Data Acquisition and Processing Report

NOAA S3003

OPR-L430-NRT6-13

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Introduction

NOAA Navigation Response Team 6 (NRT6) is a mobile hydrographic survey team that operates in the southwestern region of the United States. The primary survey platform for NRT 6 is NOAA launch S3003, a 27-ft vessel built by SeaArk of Monticello, Arkansas, and delivered to NOAA in 2004. NRT 6 is staffed by three physical scientist technicians.

NRT 6's primary mission includes acquiring hydrographic survey data used to update NOS nautical charts. The team is also equipped to rapidly respond to navigationally significant events such as natural disasters, vessel groundings and other incidents. NRT 6 responds to survey requests in the state of California and other geographic areas as necessary, made by harbormasters, pilots, and other stakeholders. Hydrographic surveys are performed using multibeam, side scan, and single beam sonars. Land-based surveying of shoreline features is performed using a Trimble GeoXH handheld GPS unit. A 32-ft trailer serves as a mobile field office, and is equipped with several data processing workstations.

This Data Acquisition and Processing Report (DAPR) details all Navigation Response Team 6 (NRT6) survey equipment and methods used to acquire and process survey data. Systems were selected for use during this project based on instructions from the Field Procedures Manual, Project Instructions, and Hydrographic Survey Specifications and Deliverables. Survey systems and methods used during this project were also chosen based on the water depth, sea and weather conditions, and the ability of the vessel to safely navigate the area.

A. Equipment

A.1 Survey Launch S3003

Survey Lunch S3003 is a 27-ft SeaArk Commander, and is used to acquire side scan sonar data, multibeam echosounder data, singlebeam echosounder data, and sound velocity profiles. The 4.5 ton launch is 8 feet wide, has a static draft of 0.5 meters, and is powered by twin 150hp Honda outboards.

S3003 Vessel Information

Hull Number:	**S3003**
Builder:	**SeaArk**
Built:	**2003**
Length Overall:	**33 ft.**
Beam:	**8 ft.**
Draft:	**1.6 ft.**
Cruising Speed	**28kts**
Min/Max Survey Speed:	**4-8kts.**
Primary Echosounder:	**Hull-mounted Simrad EM3002 MBES**
Secondary Echosounder:	**Hull-mounted ODOM Echotrac CV VBES**
Imagery System	**Towed Klein 3000 Side Scan Sonar system**
Sound Velocity Profiler:	**Sea-Bird SeaCat SBE 19+ CTD Profiler**
Surface Sound Velocity Probe:	**ODOM Digibar Pro**

A.2 Sounding Equipment

A.2.1 Shallow Water Multibeam Sonar

S3003 uses a Kongsberg Simrad EM 3002 multibeam echosounder. The EM 3002 collects sounding and backscatter data at 300 kHz with 254 receive beams, which provide an optimal swath of 130°. The system is relatively “hands-off”, with range scale, power, gain, and other parameters automatically controlled by the sonar system. See Appendixes 3 and 4 for further information on the Simrad EM3002 setup.

This sonar is interfaced with the acquisition PC using the Simrad EM3002 SIS (Seafloor Information System) software application. SIS is used to acquire data from the EM3002 by creating .ALL files. Hypack Hysweep is still used to acquire .HSX files but these files are only being used for the purpose of real time matrix display.

Figure 1: Hull-mounted Simrad EM 3000 transducer.

The sonar head contains a flat-face transducer (Mills Cross configuration) and all transmitter and receiver elements encased in an acoustically transparent medium. The transmit beam is steerable to compensate for mounting angle and vessel pitch.

The processing unit performs the beam-forming, bottom detection and controls the sonar head with respect to gain, ping rate and transmit angle. It also contains the interfaces for all time-critical external sensors such as attitude data, position, and the 1 PPS (pulse per second) signal.

EM3002 SIS (Seafloor Information System) software operates on the Hypack computer and communicates via Ethernet connection, is used to control adjustable parameters. The controller software also transmits real time sound velocity measurements (from a Micro-X Oceanographer AML velocimeter mounted near the sonar head) to the processing unit for initial beamforming and steering.

The sonar head is hull mounted aft of the vessel cabin, centered on the keel line. The POS/MV IMU is centered above the sonar head. See the CARIS HVF for offset values.

A patch test was performed July 17, 2014. However, previous year's values proved more accurate after processing and comparison. 2013 patch test values continue to be used for 2014. Please see Appendix 8 for details of the patch test.

The sound velocity probe is mounted on the transom, between the outboard engines. The probe is housed in a PVC tube, which is then inserted into two brackets attached to the transom. This removable configuration allows for higher transit speeds between survey areas, while keeping the probe protected.

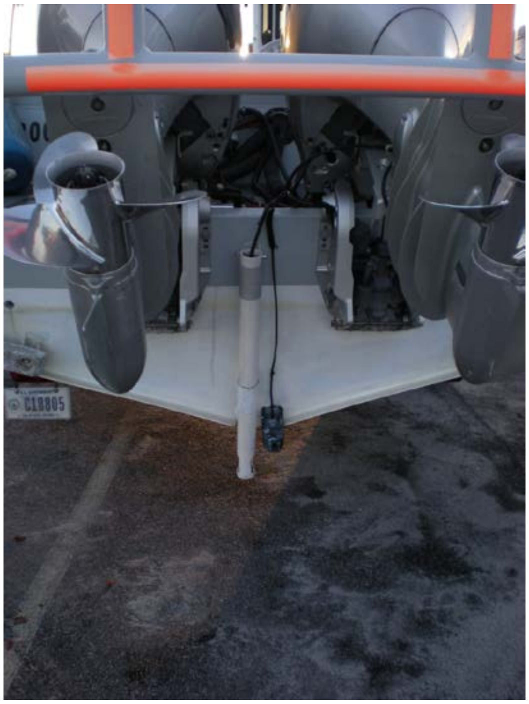

Figure 2: S3003 Digibar mount and protective PVC sheath.

A problem with this configuration is the tendency for air bubbles (turbulence) and debris, mostly floating eel grass, to become trapped in the PVC tube, leading to large errors in the sound velocity. This in turn causes the multibeam to incorrectly steer the incoming pings, seen as large "frowns" in the bathymetry. Data exhibiting this problem are noted, and data are re-acquired over the problem areas.

The problem of turbulence and eel grass has subsequently been mitigated for the most part by installing a 6 inch longer PVC tube so as to extend the velocity probe deeper below the water surface. Since this installation, we have seen fewer beam steering sound velocity errors. However, during times of calmer seas and/or cleaner water, free of floating eel grass we still prefer to use the shallower PVC tube as it is less likely to suffer debris damage and interference from the engines in the "up" position during transit between survey areas.

A.2.2 Side Scan Sonar

NRT 6 operates an Edgetech 4125 side scan sonar system, used for the detection of submerged wrecks and obstructions. Two dual simultaneous frequency sets are available for the 4125 depending on the application. The 400/900 kHz set is the perfect tool for shallow water survey applications, providing an ideal combination of range and resolution. The 600/1600 kHz set is ideally suited for customers that require ultra high resolution imagery in order to detect very small targets. Typical surveys see the SSS used in high frequency mode, with range scales between 50 and 100 meters, as specified in the HSSD section 6.2.4. The system consists of a towfish, deployed from a rotating boom on the aft deck (see figure 7). The towfish is connected to a slip ring attached to an electric winch, which is connected to the Transceiver and Processing Unit (TPU). The TPU is networked to a workstation that allows the user to control various parameters, view SSS imagery and record sonar files. Measurements to the towpoint can be found in the survey offset report, Appendix 1, and a calibration report for the system is found in Appendix 9.

Figure 3: S3003 Edgetech 4125 SSS installation.

All SSS data collection is controlled using Discover II software operating in a Microsoft Windows 7 environment on the Acquisition Workstation. Control signals are sent to the towfish and data is received from the towfish via the TPU. Data is recorded digitally and stored on the Acquisition Workstation in Edgetech format.

Side scan sonar lines are spaced according to the range scale appropriate for the water depth. Lines are planned with a minimum of 25 meters of overlap with adjacent swaths. Vessel speed is adjusted to ensure that an object one meter square in size would be detected and clearly imaged across the sonar swath. Typical SSS collection speed is five knots. Confidence checks are performed by observing operation of the SSS along pier faces, buoy blocks, and in areas with known targets.

High frequency of 600/1600 kHz set is utilized as the primary frequency for data collection, with low frequency observed, but not logged. The maximum range scale used is 100 meters, with operation on the 50 to 75 meter range scales more typical. Fish height is kept at eight to twenty percent of the range scale, except in very shallow areas (< 6 meters).

S3003 is equipped with a Dynapar cable counter used to measures the length of towfish cable deployed by counting revolutions of the towing block on the J-frame. The length of cable deployed is computed automatically and output directly to the Acquisition Workstation where it is used by the Discover II software.

A.2.3 Vertical Beam Echosounder

S3003 is equipped with an Odom Echotrac CV Vertical Beam Echosounder (VBES). The Odom CV is a single-beam echo sounder, operating at 208 kHz with an 8° beam. Unlike previous Odom Echotrac models, the CV has no display or paper record on the actual processor; rather, sounding data is displayed in Hypack. VBES data are collected infrequently, as both multibeam and side scan sonar may be operated simultaneously. This system is used infrequently, as most projects now require the collection of SWMB data.

A.2.4 Lead line

NRT6 uses a lead line for echosounder calibration tests. It is a non-stretching synthetic line, marked every half-meter, with a lead weight attached at the bottom. See Appendix 7.

A.3 Positioning Equipment

A.3.1 POS MV Positioning and Orientation System

S3003 is equipped with an Applanix Model 320 Version 5 POS/MV, interfaced with controller software installed on the Hypack computer. A Trimble SPS361 provides differential correctors to the POS/MV, and is also interfaced on the Hypack computer via Trimble Seacast software. The Inertial Measurement Unit (IMU) is located in a hatch aft of the cabin, directly over the multibeam transducer. The antennae are located on the top of the cabin, on mounts that raise them off of the deck. The antenna for the Trimble receiver is located on the top of the mast.

A.3.2 Trimble SPS361

Survey launch S3003 is equipped with a Trimble SPS361 DGPS beacon receiver.

The Trimble SPS361 is a dual-frequency GPS Heading receiver available with or without an internal MSK Beacon receiver. The SPS361 receiver is capable of DGPS positioning accuracies using any of the following differential correction sources:

- Satellite-Based Augmentation Systems (SBAS) corrections (WAAS/EGNOS/MSAS)
- DGPS RTCM corrections from the internal MSK Beacon receiver
- DGPS RTCM corrections from an external source
- RTK corrections from an external source (solution is limited to DGPS precision)
- OmniSTAR VBS correction service from an internal demodulator
- OmniSTAR VBS correction service from an external source

A.3.3 Trimble GeoXH Handheld GPS

The GeoXH is used to position AtoNs and assist with shoreline. Fixed Aids to Navigation (AtoNs) are occupied for a minute or longer, which allows for a horizontal precision of 0.1 meter or less after post processing.

NRT6 uses the standard data dictionary given in Appendix 5 of the Field Procedures Manual.

NRT6 processes rover data collected on the GeoXH using Pathfinder software. Data are post-processed using local CORS stations. Typical processing uses multiple CORS sites, as there are numerous sites in NRT6's operating area.

For AtoNs, the processed file is then exported as a SHP file, and formatted for submission to MCD, as outlined in Appendix 5 of the Field Procedures Manual.

A.4 Software

Basic descriptions of the various software used for acquisition, processing, and other tasks are listed below. For further information, including details about software versions and other information, please see the appendix 5, Hydrographic Systems Inventory.

A.4.1 Acquisition Software

A.4.1.1 Hypack

Coastal Oceanographic's Hypack Max is used for vessel navigation and line tracking during data acquisition. NRT6 used HYPACK 2014 for this survey.

Hypack Max's Survey program is used to log SBES data and is used in conjunction with Hypack Max's Hysweep Survey program to log MBES data. SBES and MBES data are logged in the Hypack "raw" format, with SBES data using the day number as an extension and MBES data using the .hsx extension. Both are ASCII text files.

A.4.1.2 Discover II

Discover II version 2012 is used to monitor and log all side scan sonar data from the Edgetech 4125 sonar. Data is recorded in .jsf format.

A.4.2 Processing Software

A.4.2.1 CARIS HIPS/SIPS

NRT6 uses CARIS HIPS/SIPS 8.1, updated with the most current hotfixes, to process all sonar data. See Appendixes 10 and 11 of the HSRR for a detailed discussion of the current CARIS HVF file.

A.4.2.2 MapInfo

Mapinfo 10.5 is used on all processing computers for project planning, and creating survey products. HydroMI, a NOAA in-house software application, is used with MapInfo to convert planned lines for use with Hypack, create chartlets, and perform a number of other survey-related tasks.

A.4.2.3 Pydro

The latest version of Pydro is installed on the three main processing workstations. Pydro is used to organize survey feature data and bathymetry, to generate reports, and for a number of other survey-related tasks.

A.4.2.4 CARIS Bathy DataBASE

The latest version of CARIS DataBASE is installed on the three main processing workstations. Pydro is used to organize survey feature data and bathymetry, to generate reports, and for a number of other survey-related tasks.

A.4.3 Other Software

Velocipy is used to process CTD casts into CARIS .SVP files, used to correct the sound velocity profile in CARIS.

B. Data Processing and Quality Control

B.1 Shallow-Water Multibeam Data

Shallow-water multibeam (SWMB) data were monitored in real-time using the 2-D and 3-D data display windows in Hypack Hysweep, and the Simrad controller window. As the Simrad EM3002 is a relatively “hands-off” system, few parameters are adjustable by the sonar operator. Ping rate, range scale, power, and gain are all automatically adjusted by the Simrad system. In the Runtime Parameters menu, under Sounder Main, the user is able to set a maximum ping rate, and a minimum and maximum depth.

Simrad SIS .ALL files were converted to CARIS HDCS files following acquisition. Tide, sound velocity (SVP), vessel offset, dynamic draft, and True Heave correctors were then applied and merged with depth, position and attitude data to compute the corrected depth and position of each sounding. The Total Propagated Uncertainty (TPU) was then computed for each sounding, using the error values included in the CARIS HIPS Vessel File (HVF). TPU values are used to create a Bathymetry Associated with Statistical Error (BASE) surface, a grid comprised of nodes that contain bathymetric and uncertainty information. NRT6 uses the Combined Uncertainty and Bathymetric Estimator (CUBE) algorithm to create BASE surfaces from SWMB data. The CUBE algorithm creates a BASE surface grid by first creating depth hypotheses at each grid node, and then using density, locale, or a combination of the two to choose the best hypothesis. NRT6 used the parameters (and the associated XML file) outlined in Hydrographic Technical Directive 2009-2 for the surfaces generated in this survey. Specifically, NRT6 used the NOAA_1m and NOAA_0.5m CUBE parameters. Please see the HVF Review, located in the HSRR, for updated information on the TPU values used in during this project.

The BASE surface is then used to conduct area-based editing in CARIS subset mode, which allows the processor to focus on specific areas with higher uncertainty values and also a high number of CUBE hypotheses. In addition to area-based editing, subset tiles were also used to systematically review the entire project area in subset mode. Both of these review methods include removing fliers and or noise in the water column, as well as picking the least depth on significant contacts. Filtering was also used to assist in cleaning noise and fliers. NRT6 used the IHO Order 1 filter in CARIS for this project.

B.2. Side Scan Sonar Data

Side Scan Sonar (SSS) data were collected and monitored with Discover II software, version 2012. Files were saved in .jsf format. Range scale, gain, and towfish height were all adjusted to ensure the collection of quality data, and that the imagery and towfish height met the requirements of the HSSD. Sonar imagery quality checks were performed on objects located within the survey area.

.jsf are converted to CARIS SIPS files, and reviewed for significant contacts using the Side Scan Editor. Contacts are then exported into Pydro, where they are then examined and categorized based on significance. Significant contacts are noted, and are later developed using SWMB. Mosaics of the data are created to ensure complete coverage of the survey area.

All SSS data were examined and re-acquired if motion artifacts, boat wakes, or refraction prevented the identification of targets while examining side scan data.

B.3. Composite Source File

A composite source file (CSF) was included with this project. The CSF items were imported into Caris Bathy DataBASE and clipped so that all objects outside the sheet extents were excluded. The items were then filtered in Caris Bathy DataBASE by object class to create a manageable workspace. Mandatory object classes were brought into Pydro and items that were deemed too shallow or dangerous to investigate were not marked “Investigate”. The remaining items were selected to investigate, and Hypack targets were exported. Boat sheets with images of the CSF items located on the chart were created, and used for notes on the items while surveying. These sheets were scanned and are located under Acquisition Logs in the CSF folder.

In Caris Bathy DataBASE, all CSF items were marked with the keyword “CSF”, and a separate “CSF Items” tab was created. The CSF items were then correlated to SSS and MB features. Items that were not found were classified “Chart-Delete”. Items that were present, but differed from the CSF description were classified secondary to sonar features, and marked “Chart-Modify”. Items that were investigated and found, but did not differ from the CSF items were classified “Chart-None”. All S-57 attributes were assigned for each CSF item investigated. If the item was not found or investigated, the S-57 information from the original CSF was retained. CSF items on the chart that were picked to be modified or deleted will also be included in the Survey Feature Report located in Appendix II.

The Navigation Response Branch is in the process of streamlining the CSF process to guarantee that future submissions include all pertinent CSF items while taking out redundancies and extra work that clutters the survey area. The new assigned feature files (AFF) will supersede the original CSFs and are currently being compiled for the San Francisco Bay area.

