optional)
Antenna Input Impedance:	50

Mechanical Specifications

Dimensions:	150 mm L x 125 mm W x 51 mm H (5.9 L x 4.9 W x 2.0 H inches)
Weight:	0.64 kg (1.4 lb)
Display:	2-line x 16-character LCD
Keypad:	3-key switch membrane
Power Connector:	2-pin circular locking
Data Connector:	DB9-S
Antenna Connector:	BNC-S
Optional GPS Output Port:	TNC-S

NMEA 0183 I/O

- Receiver Automatic, Database and Manual tune command
- Frequency and data rate query
- Receiver performance and operating status queries
- Automatic search almanac queries (proprietary)
- Baud rate selection command
- Receiver tune command
- Force cold start command (proprietary)
- Software upgrade command (proprietary)
- Configuration up-load command (proprietary)

Back Panel Configuration

Authorized Distributor:

HEMISPHERE GPS
4110 - 9th Street S.E.
Calgary, AB T2G 3C4
Canada

Phone: 403.259.3311
Fax: 403.259.8866
Toll Free: 800.274.9190
precision@hemispheregps.com
www.hemispheregps.com

GBX-PRO

High Accuracy GPS/Beacon Receiver

Combination GPS/Beacon Receiver

FEATURES

- Real-time sub-meter accuracy
- 12-Channel all-in-view GPS satellite tracking
- 5 Hz NMEA position update rates
- Dual channel beacon receiver
- State-of-the-art digital architecture
- 2-line by 16-character LCD display and 3-switch keypad
- GPS and beacon status information
- Fast satellite and beacon acquisition
- 1 PPS timing signal
- External RTCM input
- Global beacon listing
- Wide input voltage range
- Low power consumption
- Automatic and manual beacon modes
- Single "Smart" port for GPS and beacon receiver configuration

Real-Time, Performance

The CSI GBX-PRO differential GPS receiver combines the performance of CSI's third generation digital beacon receiver technology with the proven Ashtech G-12 GPS Board™ in a single high performance package.

The GBX-PRO utilizes free GPS satellite and 300 kHz beacon signals to calculate differentially corrected 3D positions with a horizontal accuracy of less than one meter (95%). The internal beacon receiver supplies differential GPS corrections to the GPS engine in the RTCM SC-104 format. Various authorities around the world broadcast free differential correction information on radiobeacon transmissions that meet the stringent integrity and reliability requirements mandated by the International Association of Light House Authorities (IALA).

The GBX-PRO also provides the facility for correction input from an external RTCM source. The GBX includes a second differential input port so that external RTCM input does not interfere with bi-directional communications on the main serial port.

Ease of Operation

The GBX-PRO receiver is designed with ease of operation in mind, incorporating a 2-line by 16-character LCD display and 3-switch keypad for configuration and operation of the internal beacon and GPS receivers. A "Smart" data port on the back panel provides access to both internal devices, through the same serial connector.

CSI's MGL-3 Combination GPS/Beacon Loop antenna simplifies installation by combining an L1 GPS patch antenna, ground plane, and an H-field beacon Loop antenna in one package. For added flexibility, you may use separate GPS and beacon antennas in conjunction with CSI's External Signal Combiner which converts two antenna outputs into a single input to the GBX-PRO.

Advanced Beacon Receiver Technology

Advanced digital signal processing techniques are the mainstay of CSI's beacon receiver products. The GBX-PRO will operate reliably in the noisy environments characteristic of many DGPS installations.

The GBX-PRO is able to operate in automatic or manual beacon tune modes. In automatic mode, the two channels of the internal beacon receiver cooperatively construct and maintain a table composed of available radiobeacons in your area. The receiver automatically locks to the station with the highest quality signal.

Configuration Software

CSI offers custom Windows 95® software for GPS and beacon receiver configuration and monitoring of receiver status. Data logging capability and a terminal interface are also included.

Warranty

CSI is committed to supporting its products and offers a one-year warranty on parts and labor.

Contact us to discover how the GBX-PRO can meet the positioning requirements of your application.

GBX-PRO – *High Accuracy GPS/Beacon Receiver*

Optional GPS Features

- 10 Hz and 20 Hz position update rates
- R.A.I.M.
- Strobe Correlator™
- Geoidal height and magnetic declination
- Base station

GPS Receiver Specifications

Channels:	12-Channel L1 C/A Code, carrier smoothed
Horizontal Diff. Accuracy:	< 1 m (95% confidence)
Differential Input:	RTCM SC-104
Input/Output Messages:	NMEA 0183
Position Update Rate:	up to 5 Hz
Raw Data Output Rate:	up to 2 Hz (code and carrier)

- Please contact CSI for detailed Ashtech G-12 GPS™ specifications

Beacon Receiver Specifications

Channels:	2 independent channels
Frequency Range:	283.5 to 325.0 kHz
Channel Spacing:	500 Hz
MSK Bit Rates:	50, 100, and 200 bps
Cold Start Time:	< 1 minute
Warm Start Time:	< 2 seconds
Demodulation:	Minimum shift keying
Sensitivity:	2.5 µV/m for 10 dB SNR
Dynamic Range:	100 dB
Frequency Offset:	± 5 Hz
Adjacent Channel Rejection:	60 dB @ f_o ± 500 Hz

GBX-PRO Communications

Interface Level:	RS-232C
Baud Rates:	2400, 4800, 9600
Correction Output Protocol:	RTCM SC-104
Input/Status Protocol:	NMEA 0183
Timing:	1 PPS ± 190 ns

GBX-PRO Environmental Specifications

Operating Temperature:	-30°C to +70°C
Storage Temperature:	-40°C to +80°C
Humidity:	95% non-condensing
EMC:	EN 60945, EN 50081-1, EN 50082-1 FCC: Part 15, sub-part J, class A digital device

GBX-PRO Power Specifications

Input Voltage:	9 - 40 VDC
Nominal Power:	4.8 W
Antenna Voltage Output:	10 VDC (5 VDC optional)

GBX-PRO Mechanical Specifications

Dimensions:	163 mm L x 125 mm W x 51 mm H (6.4" L x 4.9" W x 2.0" H)
Weight:	1.75 lb
Display:	2-line by 16-character LCD
Keypad:	3-key switch membrane
Power Connector:	2-pin circular locking
Data Connector:	DB9-S
Antenna Connector:	BNC-S