C. Corrections to Echo Soundings

C.1. Sound Velocity

NRT 6 collects conductivity, temperature, and density (CTD) data using an SBE 19+ to determine sound speed profiles, which are used to correct multibeam sonar data. The SBE19 generates a raw hexadecimal file (*.hex), which is used by Velocipy, a NOAA in-house program that coverts .hex files to files used to correct multibeam data. Velocipy is discussed in the Data Processing Software section, 3.3. Please see Appendix 6 for the latest calibration report.

An AML Oceanographer Micro-X is used for continuous sound velocity measurements at the face of the multibeam transducer to correct for the geometry of a flat transducer array. The AML Oceanographer Micro-X is mounted on the transom, housed inside a PVC tube that allows a free flow of water over the sensor. Sound speed data is sent from the AML Oceanographer Micro-X to the Hypack acquisition PC via a serial cable. Please see Appendix 6 for the latest calibration report.

Sound velocity profiles were acquired with the SeaBird Electronic SeaCat SBE19Plus Conductivity, Temperature, and Depth (CTD) profiler (see HSRR Appendixes 5 and 6 for serial numbers and calibration dates). Raw CTD data were processed using the program Velocipy.

An Odom Digibar Pro sound velocimeter, mounted on the transom, measured the speed of sound near the face of the transducer. The Simrad EM3002 has a flat-faced transducer, necessitating corrections to the returning wave front based on the speed of sound.

C.2. Vessel Offsets and Dynamic Draft Corrections

Measurements to verify the vessel offsets currently used by NRT6 were taken by a survey team from the National Geodetic Survey in March 2009. New offset measurements from the reference point to the multibeam transducer and IMU were taken following the retrofitting of the multibeam transducer. Both were relocated to points aft of the cabin.

Static and dynamic offsets, unless otherwise noted, are entered into CARIS HIPS Vessel Files (HVF). A separate HVF is used for the multibeam and singlebeam echosounders, and for 100% and 200% sidescan. Uncertainty values for all offset measurements are also recorded in the HVF, in the Total Propagated Uncertainty section.

Angular offsets and navigation timing errors of the multibeam system were determined using a patch test. A series of calibration lines are run and processed using the CARIS Calibration mode. The patch test report may be found in the 2014 HSRR, Appendix 8.

Static and dynamic offsets (settlement and squat values), angular offsets, and navigation timing errors are entered into the CARIS HIPS Vessel File (HVF), which is used to correct CARIS HDCS data.

Vessel Static Offsets

In March 2009, personnel from the National Geodetic Survey measured the offsets of all sensors aboard launch S3003, following the re-installation of the multibeam transducer to a hull-mounted configuration. NGS values for the multibeam transducer and IMU agreed with the initial post-installation measurements (measured by NRT6 personnel) to within a centimeter in all dimensions. Please see Appendix 1 for the NGS Offset Measurement Report.

NRT6 uses a reference point that is located near the vessel center of motion, from which all offsets are measured. The POS controller sets the center of Navigation and Attitude at the reference point on the IMU. Sensor offsets from the reference point are then entered into the CARIS HVF. Please see Appendix 11 for the HVF Report.

POS MV Phase Center Offset Adjustment

The phase center for the POS MV was determined to be 1 cm below the top of the antenna. The antenna was measure from its base to the top, and a value of 4.6 cm (see the engineering drawing below, Figure 1) was subtracted from the total measured value to obtain the offset from the top of the antenna to the phase center. The measured vertical offset value from the NGS survey, from the IMU to the port GPS antenna is -2.587 (in POS coordinate system with Z-axis positive downward). Corrected for the phase center, this value is now -2.577. This correction only affects the offset from the Primary GPS antenna to the IMU, which is entered in the POS Controller software. See Appendix 4 for a screen grab of the updated offset values in the POS MV Lever Arms & Mounting Angles window.

POS MV V4 Installation and Operation Guide

Drawings

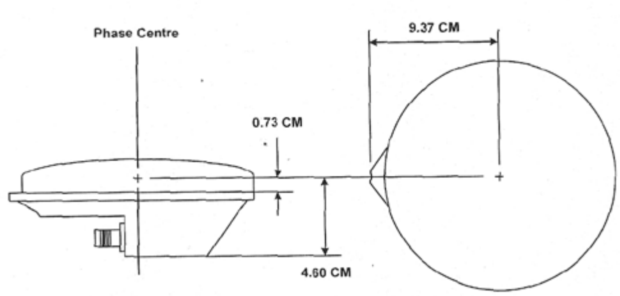

Figure 77: GPS Antenna Footprint

Figure 4: Engineering drawing from POS MV manual, Appendix E.

Vessel Dynamic Offsets

Static Draft

The static draft of the vessel was measured on March 30th, 2009. This measurement was made separately from the NGS survey, as the waterline was not clearly marked at the time of that survey. The vessel was again leveled, using the IMU plane of reference, and levels and t-squares were used for measurements. The resulting waterline value is -.024 m from the reference point, and has changed .026 m. The waterline was chosen to be the line of marine growth on the vessel hull. The main source of uncertainty in this measurement was choosing the waterline. The thickness of the marine growth line was approximately 2 cm, which is larger than the assumed uncertainty for the actual measurement, and thereby used as the Draft TPU value in the HVF.

Dynamic Draft

A dynamic draft test was conducted in October 2012. This test was performed using the Ellipsoid Referenced Dynamic Draft Method (ERDDM) or PPK method outlined in section 1.4.2.1.2.1 of the Field Procedures Manual. The results were satisfactory, and were entered into the Draft section of the CARIS HVF. Please see Appendix 2 for a report detailing the process of calculating the dynamic draft values.

C.3 Heave, Pitch, Roll, Heading, and Timing

S3003 is equipped with an Applanix POS/MV V 5, interfaced with controller software installed on the Hypack computer. A Trimble SPS361 provides differential correctors to the POS/MV, and is also directly interfaced on the Hypack computer. The Inertial Measurement Unit (IMU) is located directly above the multibeam transducer, inside a hatch that provides access to the IMU and transducer. The antennae are located on the top of the cabin, on mounts that raise them off of the deck. The antenna for the Trimble receiver is located on the top of the mast.

A GAMS calibration was performed following the re-positioning of the IMU to a location directly above the multibeam transducer.

Figure 5: View of top of house on Launch S3003. Center GPS antenna is used by Trimble SPS361 receiver, and two lower antennae are used by the POS/MV V5.

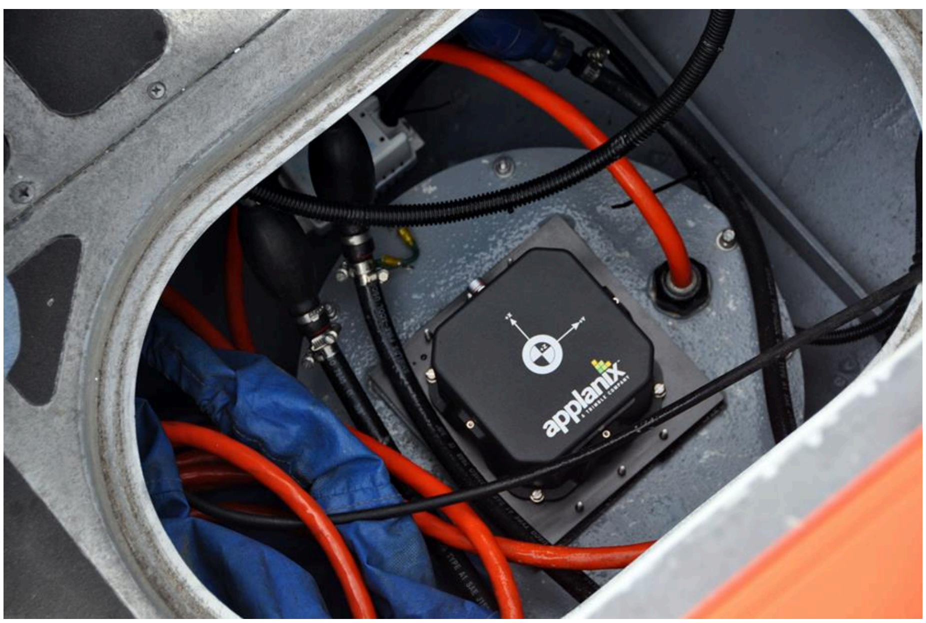

Figure 6: IMU mounted in hatch directly above the multibeam transducer.

The POS/MV 320 provided attitude data to SIS, which stored the data in the ALL multibeam file. Attitude data quality is monitored while surveying by monitoring the POS Controller window, which is installed on the Hypack workstation. Alarms are triggered when accuracy values fall below user-determined values.

As discussed in the previous section, navigation timing error is determined using the patch test, and applied to data using the CARIS HVF.

C.4 Water Level Correctors

Soundings were reduced to Mean Lower-Low Water (MLLW) using preliminary tides, taken from stations 9414750, Alameda, CA, 9414290, San Francisco, CA and 9414863 Richmond, CA. The Zone Definition File for this project was L430NRT62012CORP.zdf. The .zdf file breaks the survey area into polygons that take into account the magnitude and time differences from a primary tide gauge. Once available, the verified tide data is applied before submitting hydrographic survey data.

D. Approval

As Chief of Party, I have ensured that standard field surveying and processing procedures were used during this project in accordance with the Field Procedures Manual, and the NOS Hydrographic Surveys Specifications and Deliverables Manual, as updated for 2014.

I acknowledge that all of the information contained in this report is complete and accurate to the best of my knowledge.

Approved and Forwarded: ______________________________

Ian Colvert
Physical Scientist Technician
Acting Team Leader, NRT6

Appendix 1: S3003 Offset Report

US DEPARTMENT OF COMMERCE
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SERVICE
NATIONAL GEODETIC SURVEY
GEODETIC SERVICES DIVISION
INSTRUMENTATION & METHODOLOGIES BRANCH

NOAA SURVEY VESSEL S3003
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY
FIELD REPORT

Kendall L. Fancher
March 11, 2009

NOAA SURVEY VESSEL S3003
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

PURPOSE

The primary purpose of the survey was to precisely determine the spatial relationship between various hydrographic surveying sensors, and the components of a POS MV navigation system aboard the NOAA survey vessel S3003.

PROJECT DETAILS

This survey was conducted in Richmond, California on the 10th of March, 2009. The weather was cool and clear in the morning, with warm and clear conditions in the afternoon. For this survey, the vessel was on a trailer stabilized by the trailer tongue jack and two hydraulic bottle jacks. The vessel was leveled relative to the IMU.

INSTRUMENTATION

A Leica (Wild) TC300 precision total station was used to make all measurements.
Technical Data:

Standard Deviation

Horizontal angle	0.5 seconds
Vertical angle	0.5 seconds
Distance measurement	1mm + 1ppm

Standard precision prisms were used as sighting targets. Prisms were configured to have a zero mm offset.

PERSONNEL

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NOAA SURVEY VESSEL S3003
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

DEFINITION OF THE REFERENCE FRAME

To conduct this survey a local coordinate reference frame was established where the Northing (Y) axis runs along the centerline of the boat and is positive from the primary reference point towards the bow of the boat. The Easting (X) axis is perpendicular to the centerline of the boat and is positive from the primary reference point towards the right, when looking at the boat from the stern. The Up (Z) axis is positive in an upward direction from the primary reference point.

SURVEY METHODOLOGY

Three temporary control points, (1, 2, 3), were established around the vessel such that every point to be positioned on the launch could be observed from at least two separate locations.

Coordinates of 100.000N, 100.000E, and 100.000U were assumed for control point 1. A distance and height difference were measured between control points 1 and 2. These values were used to determine the coordinates for control point 2 of 120.469N, 100.000E, and 99.984U.

Control point 1 was occupied and control point 2 was observed for a backsight. After initialization, control point 3 and all points to be observed on the launch were observed in both direct and reverse.

Control point 2 was occupied and control point 1 was observed for a backsight. After initialization, control point 3 and all points to be observed on the launch, except for the Single Beam transducer (SB), were observed in both direct and reverse.

Control point 3 was occupied and control point 1 was observed for a backsight. After initialization, control point 2 and SB were observed in both direct and reverse.

Inverses were computed between the two positions determined for all points surveyed to evaluate the accuracy of the survey.

The reference frame was rotated using Centerline Stern (CLS) as the point of rotation. A zero degree azimuth was used during the rotation from CLS to Centerline Bow CLB). The reference frame was then translated to relocate the origin of the reference frame to Primary Centerline reference point (CL0).

NOAA SURVEY VESSEL S3003
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Inverse Results

Inverses were computed between the two occupations of each positioned point. The results of these inverses are:

ID	Horizontal Dist.(m)	Elevation Diff(m)
2	0.0005	0.0006
3	0.0003	-0.0003
SB	0.0004	0.0004
MB	0.0005	0.0002
GPSP	0.0001	0.0000
GPSS	0.0011	-0.0002
CL0	0.0028	0.0001
IMU	0.0088	-0.0010
CLT	0.0072	-0.0001
CLB	0.0022	0.0007
CLS	0.0035	-0.0003
SS	0.0092	0.0008

DISCUSSION

The positions given for the POS GPS antennas (Zephyr p/n 39105-00) are to the top center of the antenna. To correct the Z value provided in this report for each antenna to the electronic phase center, I recommend the following steps be taken;

1) Determine the physical height of the GPS antenna. This information is probably located on the antenna or with equipment documentation.
2) Investigate to find the electronic phase center offset of the antenna. This information is probably located on the antenna or with equipment documentation. This value may also be available at the NGS website for antenna modeling.
3) Subtract the total height of the antenna from the Z value for each antenna. This will give you a Z value for the antenna ARP (antenna reference point)
4) Then add to this value the electronic phase center offset value appropriate for the antenna model.

An offset value of -0.25m has been applied to the Side Scan Sonar reference point (SSS) to translate the Z value from the observed reference point to an imaginary point atop the cable in the block used for this sensor in the deployed position.

NOAA SURVEY VESSEL S3003
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Station Listing

CL0- CENTERLINE PRIMARY REFERENCE POINT
An existing punch mark set in top of the metal housing for a hatch, located inside the cab and flush with the floor surface. Stamped “CL0”.

CLB- CENTERLINE REFERENCE POINT BOW
A punch mark set in top center of a cleat, located near the bow of the vessel. Stamped “CLB”.

CLS- CENTERLINE REFERENCE POINT STERN
A punch mark set in top of the center rib in the generator hold. Stamped “CLS”.

CLT- CENTERLINE REFERENCE POINT TRANSOM
A punch mark set in top center of the transom. No stamping.

MB- MULTIBEAM TRANSDUCER REFERENCE POINT
The center of the bottom of the Multi Beam Transducer.

SB- SINGLE BEAM TRANSDUCER REFERENCE POINT
The center of the bottom of the Single Beam Transducer.

SSS- SIDE SCAN SONAR REFERENCE POINT
An unmarked point located at the center of the bottom of the swing arm at a point directly below a drill hole which is used to suspend the Side Scan Sonar cable tackle.

IMU- IMU REFERENCE TARGET
Center of a target affixed to the top of the IMU housing.

GPSP- POS GPS ANTENNA REFERENCE POINT
The top center of the port side GPS antenna for the POS system.

GPSS- POS GPS ANTENNA REFERENCE POINT
The top center of the starboard side GPS antenna for the POS system.

NOAA SURVEY VESSEL S3003
POS MV COMPONENTS SPATIAL RELATIONSHIP SURVEY

Coordinate Listing using CL0 as the Reference Frame Origin

ID	Y(m)	X(m)	Z(m)
SB	0.337	-0.159	-0.360
MB	-1.909	0.010	-0.483
GPSP	1.240	-0.744	2.520
GPSS	1.253	0.782	2.512
CL0	0.000	0.000	0.000
IMU	-1.907	0.004	-0.067
CLT	-4.217	0.020	0.308
CLB	4.601	0.010	1.230
CLS	-2.766	0.010	-0.342
SSS	-4.046	0.563	2.384

Coordinate Listing using IMU as the Reference Frame Origin

ID	Y(m)	X(m)	Z(m)
SB	2.244	-0.162	-0.293
MB	-0.001	0.006	-0.416
GPSP	3.147	-0.748	2.587
GPSS	3.160	0.778	2.579
CL0	1.907	-0.004	0.067
IMU	0.000	0.000	0.000
CLT	-2.310	0.016	0.374
CLB	6.508	0.006	1.297
CLS	-0.859	0.006	-0.275
SSS	-2.139	0.560	2.451

Appendix 2: Dynamic Draft Report

Settlement and Squat Report
Navigation Response Team 6
Launch S3003

Procedures

Acquisition

Navigation Response Team 6 is using patch test results from 2013. 2014 patch test results were inferior to 2013 results.

Data for the test were acquired on October 2nd 2012, in the vicinity of South Hampton Shoal Channel in San Francisco Bay. This was a flat, featureless area located within a reasonable distance to the vessel's current projects.

The test consisted of logging POSPac data while running a line in opposite directions. The vessel's RPMs were increased from 800 RPM to 2200 RPM by 200 RPM increments in two minute intervals. A 5 minute dead-in-the-water rest period was performed at the beginning, middle and end of the test.

Processing

Following data collection, the POSPac data was processed in Applanix POSPac MMS 5.4 SP2. A SmartBase region was created using the GPS base stations BRIB, P261, P224, SVIN and UCSF with SVIN and UCSF being the control stations.