GBX-PRO Operating Modes

GBX-3 Mode (Default)	GBX outputs GPS NMEA messages (Default Mode)
MBX-3 Mode:	GBX outputs RTCM for use by an external GPS receiver
GBX-E Mode:	Correction input from an external RTCM source

Pin-Out, RS-232C

DB9 Pin #	Description
2	TXA, GBX NMEA 0183 output
3	RXA, GBX NMEA 0183 input
5	Signal return
8	RXB, external RTCM input
9	1 PPS output (TTL logic level, 75Ω)

GBX-PRO Accessories

Antenna:	MGL-3
Power Cables:	Various
Antenna Cables:	Various
Data Cables:	Various
CSI GPS Command Center:	MS Windows 95® GPS control software
CSI Beacon Command Center:	MS Windows 95® beacon control software

MGL-3 Combination Antenna

Beacon Frequency Range:	283.5 to 325.0 kHz
Beacon LNA Gain:	34 dB
GPS Frequency Range:	L1 (1575 MHz)
GPS LNA Gain:	30 dB
Dimensions:	128 mm square x 84 mm H (5.1" square x 3.3" H)
Weight:	0.45 kg (1.0 lb)
Antenna Connector:	TNC-S
Enclosure:	PVC plastic
Mount:	1-14-UNS-2B (marine std.)
Input Voltage:	4.9 to 13.0 VDC
Input Current:	50 to 60 mA
Operating Temperature:	-30°C to +70°C
Storage Temperature:	-40°C to +80°C
Relative Humidity:	100% condensing

CSI Authorized Dealer

Communication Systems International, Inc.
1200 – 58th Avenue S.E., Calgary, AB, Canada, T2H 2C9
Phone: (403) 259-3311 Fax: (403) 259-8866
Web: www.csi-dgps.com e-mail: info@csi-dgps.com

Manufacturer	Description	Software Version	Serial #
QPS	QINSy	8.00.2009.07.21	
QPS	Qomposer	1.30.2008.02.08.1	
CARIS	Hips	6.1 w/ Service Pack 2 and Hotfixes 1-8	
IVS 3D	Fledermaus	v6.7	
Global Mapper	Global Mapper	v11	
Kongsberg	Seafloor Information System	v3.6.0	
Microsoft	Office 2007		
Open Office	Open Office	v3.1.1	
Seabird	Seaterm	v1.59	
Vailport	DataLog Express	0040/7115/e4 07/08/2009	

M/V Defender IV

Nomenclature	Model	Serial Number	Comments
Furuno AIS/DGPS	FA-150	016764	Transponder FA1501 S/N 3552-7456
Hemisphere Beacon Receiver	MBX 4	0923-9416-0006	
Ixsea Gyro/MRU	Octans	3453-470	
Trimble DGPS	SPS-851	4822K56259	Zephyr Model 2 Antenna S/N 1440912525
QPS Navigation Software	QINSy	Version 8.0 Release 8.00.2009.07.21	
Reson Multibeam Echo Sounder	Seabat 8101	19315-81P	Transducer S/N 099809
Seabird CTD	Seacat SBE 19 Plus	19P46434-5077	
Navigation Computer	Windows XP SP3	Acq 2	
Multibeam Acquisition Computer	Windows XP SP3	Acq 4	
Seabird Seaterm Software		Version 1.59	

M/V Beaver

Nomenclature	Model	Serial Number	Comments
Octopus Precision Attitude and Positioning System	F180	F1107078	
Kongsberg Multibeam Echo Sounder	EM3002	1561	Transducer S/N 229
Trimble DGPS	DSM-232	0225106471	
Hemisphere Beacon Receiver	GBX Pro	0234-10381-0001	
Valeport Sound Velocity Profiler	MIDAS SVP	19024	
Seabird CTD	Seacat SBE 19	1916199-1767	
SIS Acquisition Computer	Windows XP SP3		
Kongsberg SIS Software		Version 3.6	
Seabird Seaterm Software		Version 1.59	
Valeport Datalog Express Software		Version 0400/7115/E4 07/08/2009	

Ethernet
Bluetooth
Wi-Fi

OCTANS

SURFACE GYROCOMPASS AND MOTION SENSOR

OCTANS, with Ethernet output, is an IMO certified survey grade gyrocompass and complete motion sensor. It is based on IXSEA's FOG technology, which outputs true heading, roll, pitch, surge, sway, heave, speed, acceleration and rate of turn.

FEATURES

- Complete gyrocompass and motion sensor
- Fiber Optic Gyroscope (FOG), unique strap-down technology
- Ethernet, Bluetooth, Wi-Fi
- IMO Certification
- Small, portable plug and play system

BENEFITS

- High-performance real-time outputs of true heading, roll, pitch SAFE HEAVE™, surge, sway as well as acceleration and rate of turn
- No spinning element hence maintenance free
- Wireless network ready
- Pre-approved international quality and safety standard
- Saves valuable time

Courtesy of Boskalis

IXSEA

APPLICATIONS

• Multibeam hydrographic survey • AUV • DP vessels • Dredging • Emergency gyro for submarines • Main AHRS for navigation and dynamic monitoring

OCTANS

TECHNICAL SPECIFICATIONS

IMO Certified
N° 09807/B0 EC

PERFORMANCE

Heading	
Accuracy	0.1 deg secant latitude (1) (2)
Resolution	0.01 deg
Settling time (static conditions)	< 1 min
Full accuracy settling time (all conditions)	< 5 min
Heave / Surge / Sway	
Accuracy	5 cm or 5% (whichever is highest) Set-up free (SAFE-HEAVE ™)
Roll / Pitch	
Dynamic accuracy	0.01 deg (for ±90 deg amplitude)(2)
Range	No limitation (-180 deg to 180 deg)
Resolution	0.001 deg

OPERATING RANGE / ENVIRONMENT

Vibrations	1 g sine (5 to 50 Hz)
Follow-up speed	Up to 750 deg/s
Shocks Operating / Survival	30 g 6 ms / 50 g 11 ms
MTBF	30,000 hours
Operating / Storage Temperature	-40 °C to +60 °C / +80 °C
No warm-up effects	
No latitude or speed limitation	

PHYSICAL CHARACTERISTICS

Dimensions (L x W x H)	280 x 136 x 150 mm
Weight in air	4.6 Kg
Water proof	IP66
Material	Aluminium
Mounting / Connectors	3 off M6 Holes / Souriau military
Inputs	Ethernet / 2 serial / 4 pulses
Outputs	Ethernet / 3 serial / 2 pulses Wi-Fi / Bluetooth

INTERFACES

Output protocols	Industry standards: NMEA 0183, binary
Serial I/O	RS232 or RS422 (user specific)
Baud rates	600 bauds to 115 kbauds
Output frequency	0.1 Hz to 200 Hz
Ethernet	UDP / TCP Client / TCP serveur
Data time stamping accuracy	< 100 microseconds
Power supply / consumption	24 VDC / 18 W

(1) Secant latitude = 1 / cosine latitude
(2) RMS value

Specifications subject to change without notice

IXSEA : • EMEA : +33 (0)1 30 08 98 88 • AMERICAS : +1 (781) 937 8800 • ASIA : +65 6747 4912 • www.ixsea.com

2006-05-PS-OCTSUR

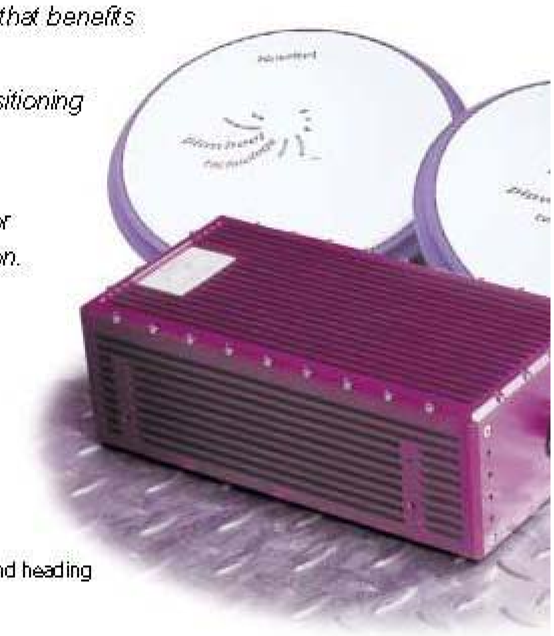

KEY APPLICATIONS:
Multibeam / Geophysical / single beam survey
Dynamic positioning
Platform stabilisation and motion measurement
F180
Attitude and Positioning System
Precise, reliable, dynamic attitude and positioning for the marine environment
• exportable
• affordable
• compatible
• available
• compact
• tried and tested
• supported
OCTOPUS
LeadingGeoSurveySolutions

F180 Attitude and

The Octopus F180 provides the user with highly accurate and reliable motion and position data, in a cost-effective solution that benefits from minimal export restrictions worldwide.

Delivering precise heave, roll, pitch, heading and positioning information in real time, it is a simple, easy-to-use 'plug and play' package.

The F180 is available in flexible 'wet pod', 'one box' or OEM configurations, depending upon your application.



FEATURES

- High accuracy GPS aided inertial navigation system
- Compatible with all leading multibeam sonars
- Plug and play with automatic alignment routine
- Sub 5 minute initialisation
- Zero data degradation and zero drift in all survey dynamics
- Available as one-box 2.5kg, wet pod or OEM package
- Remote location (lever-arm) output of heave, attitude, position and heading
- Optional processed heave output for long swell periods
- Unique WGS84 intelligent strapdown navigation module
- Accepts RTK and differential corrections as standard
- Standard data o/p formats
- Flexible ownership plans

▲ 'One box' 2.5kg dry-mounted Inertial Measurement Unit with Pinwheel Technology GPS antenn

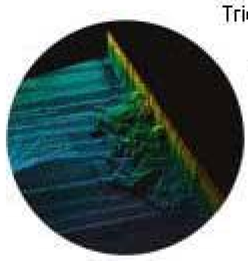
BENEFITS

- Easy to export worldwide – minimal restrictions
- Precise and reliable dynamic, attitude, heading and position
- Replaces standalone motion sensor, marine gyrocompass and GPS
- Lower cost of ownership
- Simple to operate – no precision alignment necessary
- Less weather down-time
- Greater survey productivity
- Premier 24/7 worldwide technical support

◀ 'Wet pod' Inertial Measurement Unit with 19" rack interface for mounting with transducers.

Positioning System

Originally developed for the high-speed world of motor racing, the proven technology in the F180 has been modified and enhanced to produce a commercial-off-the-shelf product that is designed for the most dynamic offshore conditions and any precision marine survey application.



Tried and tested performance

The F180's performance has been documented and the system tried and tested by leading multibeam manufacturers and survey contractors who require reliable and accurate measurements for their marine survey requirements. The F180 is designed to meet and exceed the demands of IHO (International Hydrographic Organisation) Special Order requirements.

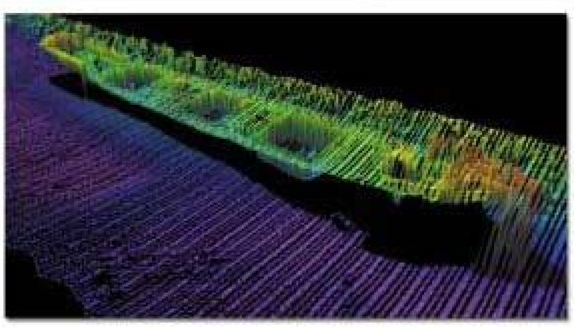
Heave error reduction

The F180 has the optional ability to output processed heave in near real-time allowing compensation of heave errors from very long swell periods.

To allow easy installation, the outputs of the F180 can be mapped to a remote position (e.g. transducer mounting) to give accurate heave, attitude, position and heading at the critical location.

Technical support

Survey vessels and offshore platforms operate worldwide, often in remote locations and in all time zones, which is why the F180 is available off the shelf, is exportable, easy to install and operate – and is supported around the clock by renowned CodaOctopus 24/7 support service.