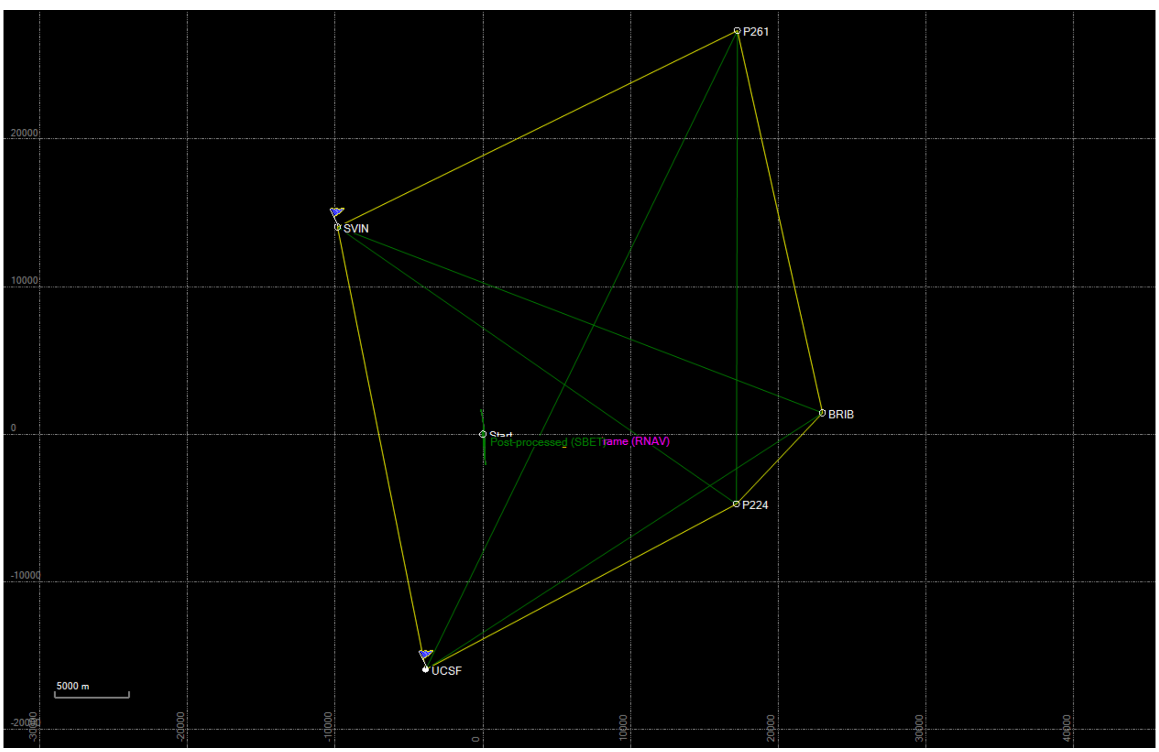


Figure 1. SmartBase Region for NRT 6 ERDDM

The produced SBET (Smoothed Best Estimate of Trajectory) was then processed in Pydro 12.9 (r3952) with the ProcSBETDynamicDraft.py macro using the tide correction functionality and a 4^{th} order polynomial curve. A ZDF from the OPR-L430-NRT6-12 project was used to determine the zone values and tide gauge data to download.

Results

The results from Figure 2 generated by the macro were entered into the Draft section of the CARIS HVF, NRT6_S3003_EM3002.hvf on October 2nd with time stamp 2012-276, 00:00. The uncertainty from this test was taken from the 2 STD value of approximately 0.09 found in Figure 2 and entered in the HVF under the TPU StdDev entry Delta Draft. The results of this test compare favorably to previous year's results.

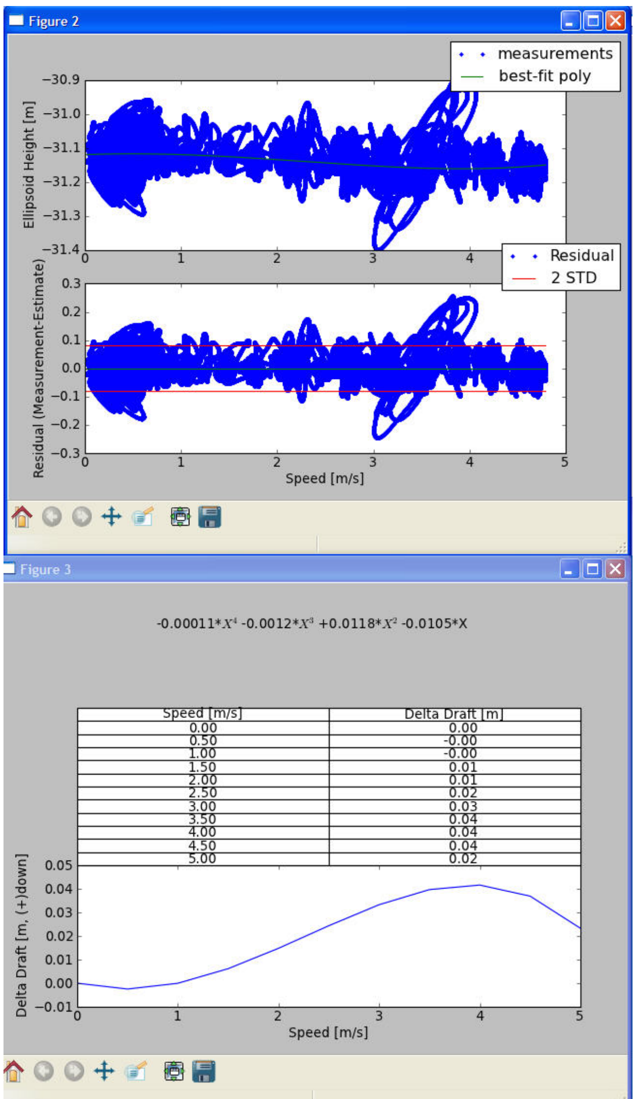
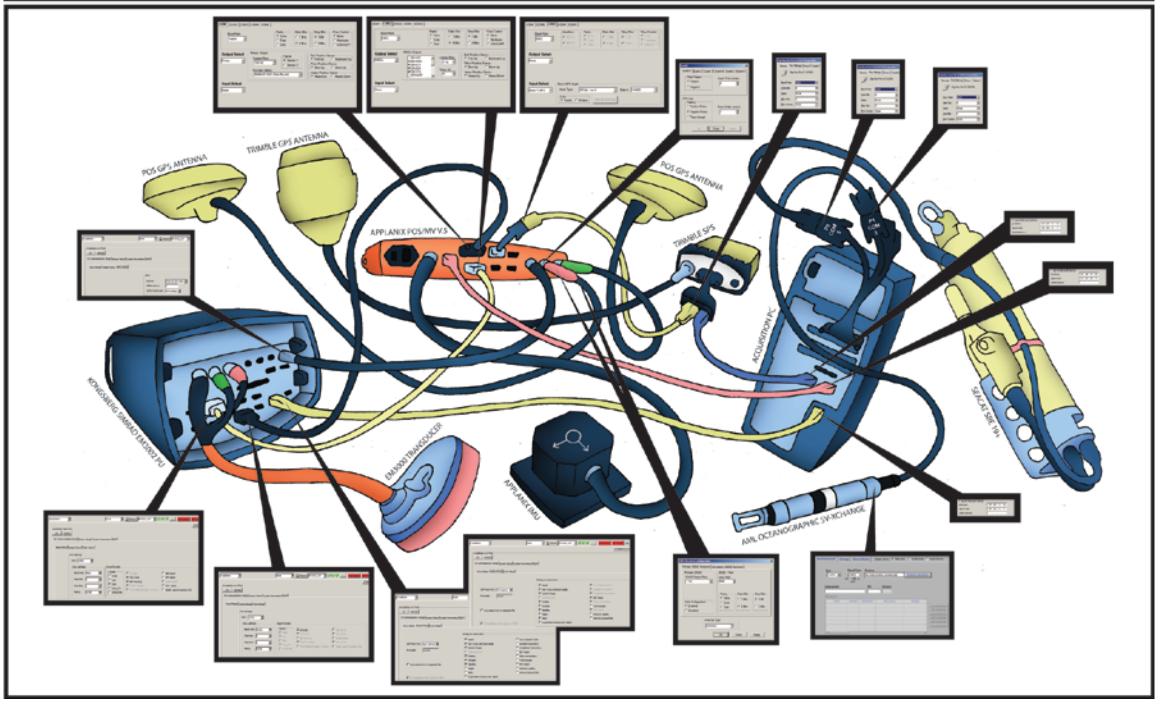


Figure 2. Plots generated by the Pydro macro used to populate the CARIS HVF

Appendix 3: Survey Systems Wiring Diagram for Launch S3003

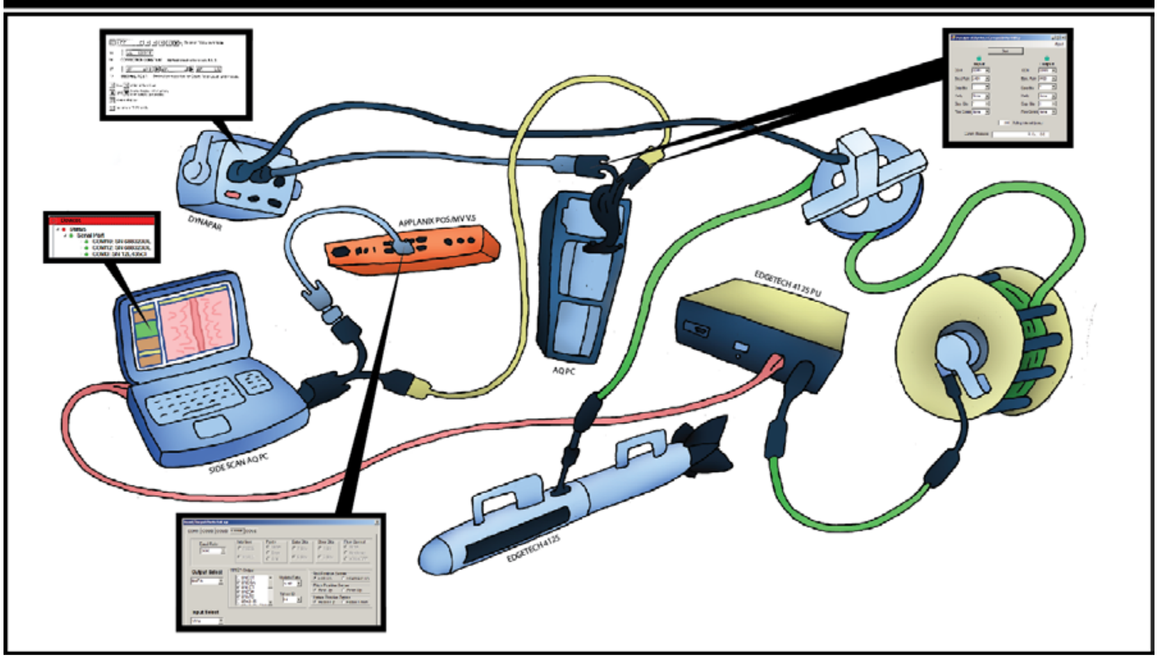
NOAA NRT6 S3003 EM3002 SCHEMATIC

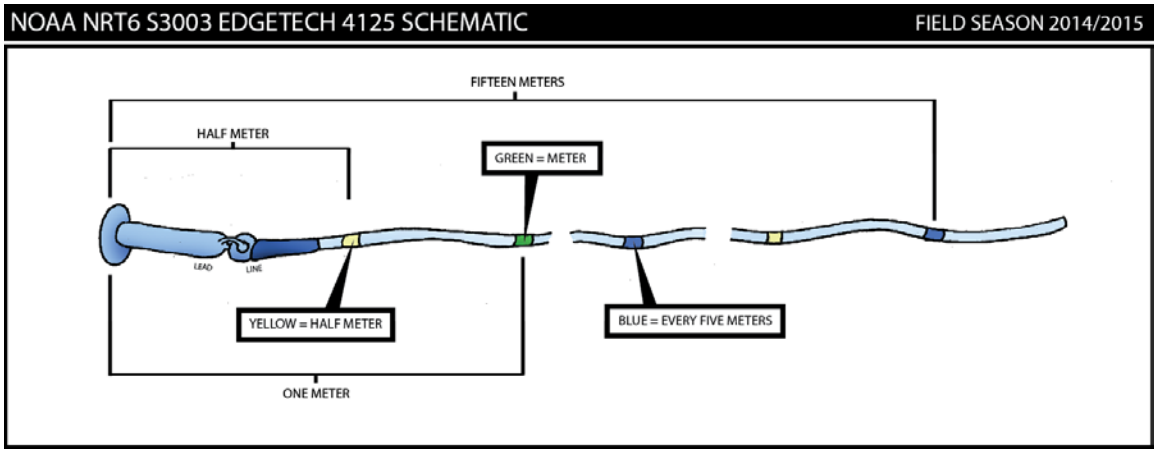
FIELD SEASON 2014/2015



NOAA NRT6 S3003 EDGETECH 4125 SCHEMATIC

FIELD SEASON 2014/2015

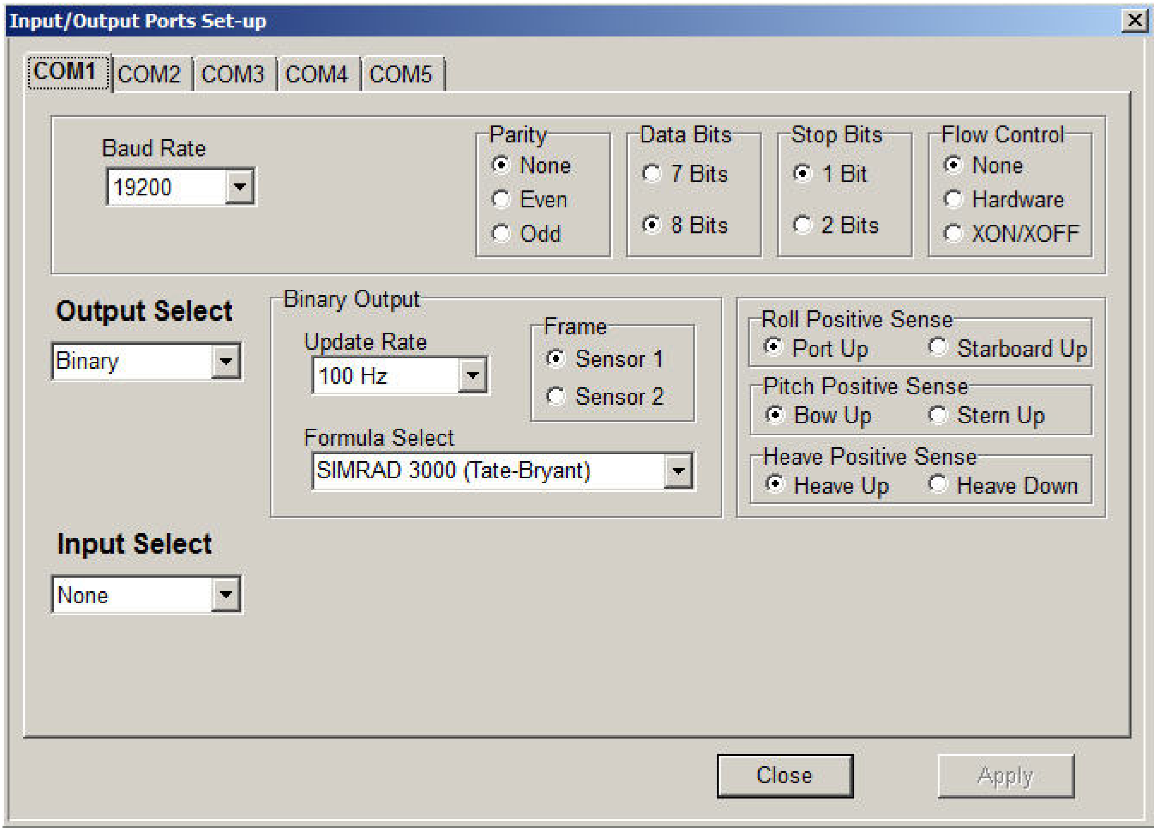



NOAA NRT6 S3003 EDGETECH 4125 SCHEMATIC
FIELD SEASON 2014/2015
FIFTEEN METERS
HALF METER
GREEN = METER
LEAD
LINE
YELLOW = HALF METER
BLUE = EVERY FIVE METERS
ONE METER