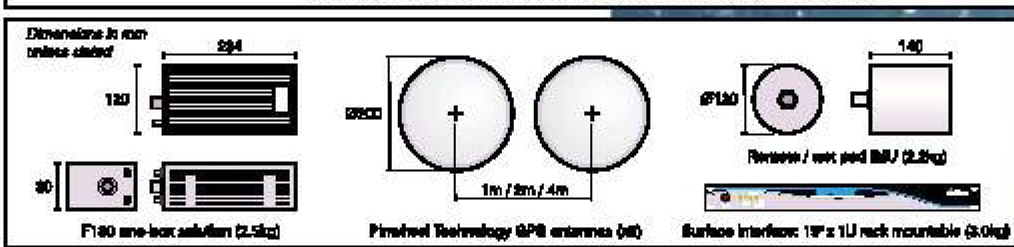
Noise free, accurate and reliable

The F180 uses an advanced 23-state Kalman filter to combine the best qualities of Inertial Navigation Systems (INS) with those of GPS to give noise free, accurate and reliable measurements even during short GPS dropouts. This is very important in high multipath conditions or in survey areas such as ports and harbours, riverbanks, near-shore coastal waters and around offshore structures.

▲ *Courtesy of Srne Portland UK*
Data collected with Reson 8125 multibeam system and F180.

Technical Specification

PERFORMANCE	*RTK*	*DGPS*
Position (m CEP)	0.02	0.5 - 4.0
Velocity (m inus 1)	0.03	0.03
Roll and pitch	< 0.025°	< 0.025°
True heading	1m baseline - 0.1° 2m baseline - 0.05° 4m baseline - 0.025°	1m baseline - 0.1° 2m baseline - 0.05° 4m baseline - 0.025°
Heave	5% of heave amplitude or 5 cm	5% of heave amplitude or 5 cm
PHYSICAL		
Weight	F180 one-box solution Remote / wet pod IMU Surface interface	2.5kg 2.2kg 3.0kg
Power	F180 one-box solution Remote / wet pod IMU Surface interface	9 - 18Vdc 25 Watts 110 - 240 Vac 60 Watts max
Temperature	IMU Antennas Surface rack	-10 to 60°C -40 to 60°C 0 to 60°C
Humidity	IMU (single box and wet pod) Antennas Surface rack	100% 100% 5 to 95% RH none condensing
Vibration	F180 one-box solution and remote / wet pod IMU	0.1g²/Hz 5-500 Hz
Cables	F180 one-box solution Remote / wet pod IMU to surface Antenna	5m standard power, serial and ethernet ethernet combined 25m standard, others to order 15m / 30m standard, others to order
INTERFACES	*Function*	*Output*
Ethernet Interface (100base-T)	Control, set-up and diagnosis of F180 using F180 windows application software.	High data rate output packet (100 Hz) for high speed interfacing. Outputs include position, attitude, heading, velocity, track, speed, acceleration, status performance and raw data.
Serial 1	Attitude data	TSS1, Simrad EM3000 and other standard attitude strings. RS232 (DB9) up to 100Hz at 115k baud.
Serial 2	NMEA position data	GGA position, HDT heading. RS232 (DB9) up to 115k baud
Serial 3	RTK/Differential correction input	RS232 (DB9) up to 115k baud
Other	1 PPS	
Optional	Up to 4 additional serial outputs and format types analogue heave pitch and roll outputs	
Software	Windows application allowing real time display of all output parameters and status messages. Allows reconfiguration of key variables including o/p formats and antenna baselines etc.	



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EM3002 and RESON 8101 CALIBRATION (PATCH TEST)

Multibeam Calibration

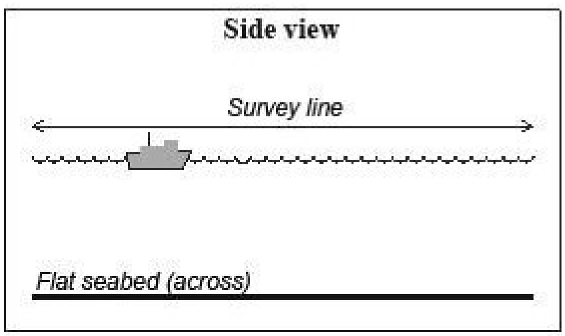
On a flat area only roll error will cause significant depth errors. Sound speed and echo sounder errors are not considered in this discussion. Thus if the survey is to be run in a reasonably flat area, it may be sufficient to perform roll calibration only. Usually, however, a full calibration is required, and the calibration should then be done so that sensor errors, except for the one which is to be determined, have no influence on the echo sounder data. Note that the positioning accuracy is vital for good calibration results.

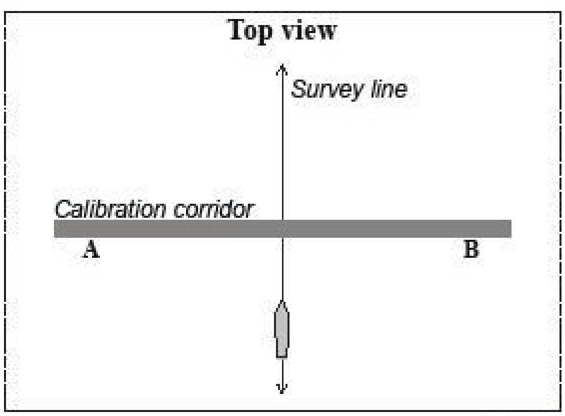
The ideal calibration area is partly flat and partly a fairly sloped with little change in depth acrosstrack, and with a distinct feature such as a peak or hollow in the flat area. If the heading and positioning errors are negligible, the flat area is not required if the slope has a reasonably constant depth acrosstrack. The slope used for pitch and time delay calibration should have an appreciable relative change in depth from top to bottom, 30%, if pitch offset and time delay are to be resolved accurately.