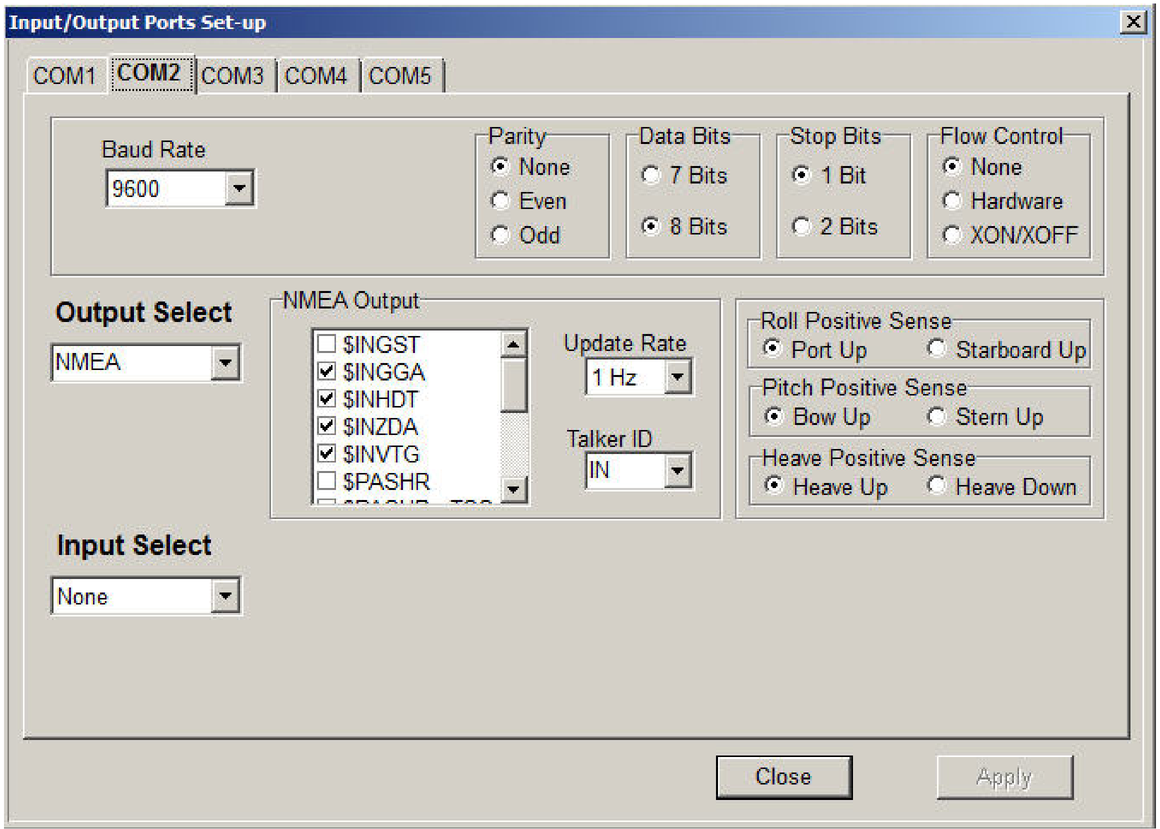
Appendix 4: NRT6 Hydrographic Systems Setup

POS Settings

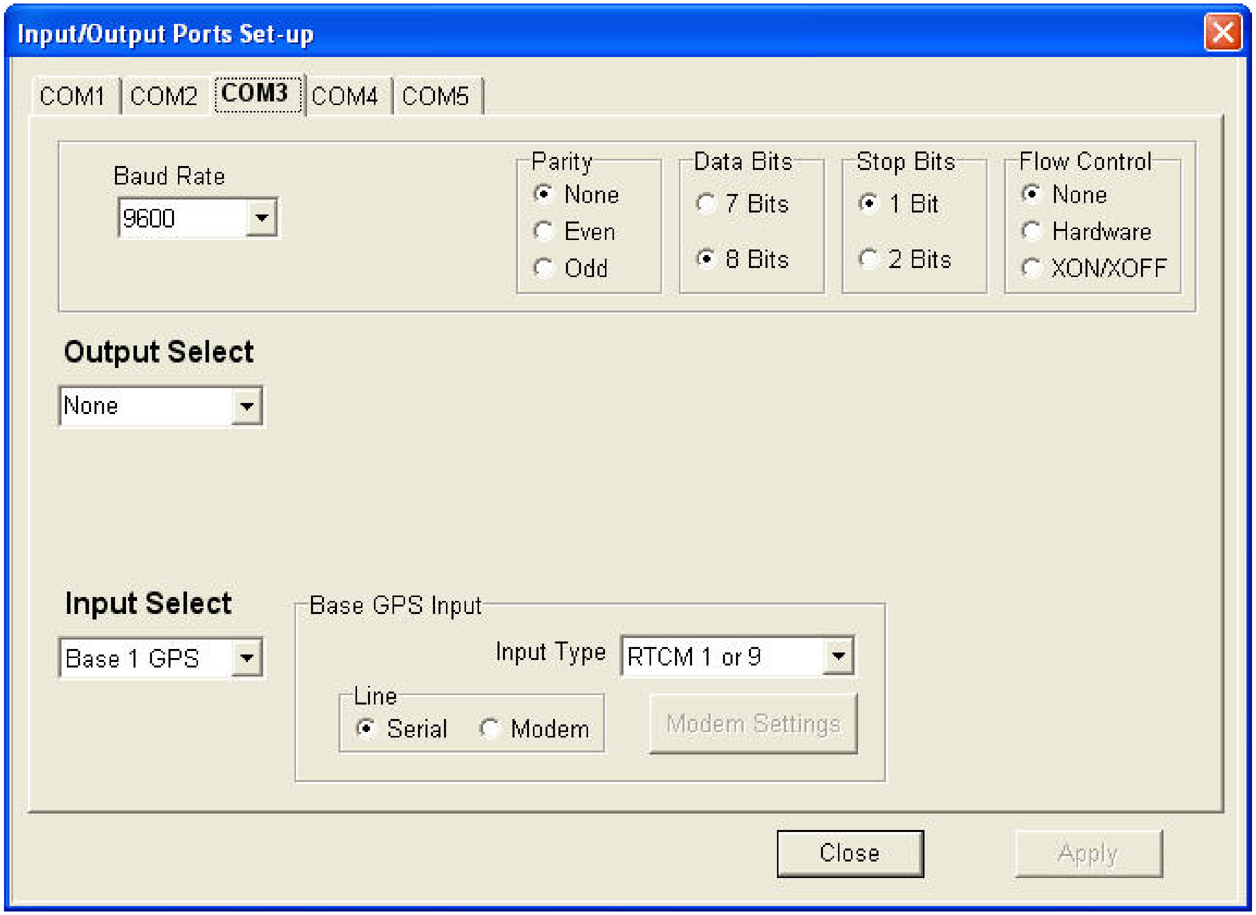
Com Ports



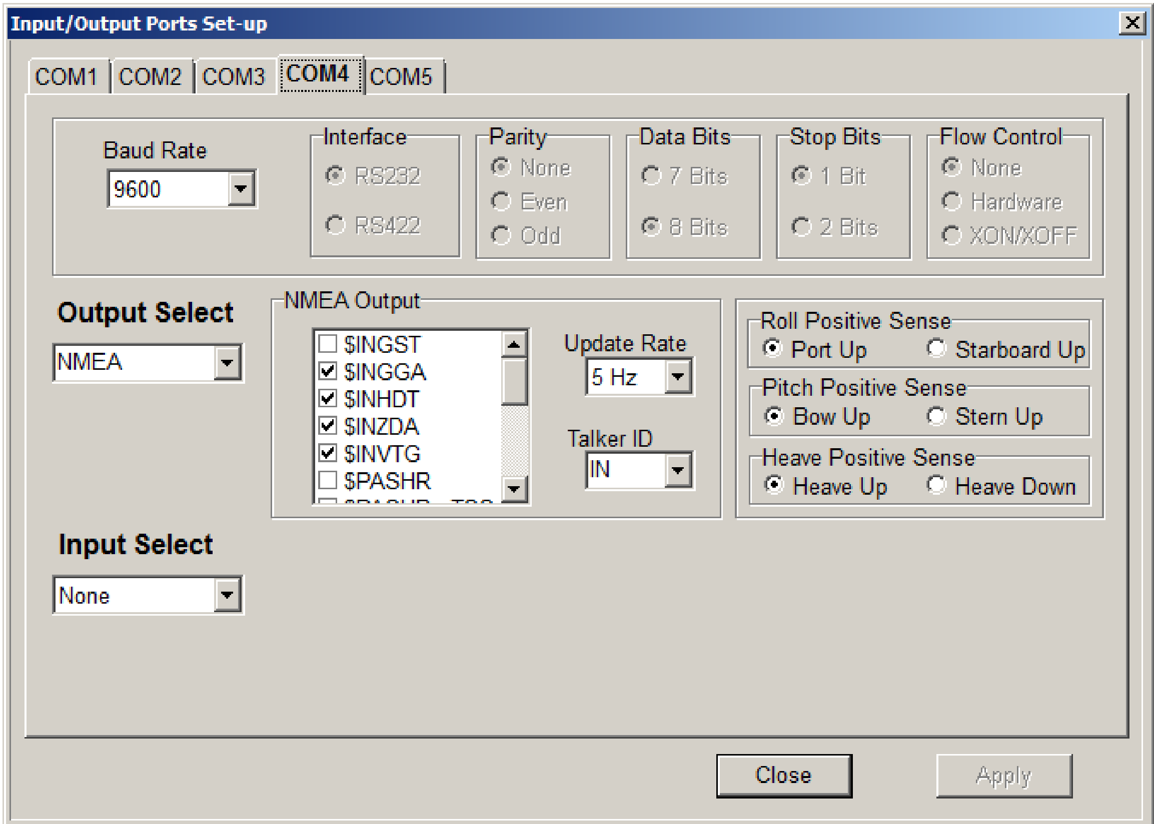
Com 1: Attitude data to Simrad



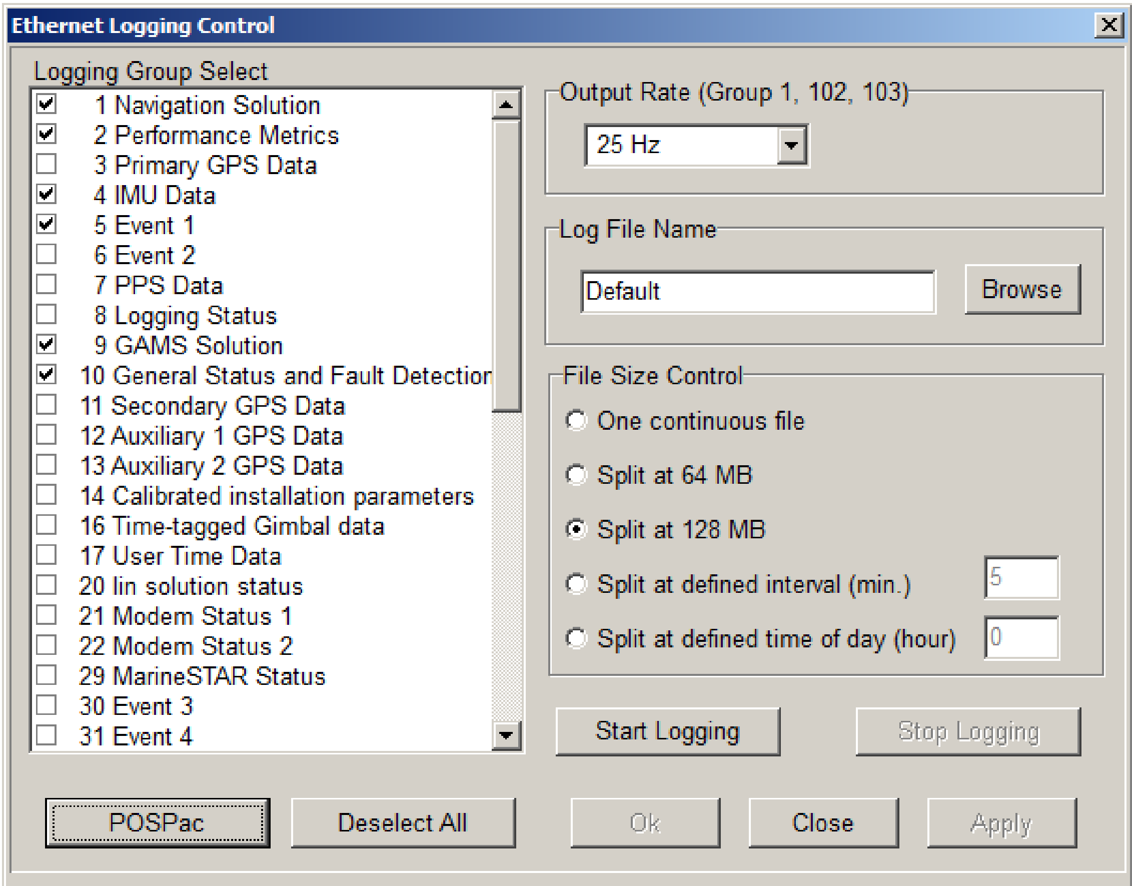
Com 2: Navigation and ZDA timing to Simrad



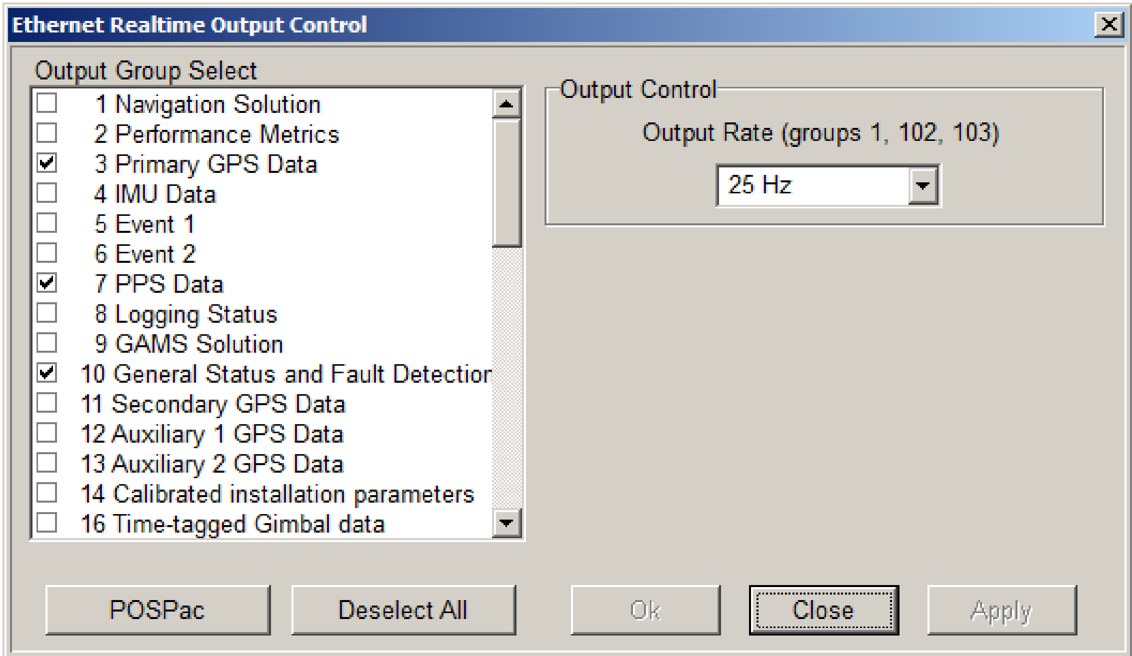
Com 3: DGPS corrector input into POS MV.



COM 4: Navigation to Klein 3000 side scan sonar



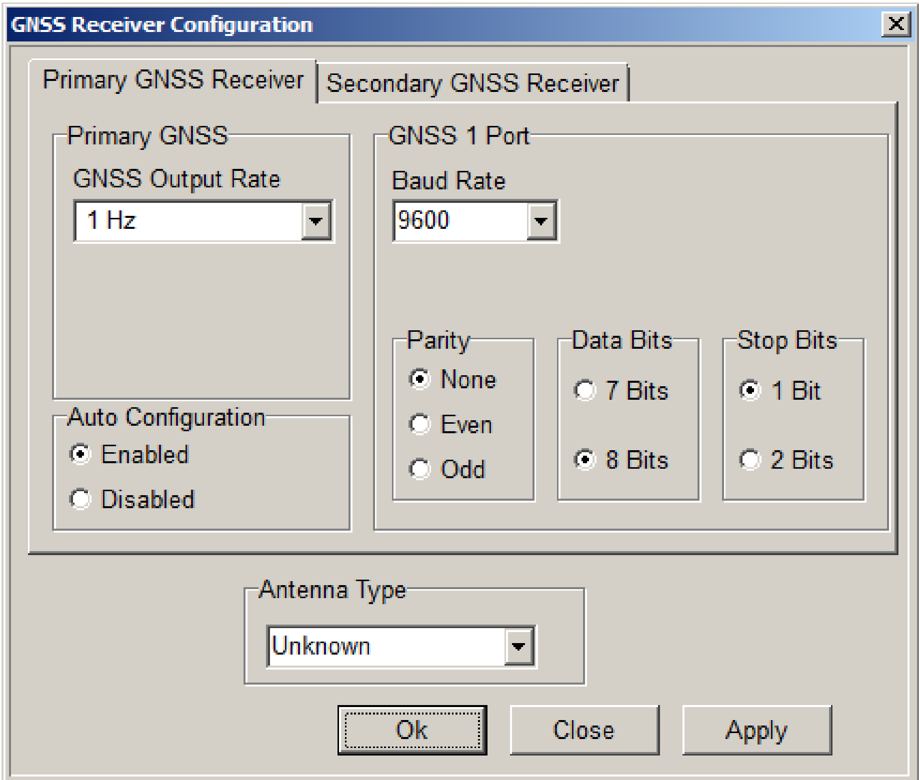
Click POSPac button for correct settings in Ethernet Logging Control.



These sentences were recommended by Hypack in a document on POS net setup. It recommends only using these devices, otherwise Hypack will crash.