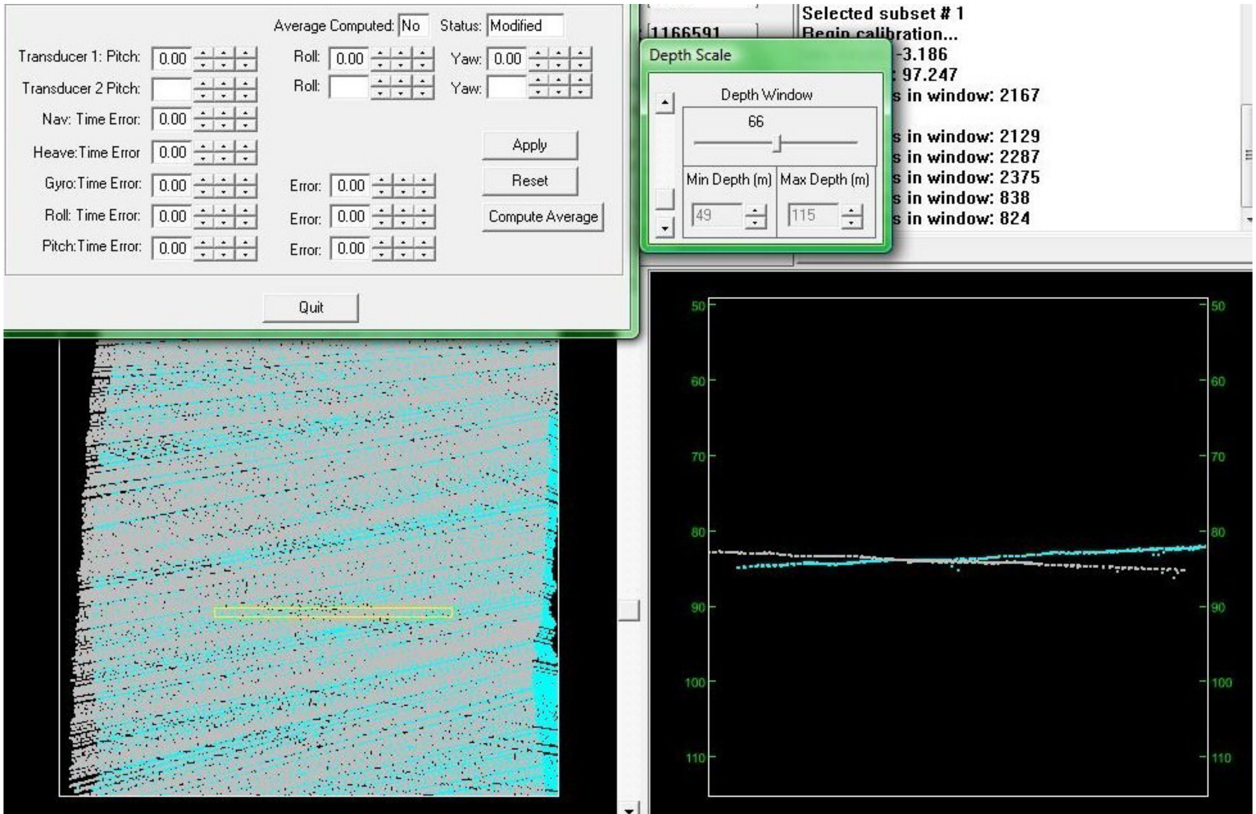
Procedures for running a MBES calibration
(patch test)

Roll offset in the acrosstrack direction

Choose an area that is relatively flat acrosstrack. Survey a sufficiently long line twice in opposite directions. Ensure that a sufficient lead-in time is used for the roll sensor to stabilize. The corridor used to compare data from the two survey data sets should be placed orthogonally to the survey lines. If there is a roll offset, there will be a depth difference between the two data sets, increasing with acrosstrack distance from the center where it is zero.



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Roll: 0.00
Yaw: 0.00
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Roll:
Yaw:
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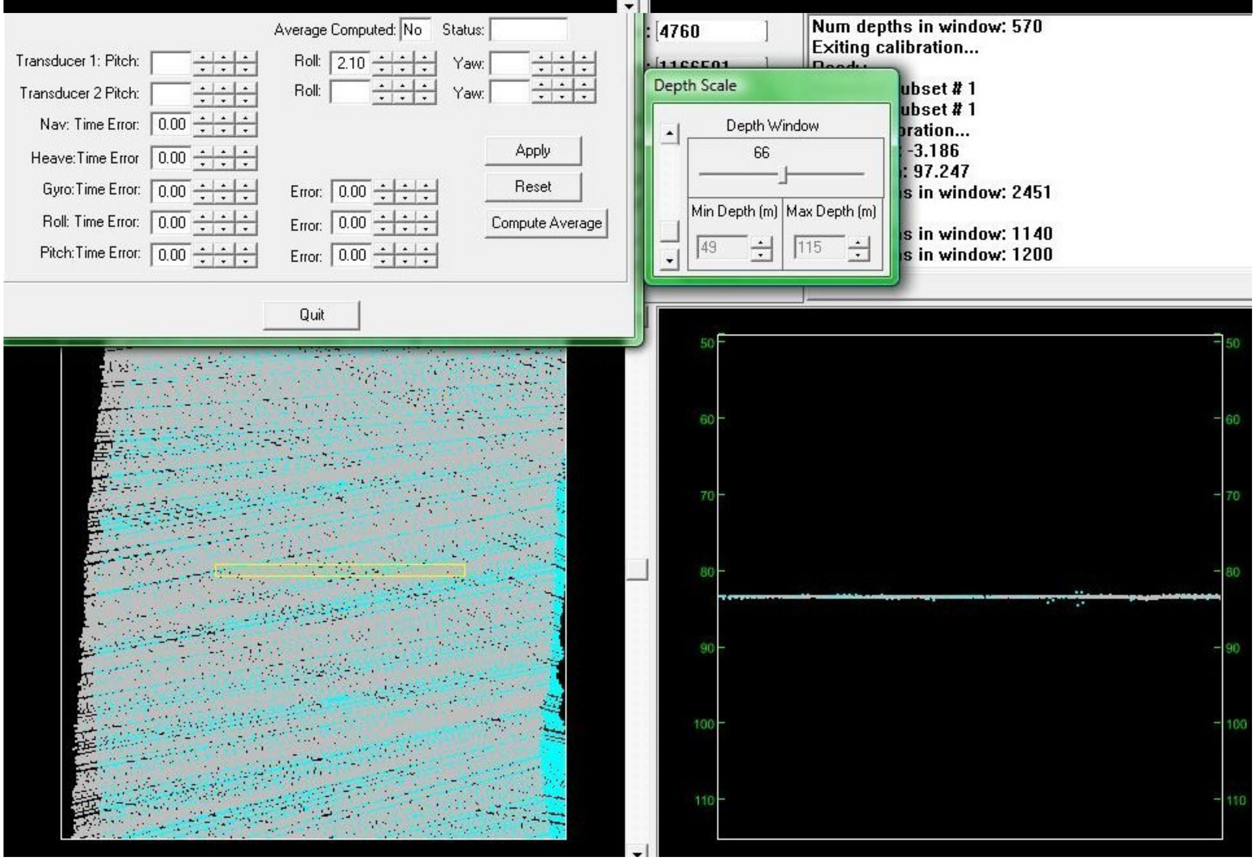
Heave:Time Error 0.00
Gyro:Time Error: 0.00
Roll: Time Error: 0.00
Pitch:Time Error: 0.00
Error: 0.00
Error: 0.00
Error: 0.00
Apply
Reset
Compute Average
Quit
Depth Scale
Depth Window
66
Min Depth (m)
Max Depth (m)
49
115
Selected subset # 1
Begin calibration...
-3.186
97.247
s in window: 2167
s in window: 2129
s in window: 2287
s in window: 2375
s in window: 838
s in window: 824
50
60
70
80
90
100
110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Yaw:
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Roll: Time Error: 0.00
Pitch:Time Error: 0.00
Error: 0.00
Error: 0.00
Error: 0.00
Apply
Reset
Compute Average
Quit
Depth Scale
Depth Window
66
Min Depth (m)
Max Depth (m)
49
115
4760
Num depths in window: 570
Exiting calibration...
ubset # 1
ubset # 1
ration...
-3.186
: 97.247
s in window: 2451
s in window: 1140
s in window: 1200
50
60
70
80
90
100
110