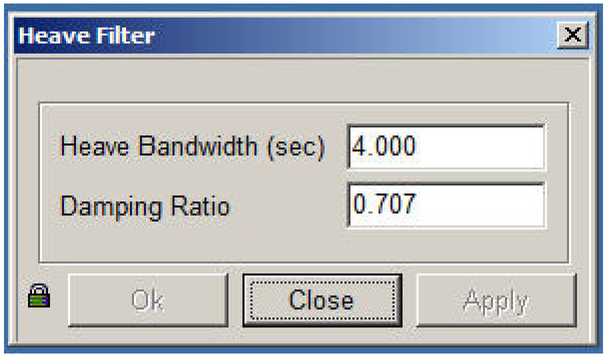
Other Settings

GPS Receiver Configuration

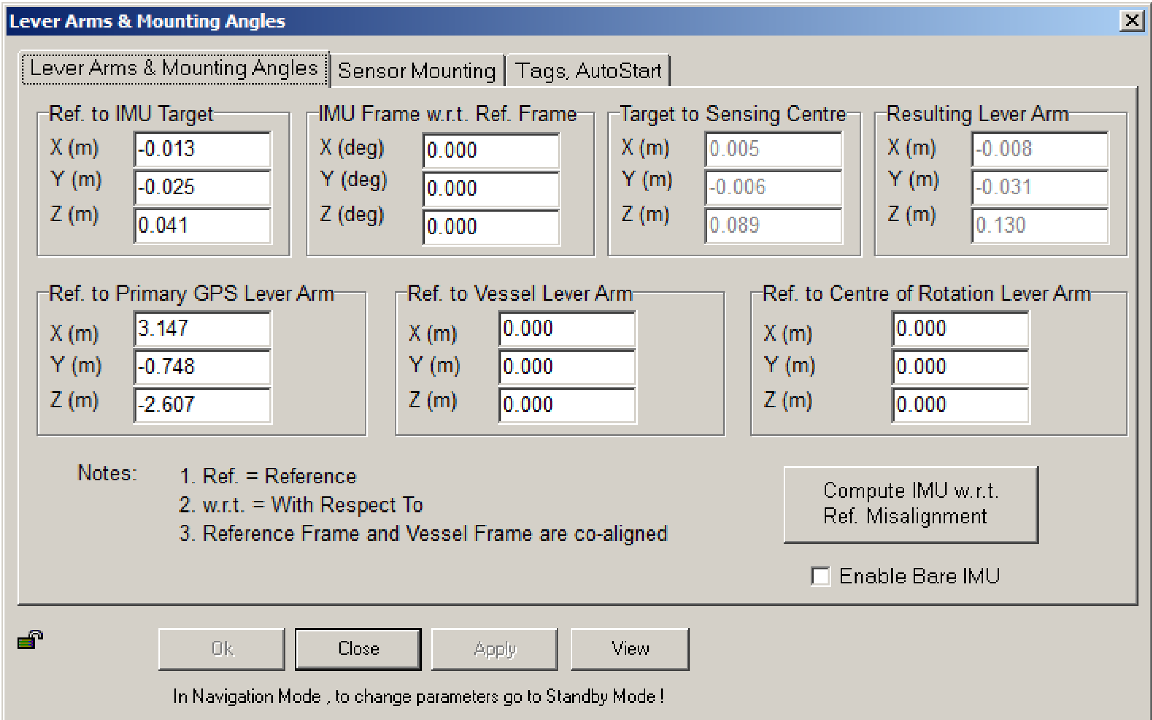


The Secondary GPS Receiver settings are the same as the primary.

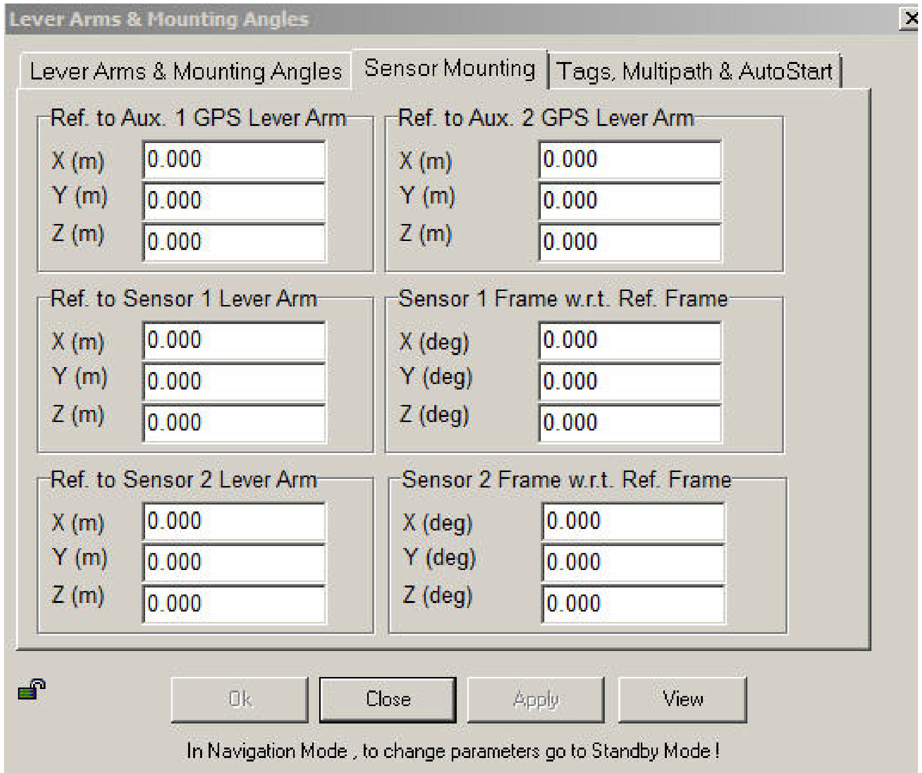
Heave Filter



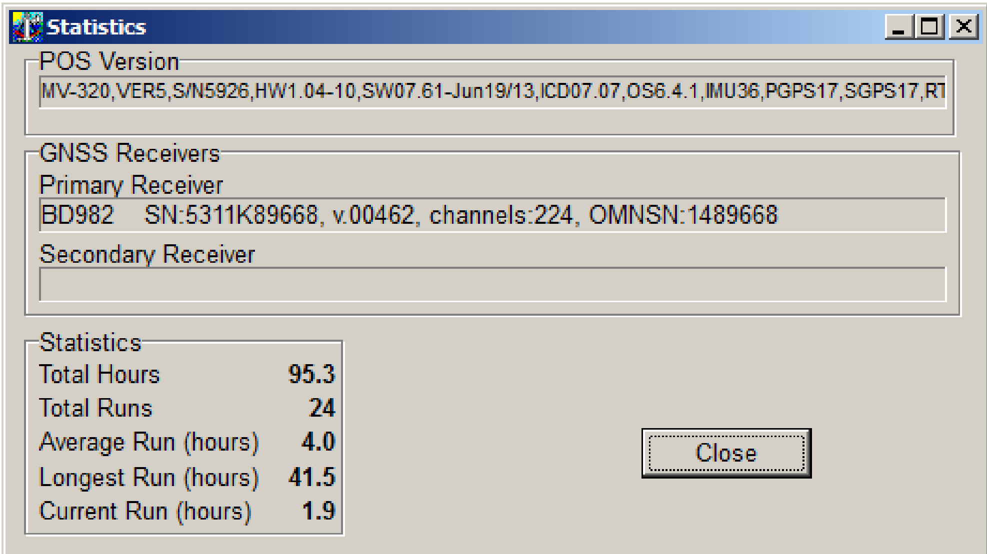
Lever Arms and Mounting



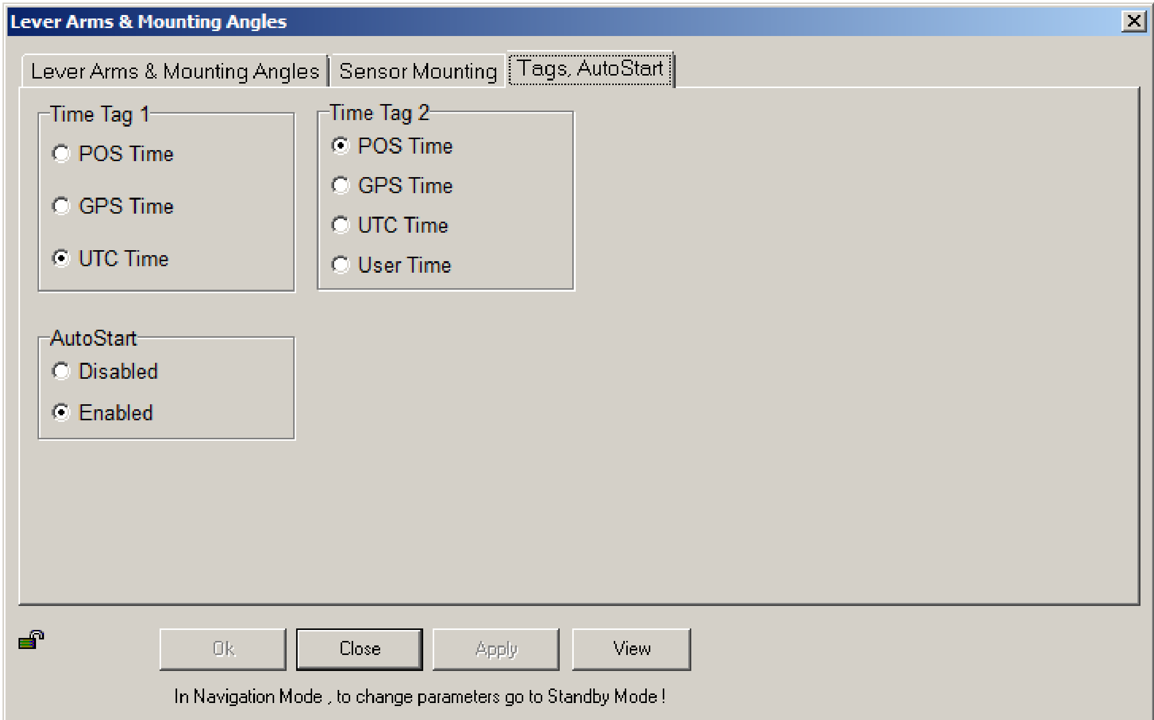
Sensor Mounting

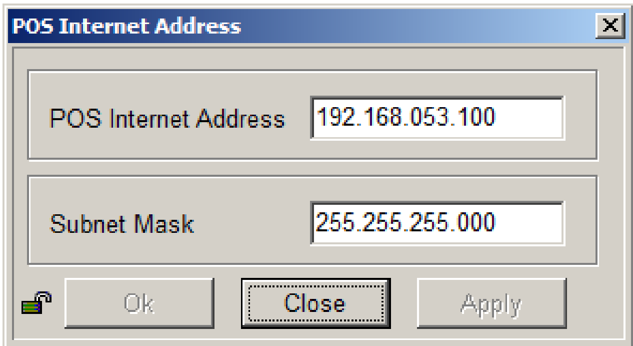

Lever Arms & Mounting Angles
Lever Arms & Mounting Angles
Sensor Mounting
Tags, Multipath & AutoStart
Ref. to Aux. 1 GPS Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Ref. to Aux. 2 GPS Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Ref. to Sensor 1 Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Sensor 1 Frame w.r.t. Ref. Frame
X (deg) 0.000
Y (deg) 0.000
Z (deg) 0.000
Ref. to Sensor 2 Lever Arm
X (m) 0.000
Y (m) 0.000
Z (m) 0.000
Sensor 2 Frame w.r.t. Ref. Frame
X (deg) 0.000
Y (deg) 0.000
Z (deg) 0.000
Ok
Close
Apply
View
In Navigation Mode , to change parameters go to Standby Mode !

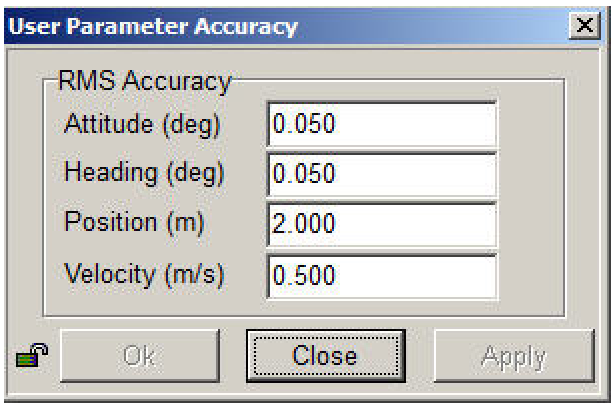
Statistics

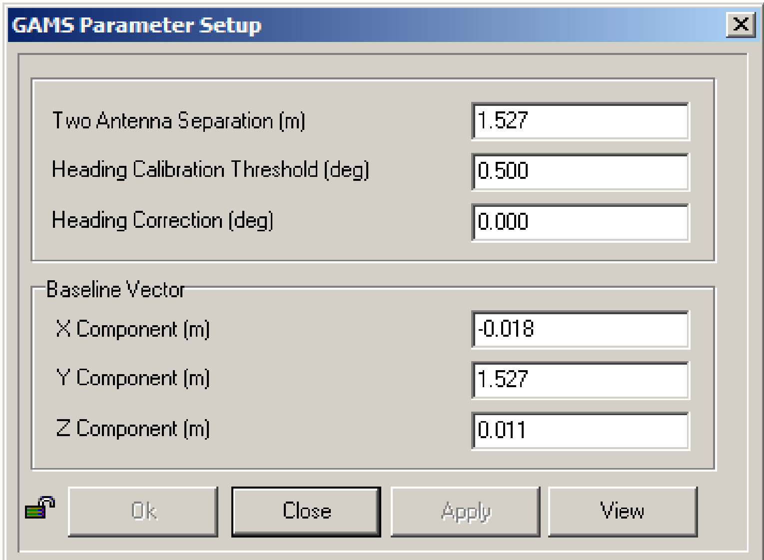


Tags, Multipath amd Autostart


Lever Arms & Mounting Angles
Lever Arms & Mounting Angles
Sensor Mounting
Tags, AutoStart
Time Tag 1
POS Time
GPS Time
UTC Time
Time Tag 2
POS Time
GPS Time
UTC Time
User Time
AutoStart
Disabled
Enabled
Ok
Close
Apply
View
In Navigation Mode , to change parameters go to Standby Mode !


POS Internet Address
POS Internet Address
192.168.053.100
Subnet Mask
255.255.255.000
Ok
Close
Apply

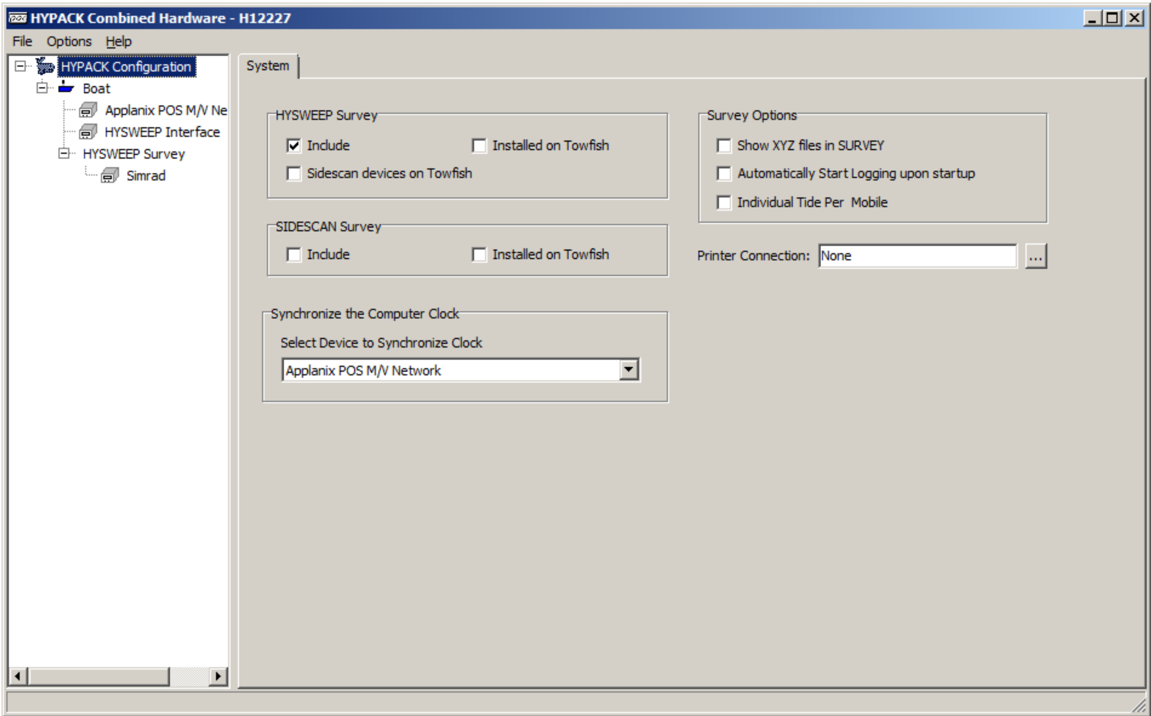

User Parameter Accuracy
RMS Accuracy
Attitude (deg)
0.050
Heading (deg)
0.050
Position (m)
2.000
Velocity (m/s)
0.500
Ok
Close
Apply

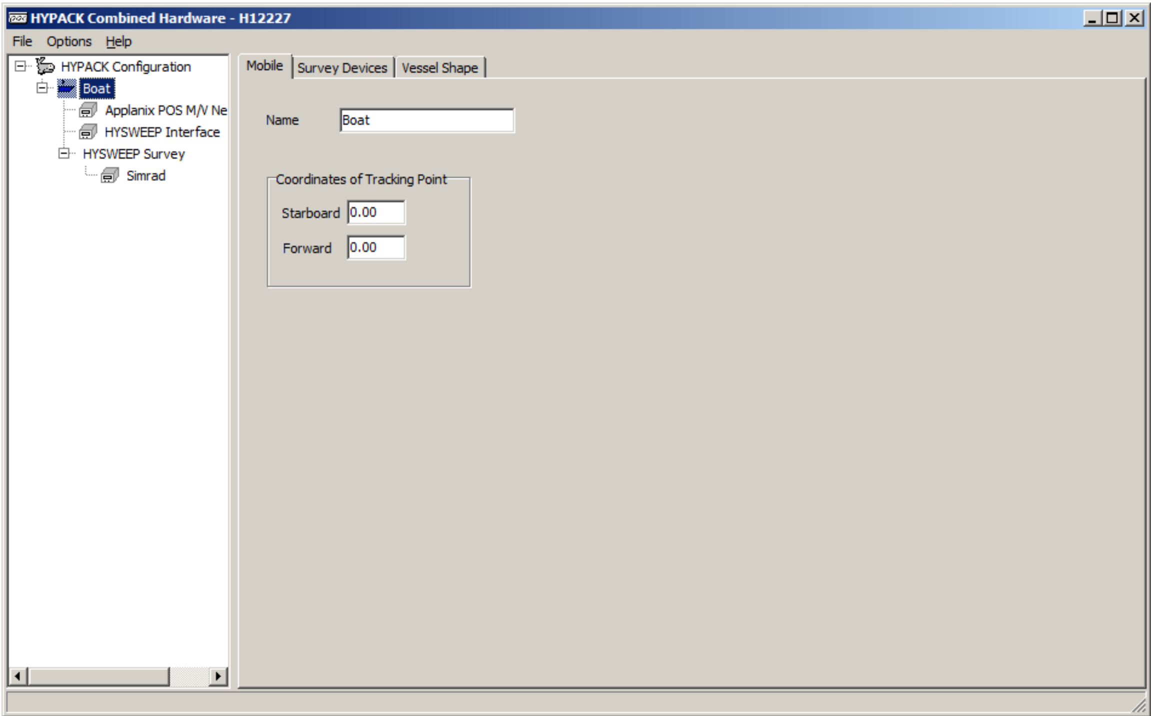


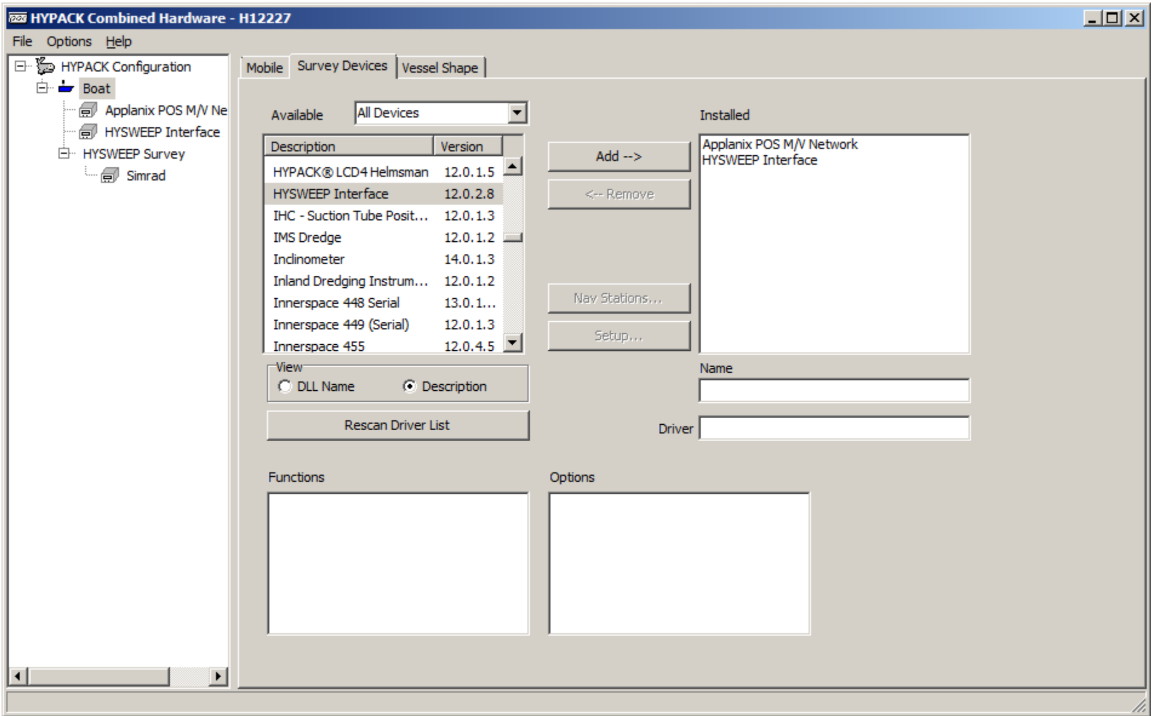
Hypack Settings

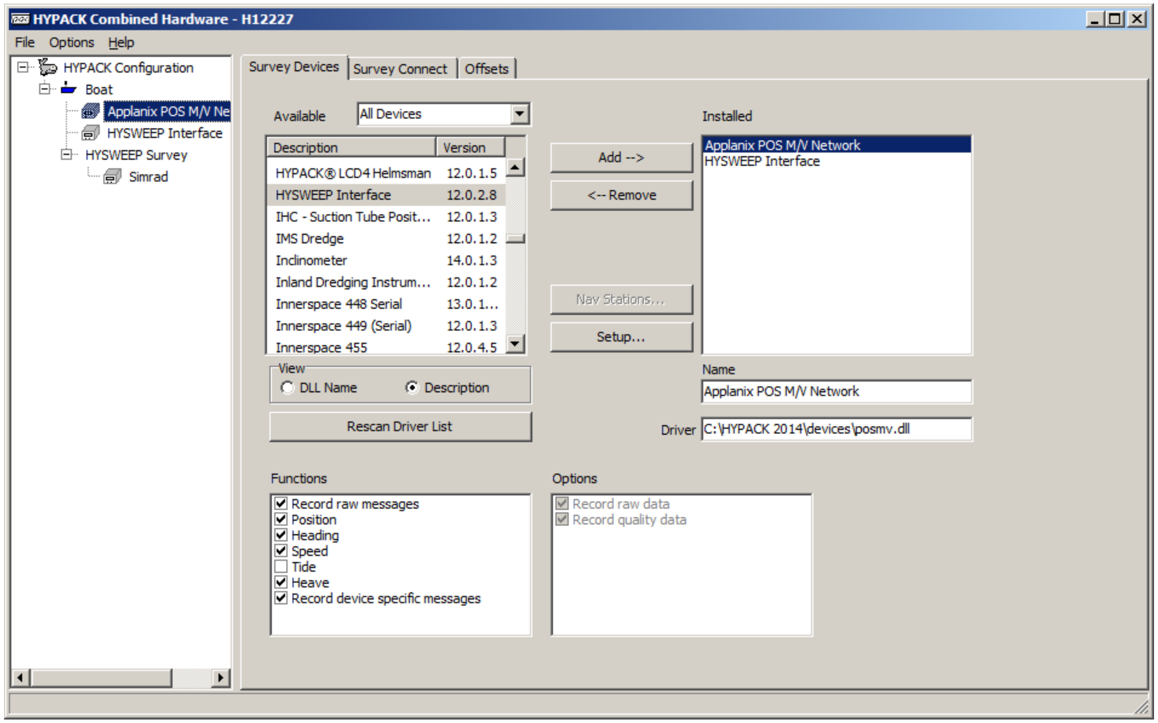
Hypack Hardware

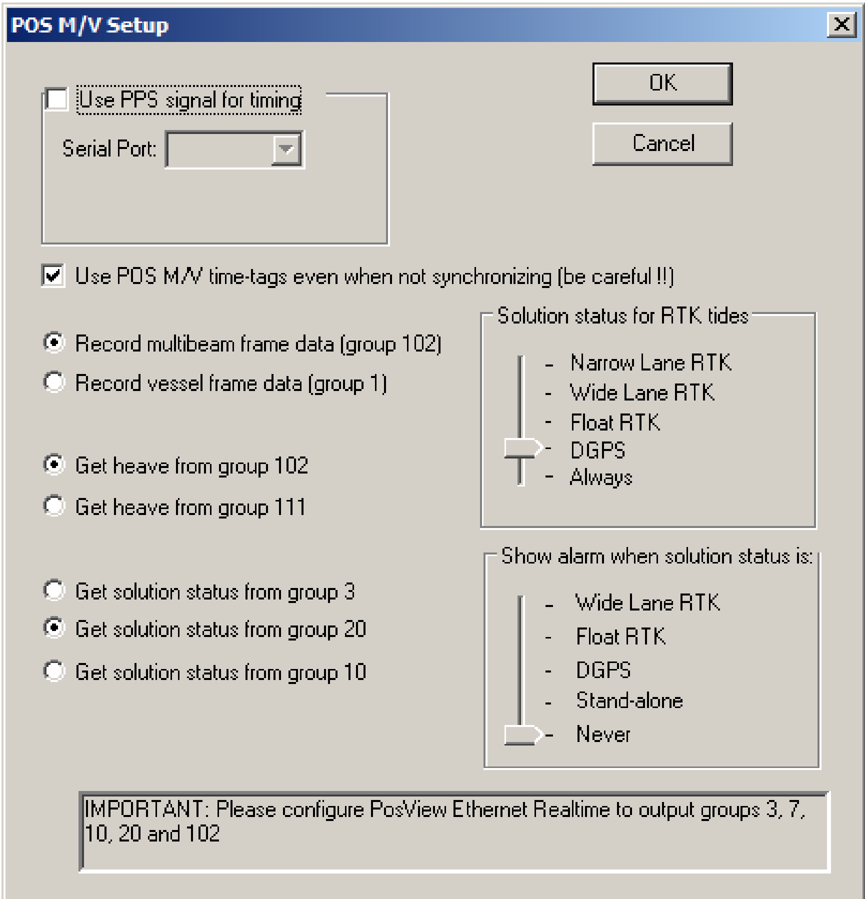
Hypack Hardware Overview

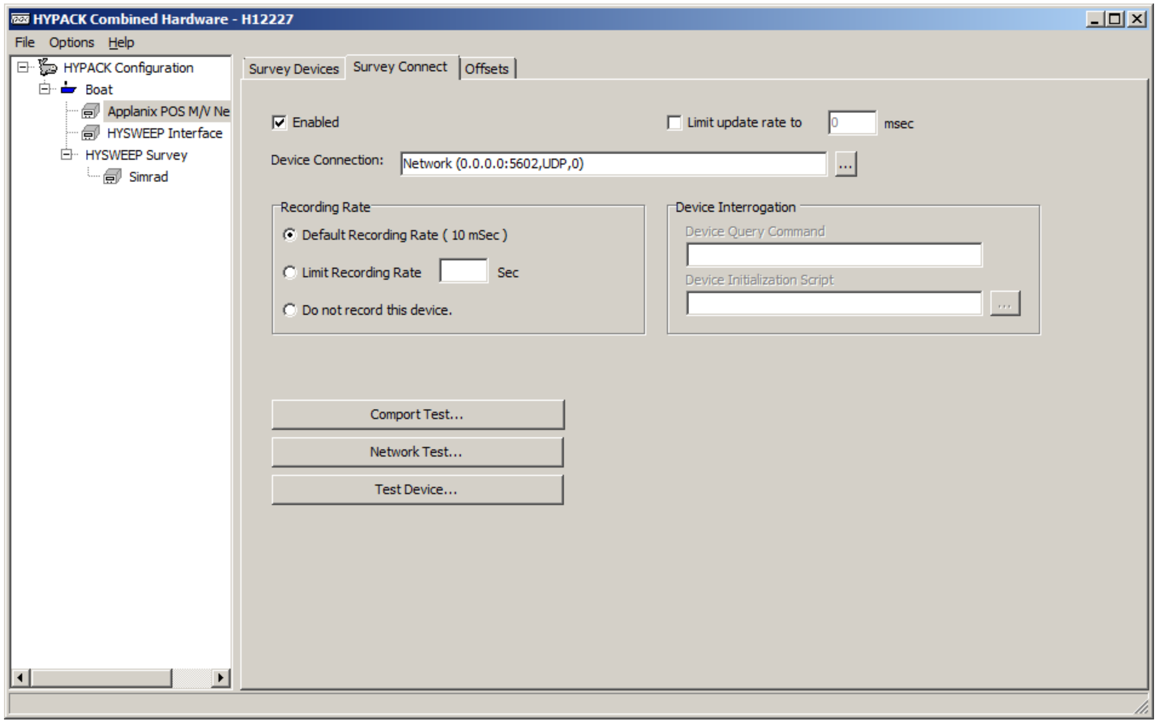

HYPACK Combined Hardware - H12227
File
Options
Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
System
HYSWEEP Survey
Include
Installed on Towfish
Sidescan devices on Towfish
SIDESCAN Survey
Include
Installed on Towfish
Synchronize the Computer Clock
Select Device to Synchronize Clock
Applanix POS M/V Network
Survey Options
Show XYZ files in SURVEY
Automatically Start Logging upon startup
Individual Tide Per Mobile
Printer Connection:
None

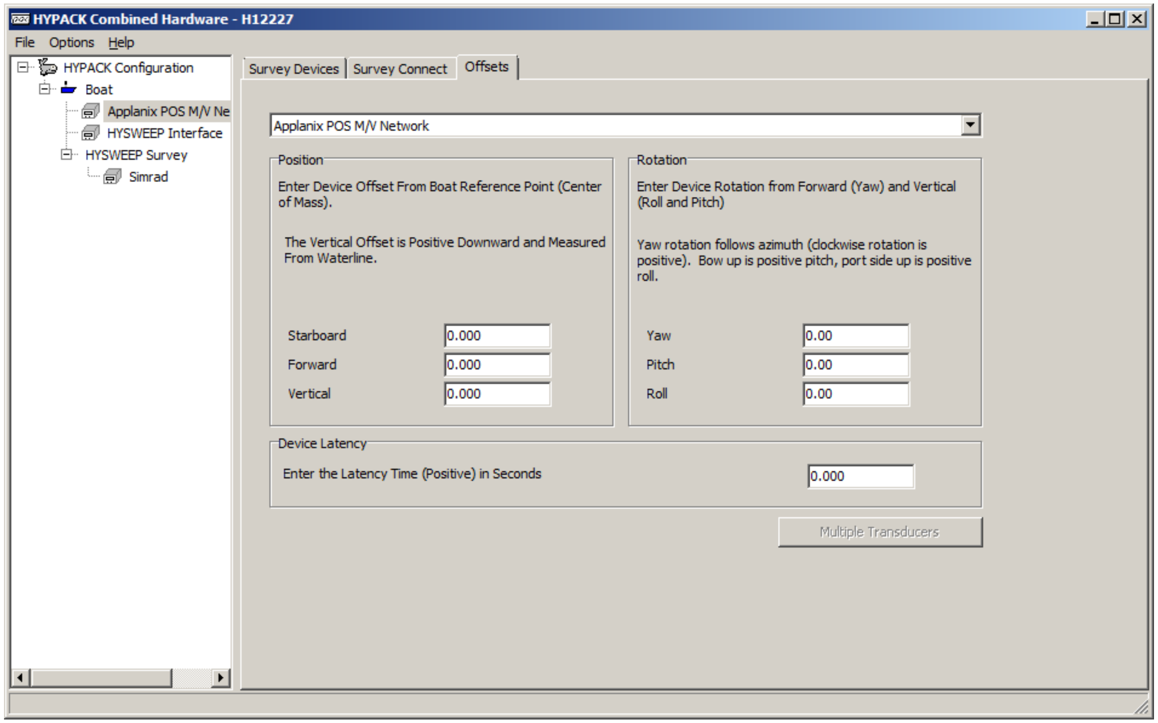

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Mobile
Survey Devices
Vessel Shape
Name
Boat
Coordinates of Tracking Point
Starboard
0.00
Forward
0.00

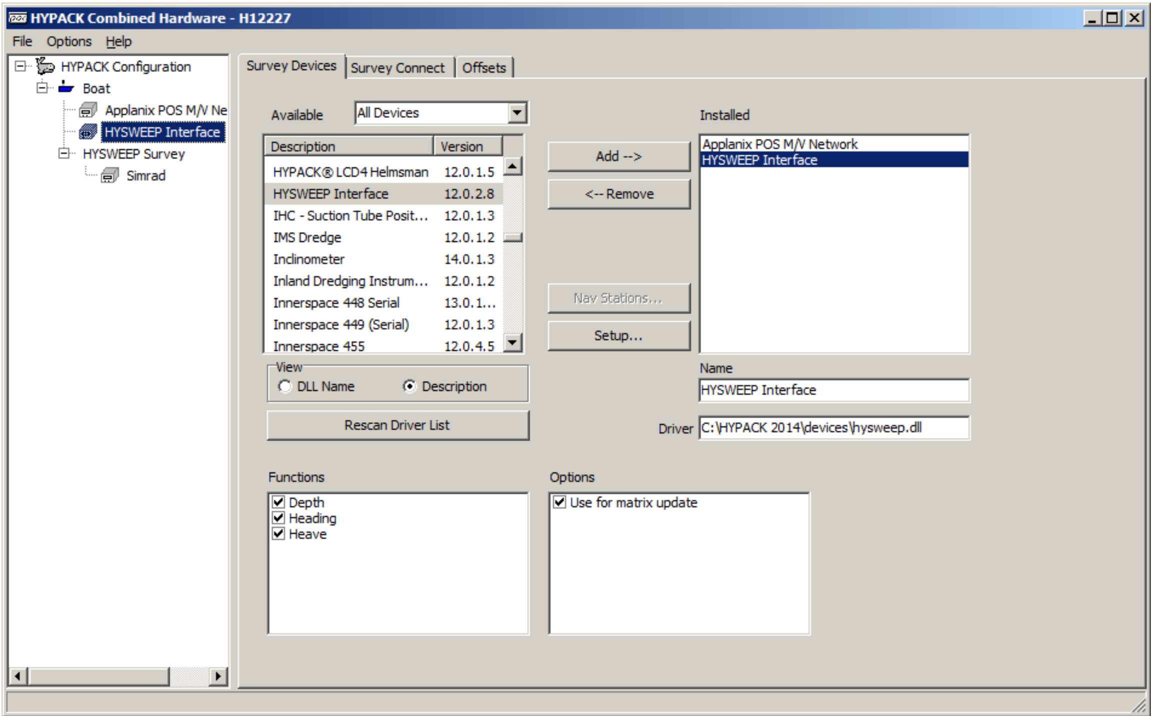

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Mobile
Survey Devices
Vessel Shape
Available
All Devices
Description
Version
HYPACK® LCD4 Helmsman 12.0.1.5
HYSWEEP Interface 12.0.2.8
IHC - Suction Tube Posit... 12.0.1.3
IMS Dredge 12.0.1.2
Inclinometer 14.0.1.3
Inland Dredging Instrum... 12.0.1.2
Innerspace 448 Serial 13.0.1...
Innerspace 449 (Serial) 12.0.1.3
Innerspace 455 12.0.4.5
View
DLL Name
Description
Rescan Driver List
Add -->
<-- Remove
Nav Stations...
Setup...
Installed
Applanix POS M/V Network
HYSWEEP Interface
Name
Driver
Functions
Options