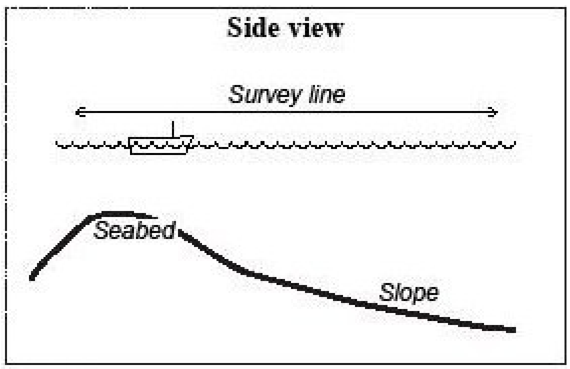
Pitch offset and time delay

Choose an area with a continuous but not too steep slope alongtrack. Survey a sufficiently long line twice in opposite directions with the same vessel speed, and once with a significantly lower speed. The direction is not important in the last survey. Ensure that a sufficient lead-in time to the line is used for the pitch sensor to stabilize.

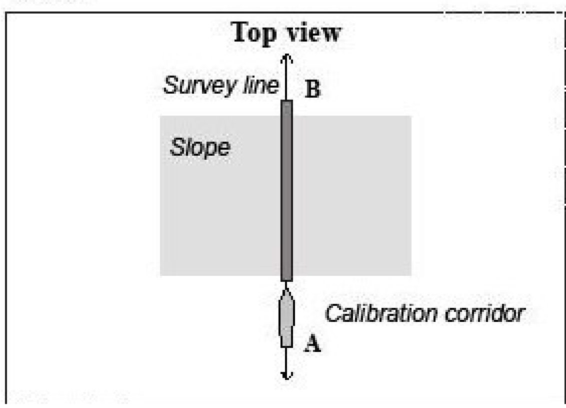
The corridor used to compare data from the survey data sets should be placed parallel to the survey line on the vessel track. Any alongtrack depth difference between the runs may be due to four different factors:

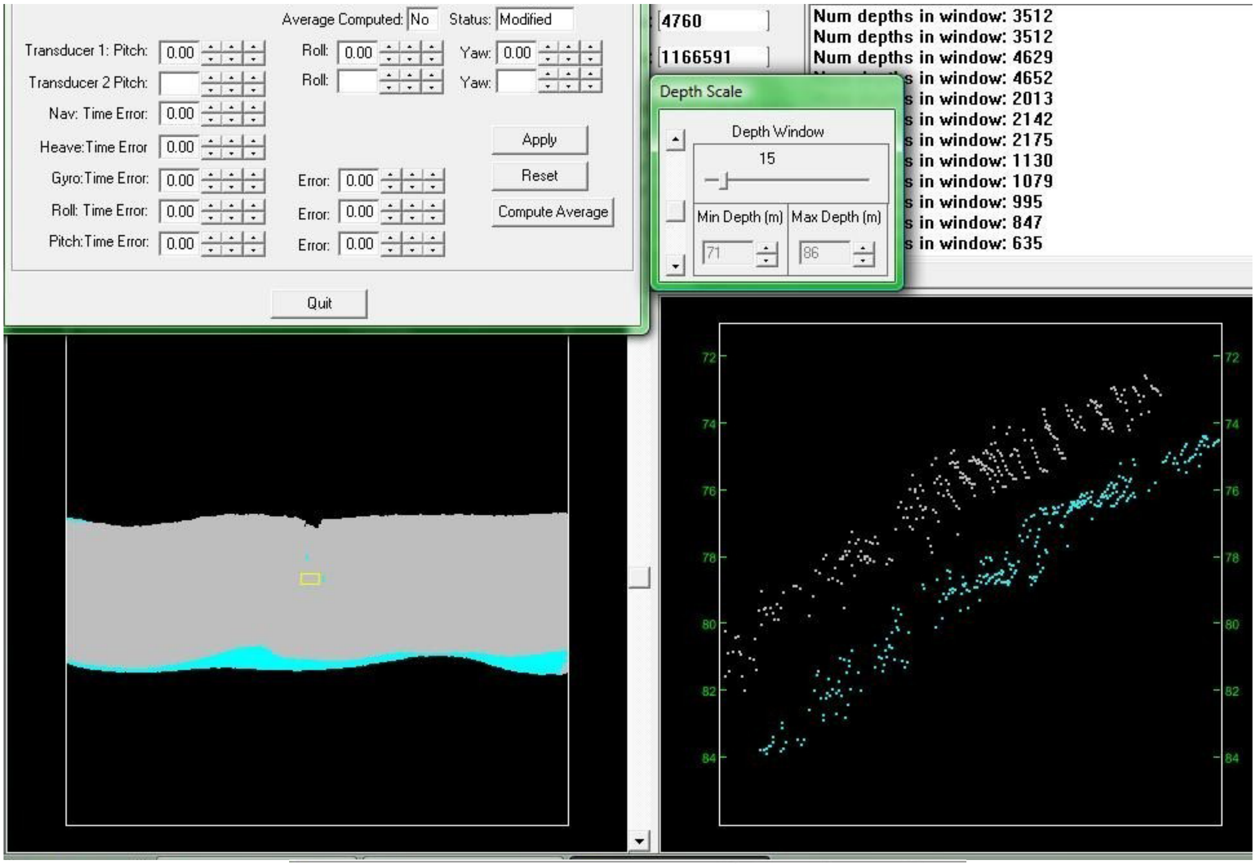
• Pitch offset.
• Time delay between actual position and position when position datagram is supposed to be valid.
• Multibeam echo sounders with transducers: Position distance offset (either due to an error in the positioning system or an error in entered locations).
• Tide difference.