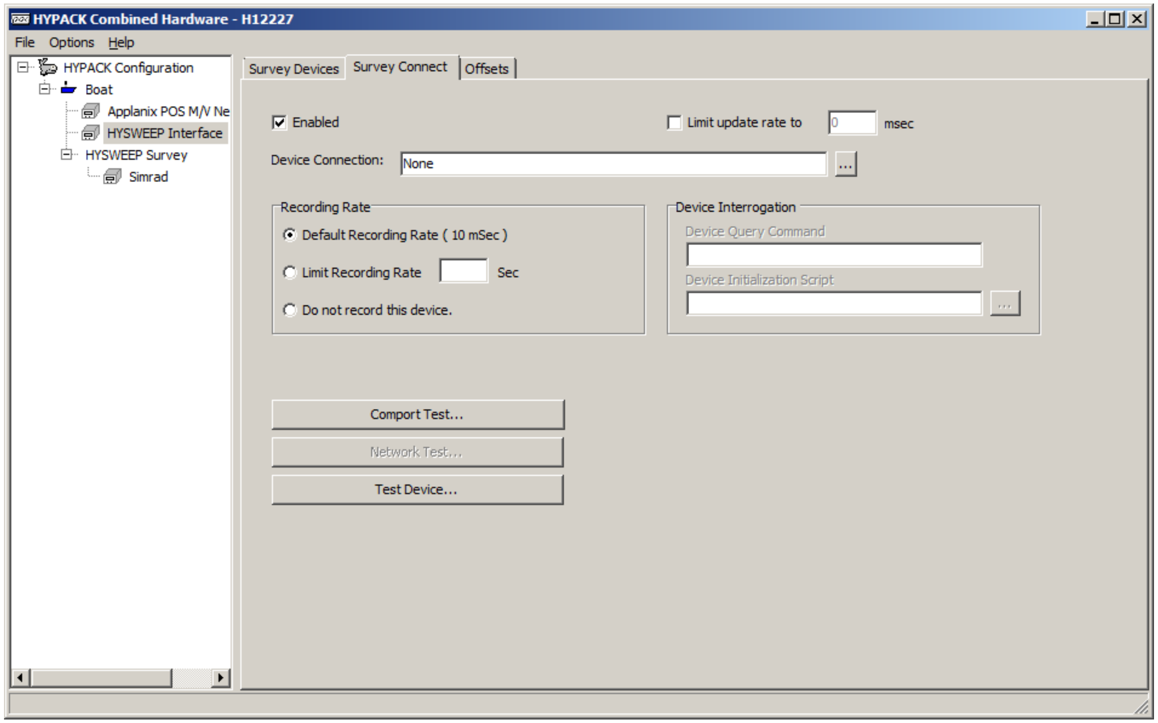

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Survey Devices
Survey Connect
Offsets
Available
All Devices
Installed
Description
Version
HYPACK® LCD4 Helmsman 12.0.1.5
HYSWEEP Interface 12.0.2.8
IHC - Suction Tube Posit... 12.0.1.3
IMS Dredge 12.0.1.2
Inclinometer 14.0.1.3
Inland Dredging Instrum... 12.0.1.2
Innerspace 448 Serial 13.0.1...
Innerspace 449 (Serial) 12.0.1.3
Innerspace 455 12.0.4.5
Add -->
<-- Remove
Nav Stations...
Setup...
Applanix POS M/V Network
HYSWEEP Interface
View
DLL Name
Description
Rescan Driver List
Name
Applanix POS M/V Network
Driver
C:\HYPACK 2014\devices\posmv.dll
Functions
Record raw messages
Position
Heading
Speed
Tide
Heave
Record device specific messages
Options
Record raw data
Record quality data

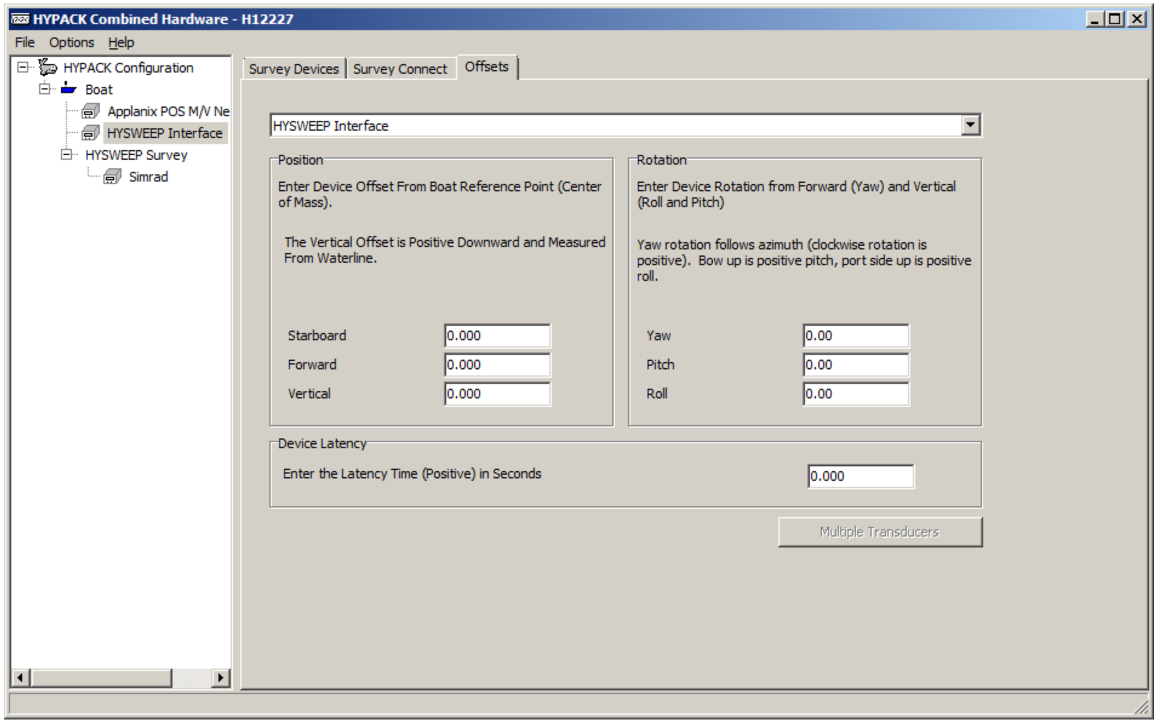

POS M/V Setup
Use PPS signal for timing
Serial Port:
OK
Cancel
Use POS M/V time-tags even when not synchronizing (be careful !!)
Record multibeam frame data (group 102)
Record vessel frame data (group 1)
Get heave from group 102
Get heave from group 111
Get solution status from group 3
Get solution status from group 20
Get solution status from group 10
Solution status for RTK tides
Narrow Lane RTK
Wide Lane RTK
Float RTK
DGPS
Always
Show alarm when solution status is:
Wide Lane RTK
Float RTK
DGPS
Stand-alone
Never
IMPORTANT: Please configure PosView Ethernet Realtime to output groups 3, 7, 10, 20 and 102

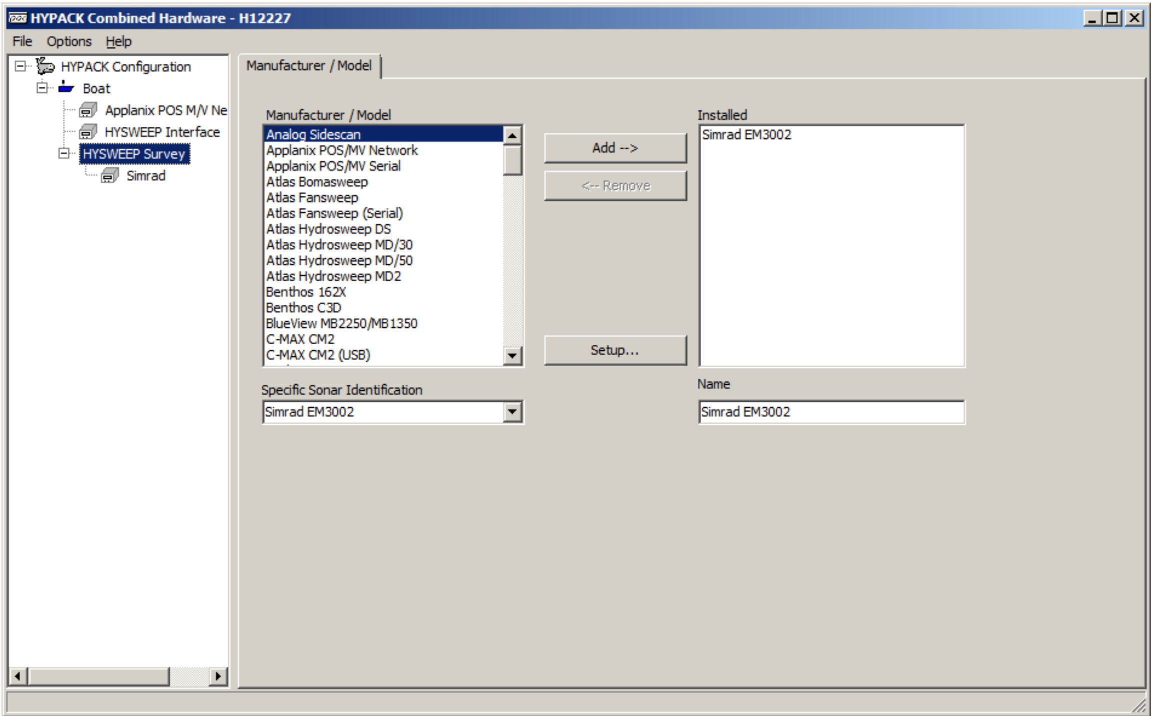

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Survey Devices
Survey Connect
Offsets
Enabled
Limit update rate to
0
msec
Device Connection:
Network (0.0.0.0:5602,UDP,0)
Recording Rate
Default Recording Rate (10 mSec)
Limit Recording Rate
Sec
Do not record this device.
Device Interrogation
Device Query Command
Device Initialization Script
Comport Test...
Network Test...
Test Device...

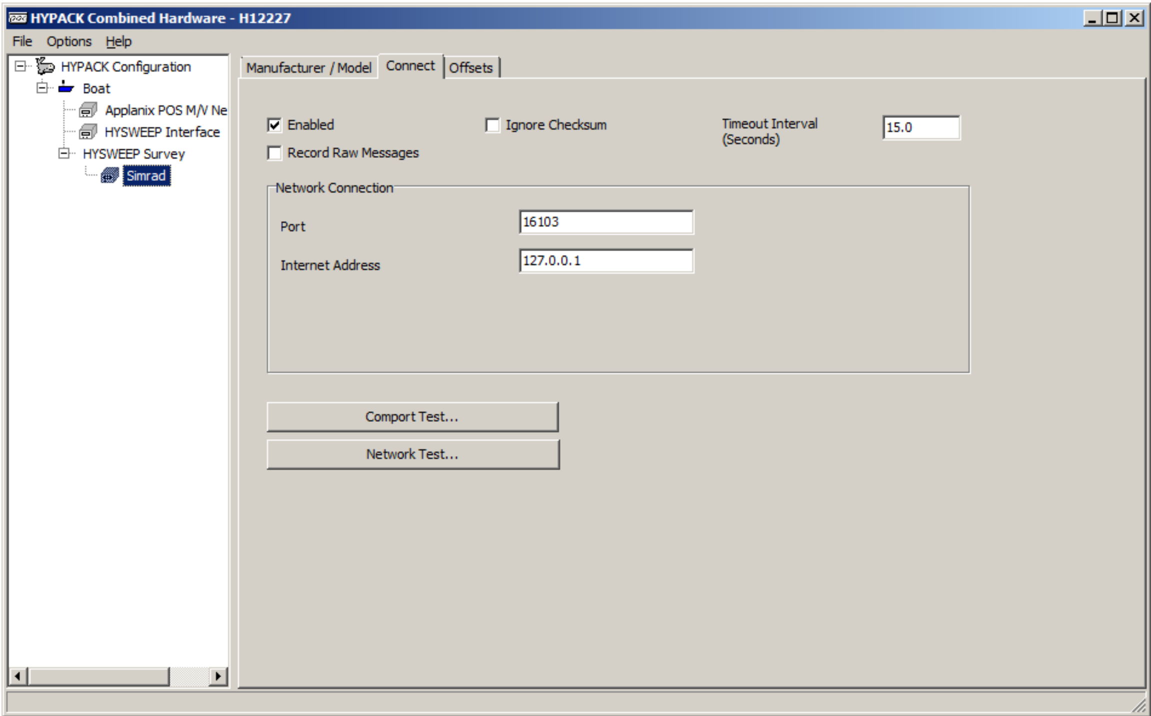

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Survey Devices
Survey Connect
Offsets
Applanix POS M/V Network
Position
Enter Device Offset From Boat Reference Point (Center of Mass).
The Vertical Offset is Positive Downward and Measured From Waterline.
Starboard 0.000
Forward 0.000
Vertical 0.000
Rotation
Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch)
Yaw rotation follows azimuth (clockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.
Yaw 0.00
Pitch 0.00
Roll 0.00
Device Latency
Enter the Latency Time (Positive) in Seconds 0.000
Multiple Transducers

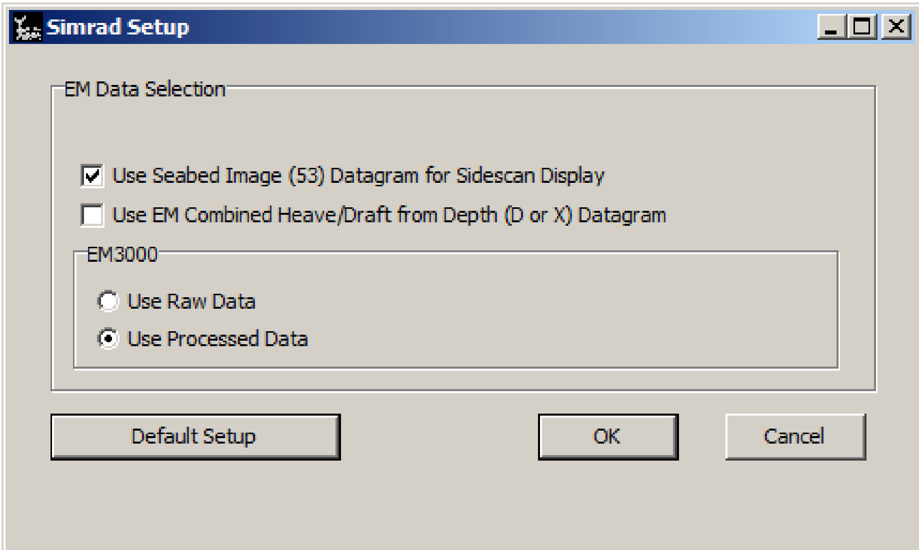

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Survey Devices
Survey Connect
Offsets
Available
All Devices
Description
Version
HYPACK® LCD4 Helmsman 12.0.1.5
HYSWEEP Interface 12.0.2.8
IHC - Suction Tube Posit... 12.0.1.3
IMS Dredge 12.0.1.2
Inclinometer 14.0.1.3
Inland Dredging Instrum... 12.0.1.2
Innerspace 448 Serial 13.0.1...
Innerspace 449 (Serial) 12.0.1.3
Innerspace 455 12.0.4.5
View
DLL Name
Description
Rescan Driver List
Add -->
<-- Remove
Nav Stations...
Setup...
Installed
Applanix POS M/V Network
HYSWEEP Interface
Name
HYSWEEP Interface
Driver
C:\HYPACK 2014\devices\hysweep.dll
Functions
Depth
Heading
Heave
Options
Use for matrix update

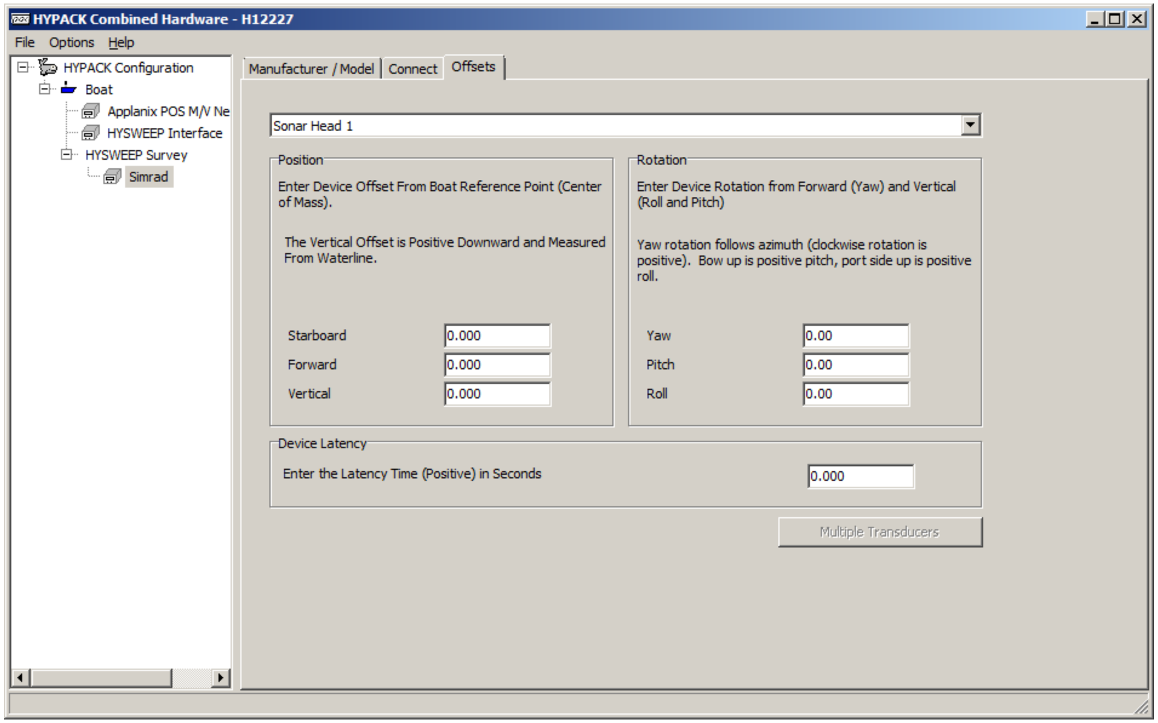

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Survey Devices
Survey Connect
Offsets
Enabled
Limit update rate to
0
msec
Device Connection:
None
Recording Rate
Default Recording Rate (10 mSec)
Limit Recording Rate
Sec
Do not record this device.
Device Interrogation
Device Query Command
Device Initialization Script
Comport Test...
Network Test...
Test Device...