Note that a depth error on a constant gradient slope, due to pitch offset, increases with increasing depths, while that due to position time delay increases with vessel speed, while that due to distance offset is independent of depth and speed. Comparing data from the two lines in the same direction, but with different vessel speed, will thus allow the time delay to be found. After the correction for any time delay error has been applied to the data, the pitch offset can be determined from the two lines run in opposite directions. Any distance offset must of course first be removed.


Side view
Survey line
Seabed
Slope

(CD3571)


Top view
Survey line
B
Slope
Calibration corridor
A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Roll: 0.00
Yaw: 0.00
Transducer 2 Pitch:
Roll:
Yaw:
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Heave:Time Error 0.00
Gyro:Time Error: 0.00
Roll: Time Error: 0.00
Pitch:Time Error: 0.00
Error: 0.00
Error: 0.00
Error: 0.00
Apply
Reset
Compute Average
Quit
4760
1166591
Depth Scale
Depth Window
15
Min Depth (m)
Max Depth (m)
71
86
Num depths in window: 3512
Num depths in window: 3512
Num depths in window: 4629
s in window: 4652
s in window: 2013
s in window: 2142
s in window: 2175
s in window: 1130
s in window: 1079
s in window: 995
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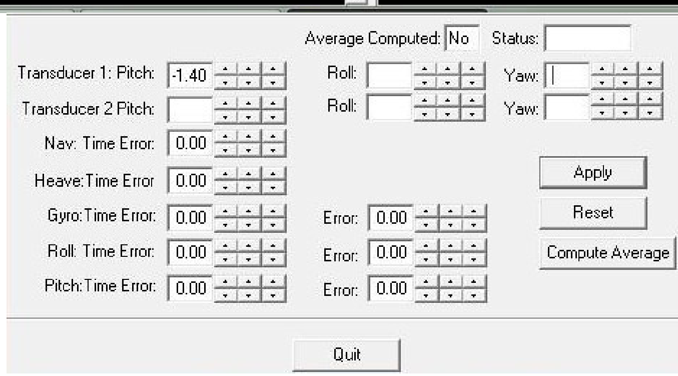
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Roll:
Yaw:
Transducer 2 Pitch:
Roll:
Yaw:
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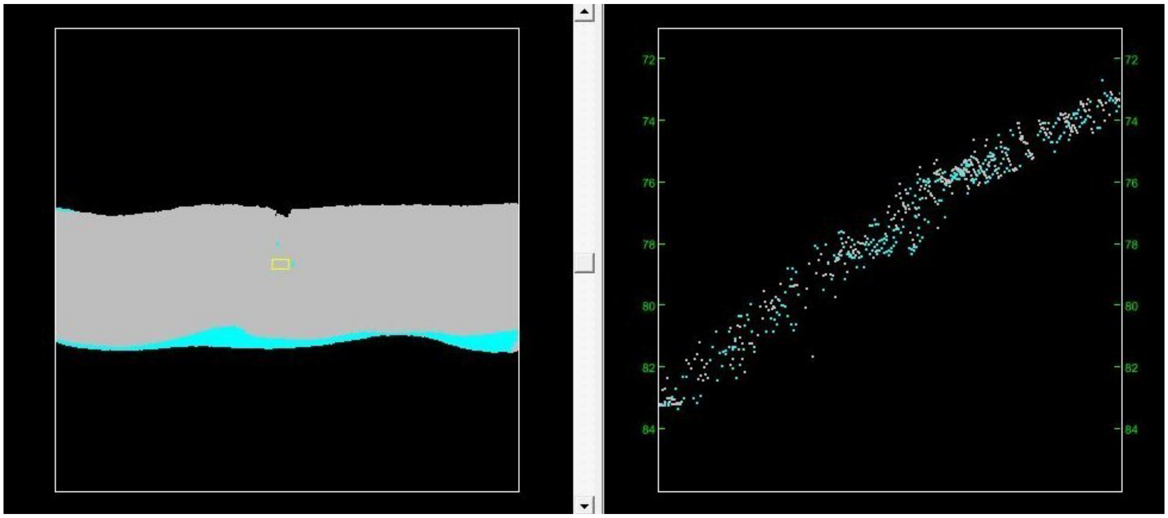
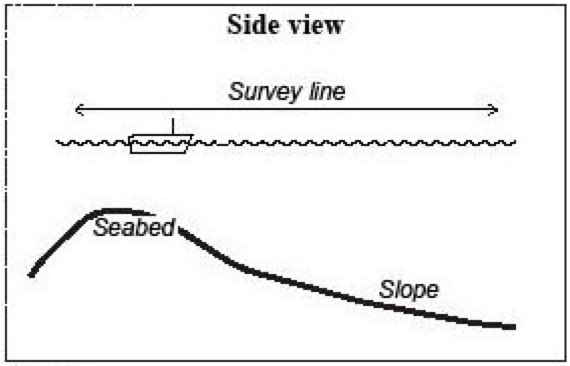
Heave:Time Error 0.00
Gyro:Time Error: 0.00
Roll: Time Error: 0.00
Pitch:Time Error: 0.00
Error: 0.00
Error: 0.00
Error: 0.00
Apply
Reset
Compute Average
Quit

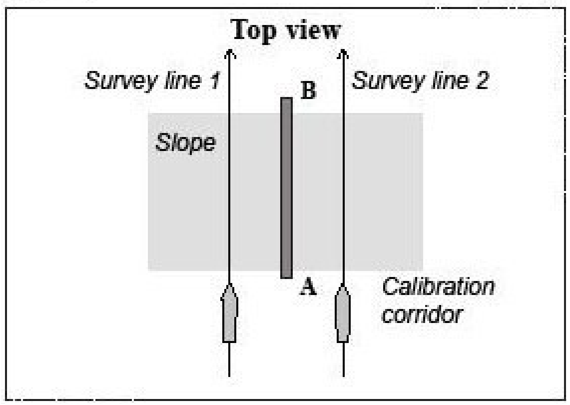


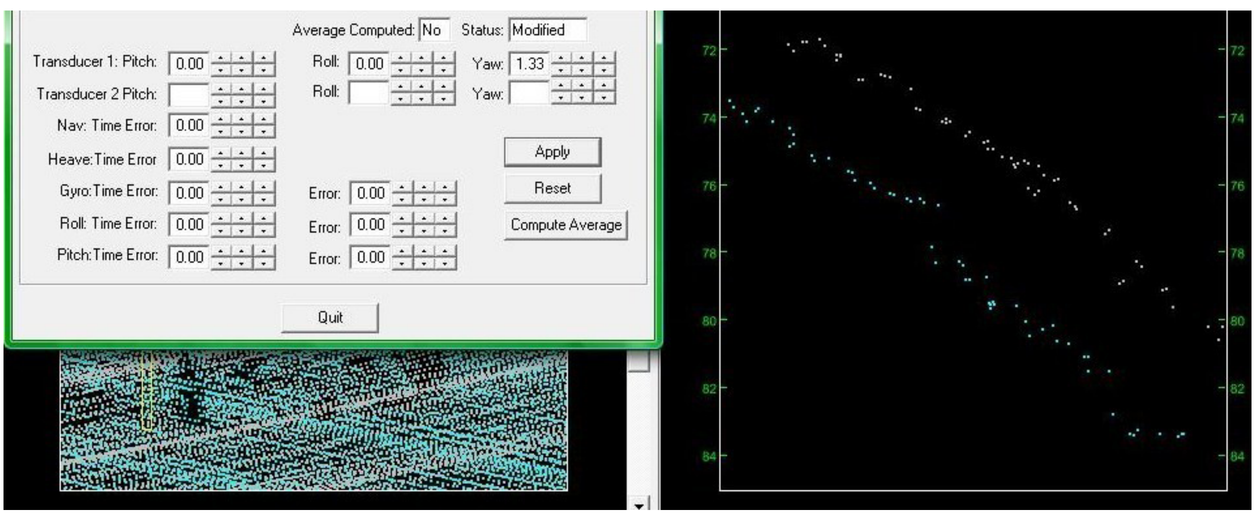
Heading offset

Run two parallel lines up or down a slope in the same direction, separated, but with overlap in-between. The corridor used for comparison should be placed alongtrack in-between the lines. Any heading offset will give a depth difference between the two lines.


Side view
Survey line
Seabed
Slope

(CD21801)


Top view
Survey line 1
Survey line 2
B
Slope
A
Calibration corridor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Transducer 2 Pitch:
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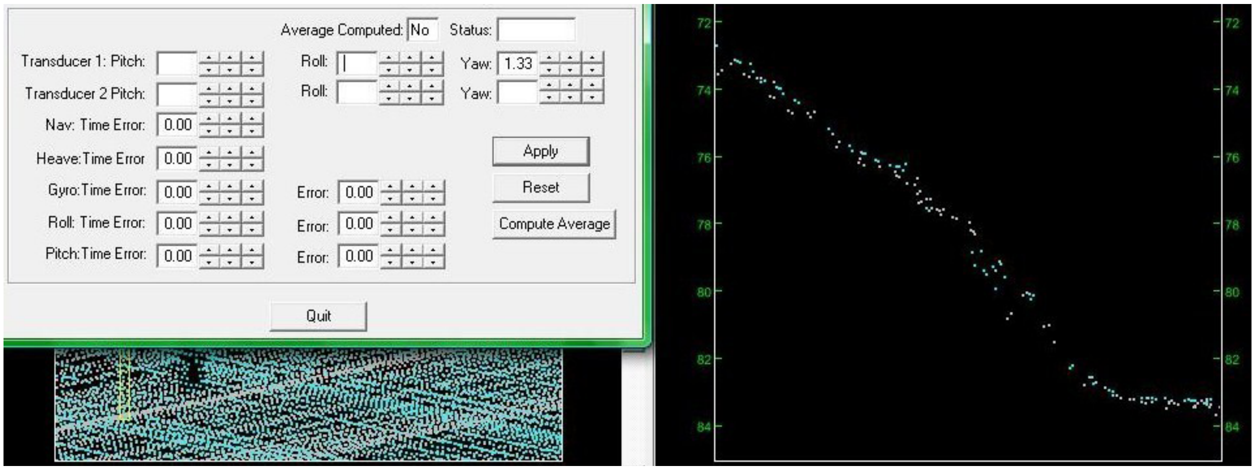
Heave:Time Error 0.00
Gyro:Time Error: 0.00
Roll: Time Error: 0.00
Pitch:Time Error: 0.00
Roll: 0.00
Roll:
Yaw: 1.33
Yaw:
Error: 0.00
Error: 0.00
Error: 0.00
Apply
Reset
Compute Average
Quit
72
74
76
78
80
82
84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Roll:
Yaw: 1.33
Transducer 2 Pitch:
Roll:
Yaw:
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Heave:Time Error 0.00
Gyro:Time Error: 0.00
Error: 0.00
Roll: Time Error: 0.00
Error: 0.00
Pitch:Time Error: 0.00
Error: 0.00
Apply
Reset
Compute Average
Quit