HYPACK Combined Hardware - H12227
File
Options
Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Survey Devices
Survey Connect
Offsets
HYSWEEP Interface
Position
Enter Device Offset From Boat Reference Point (Center of Mass).
The Vertical Offset is Positive Downward and Measured From Waterline.
Starboard 0.000
Forward 0.000
Vertical 0.000
Rotation
Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch)
Yaw rotation follows azimuth (clockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.
Yaw 0.00
Pitch 0.00
Roll 0.00
Device Latency
Enter the Latency Time (Positive) in Seconds 0.000
Multiple Transducers


HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Manufacturer / Model
Manufacturer / Model
Analog Sidescan
Applanix POS/MV Network
Applanix POS/MV Serial
Atlas Bomasweep
Atlas Fansweep
Atlas Fansweep (Serial)
Atlas Hydrosweep DS
Atlas Hydrosweep MD/30
Atlas Hydrosweep MD/50
Atlas Hydrosweep MD2
Benthos 162X
Benthos C3D
BlueView MB2250/MB1350
C-MAX CM2
C-MAX CM2 (USB)
Add -->
<-- Remove
Setup...
Installed
Simrad EM3002
Specific Sonar Identification
Simrad EM3002
Name
Simrad EM3002

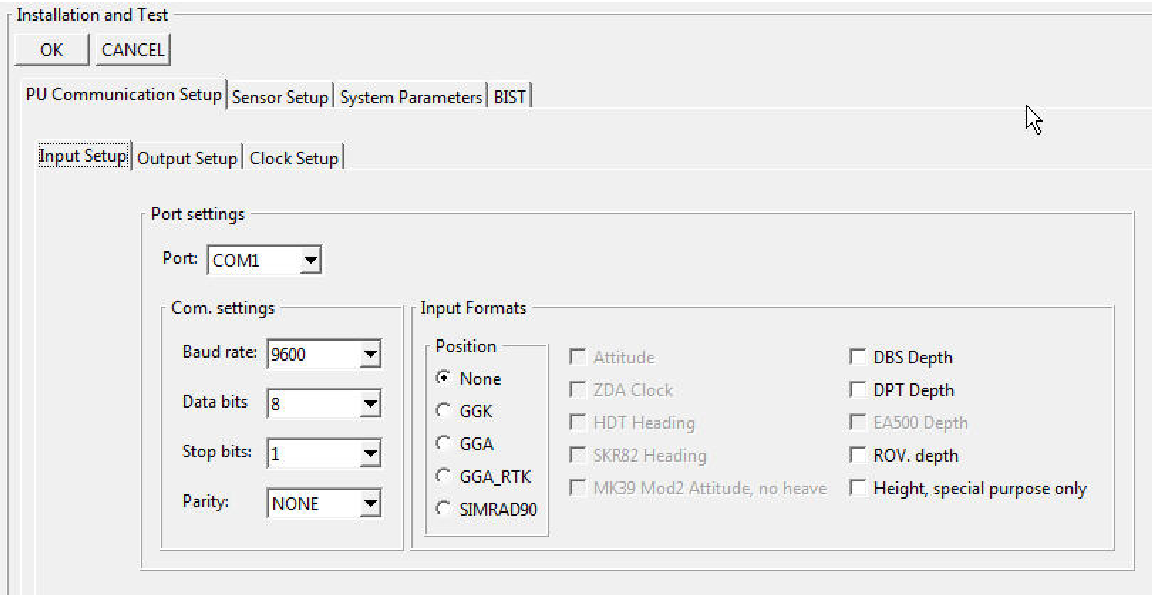

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Manufacturer / Model
Connect
Offsets
Enabled
Ignore Checksum
Timeout Interval (Seconds)
15.0
Record Raw Messages
Network Connection
Port
16103
Internet Address
127.0.0.1
Comport Test...
Network Test...

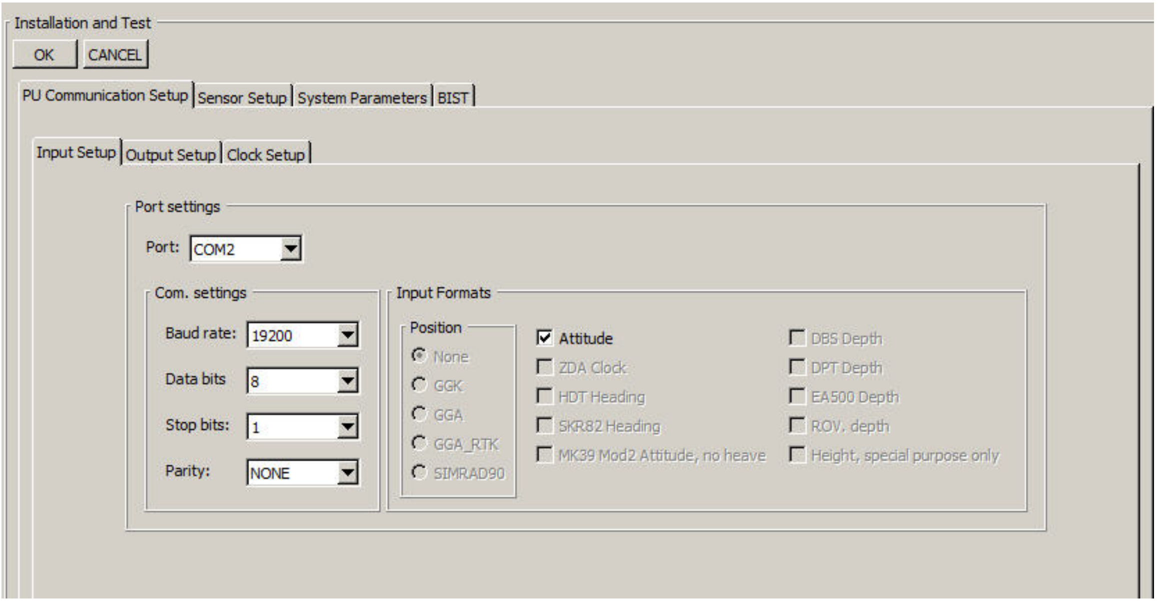

Simrad Setup
EM Data Selection
Use Seabed Image (53) Datagram for Sidescan Display
Use EM Combined Heave/Draft from Depth (D or X) Datagram
EM3000
Use Raw Data
Use Processed Data
Default Setup
OK
Cancel

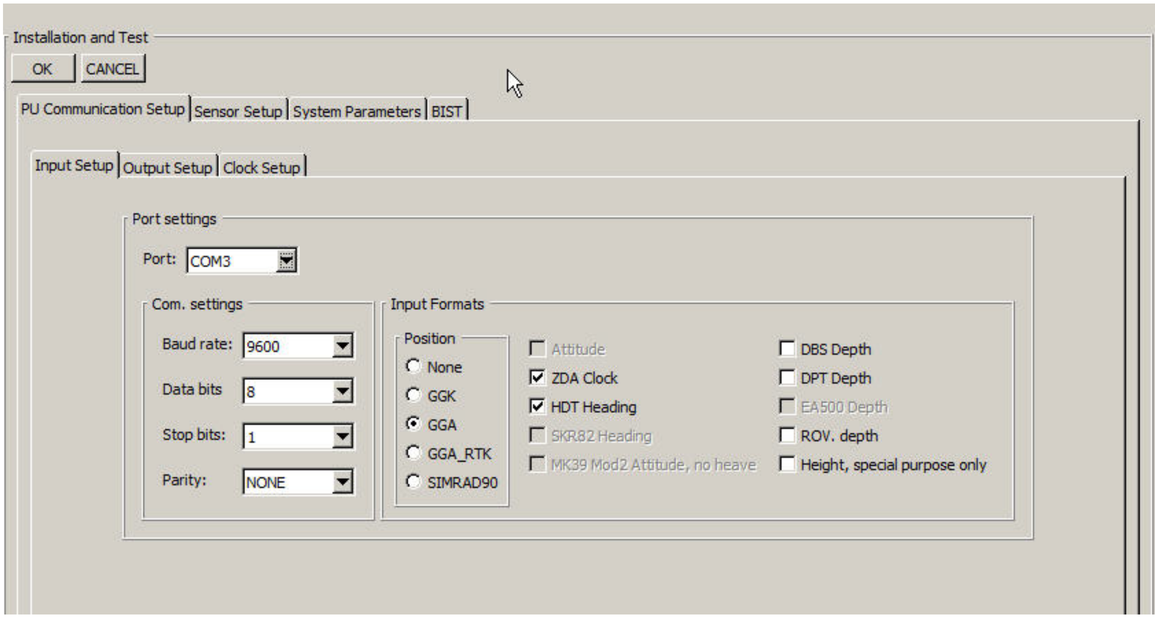

HYPACK Combined Hardware - H12227
File Options Help
HYPACK Configuration
Boat
Applanix POS M/V Ne
HYSWEEP Interface
HYSWEEP Survey
Simrad
Manufacturer / Model
Connect
Offsets
Sonar Head 1
Position
Enter Device Offset From Boat Reference Point (Center of Mass).
The Vertical Offset is Positive Downward and Measured From Waterline.
Starboard 0.000
Forward 0.000
Vertical 0.000
Rotation
Enter Device Rotation from Forward (Yaw) and Vertical (Roll and Pitch)
Yaw rotation follows azimuth (clockwise rotation is positive). Bow up is positive pitch, port side up is positive roll.
Yaw 0.00
Pitch 0.00
Roll 0.00
Device Latency
Enter the Latency Time (Positive) in Seconds 0.000
Multiple Transducers

SIS EM 3002 Controller Settings

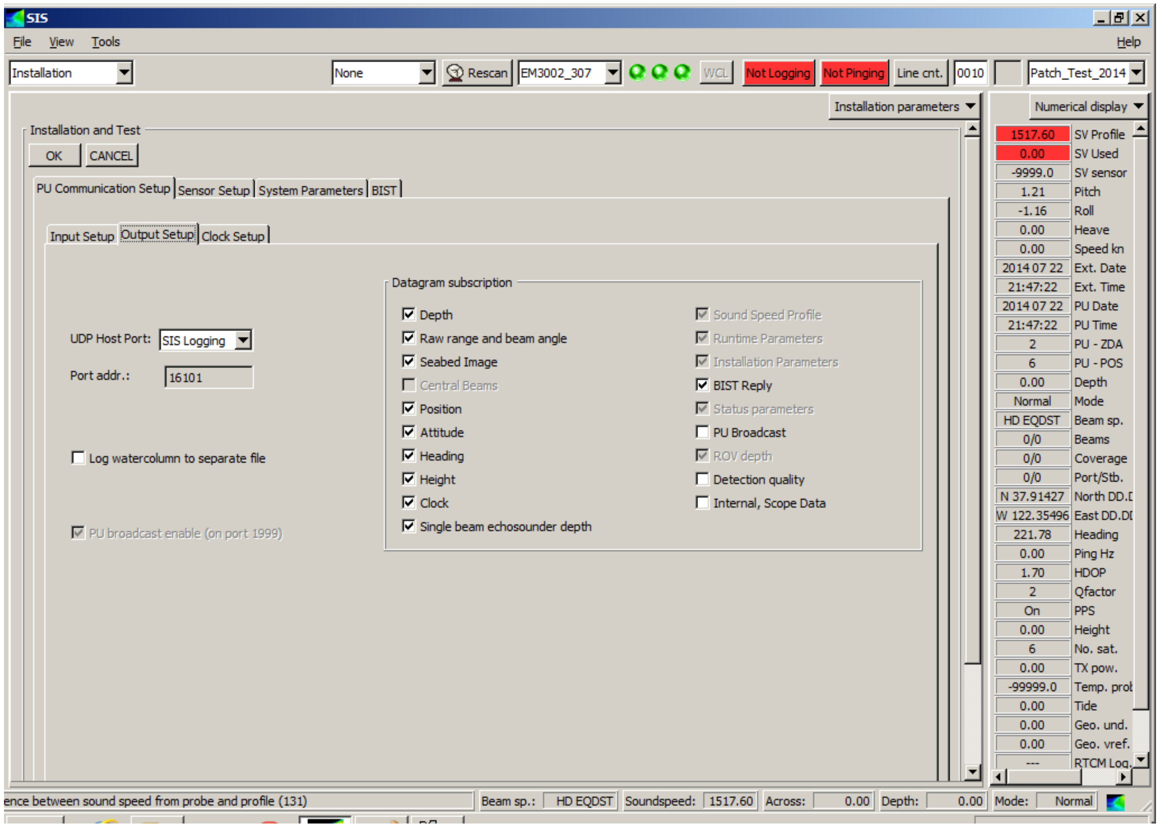
Input Setup

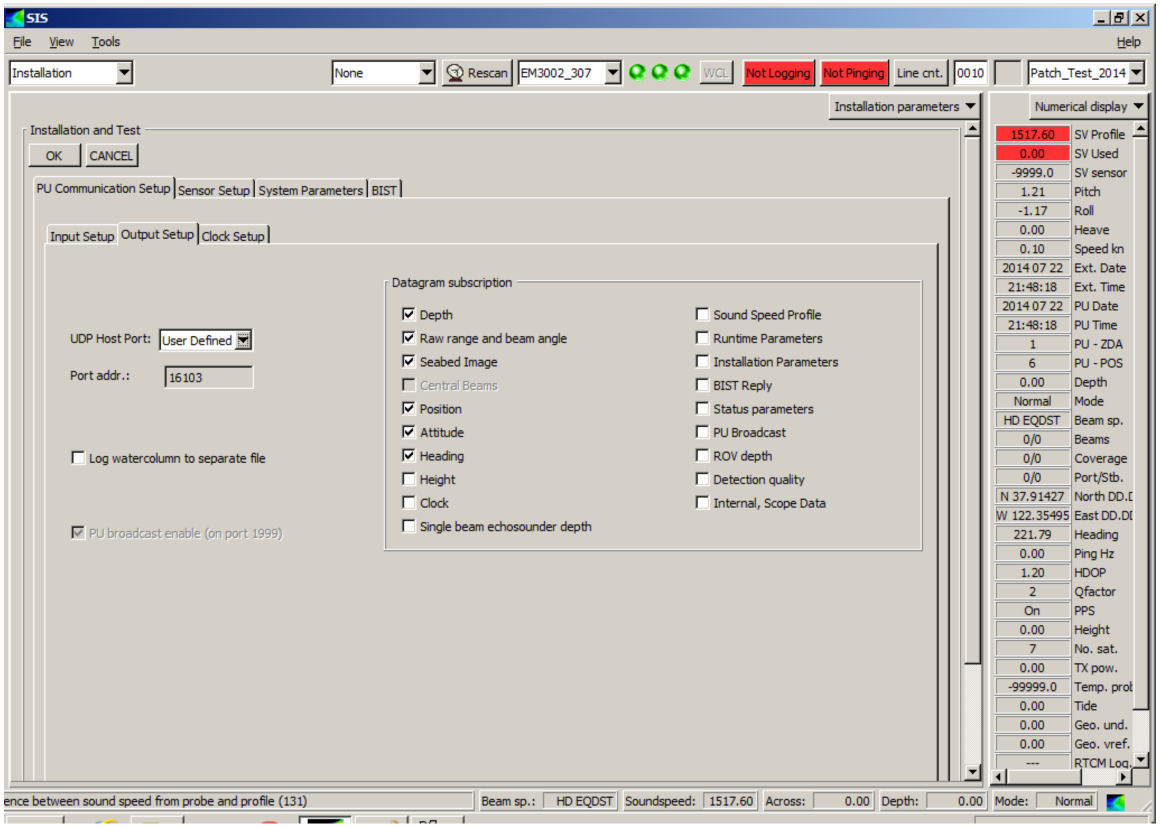



Installation and Test
OK
CANCEL
PU Communication Setup
Sensor Setup
System Parameters
BIST
Input Setup
Output Setup
Clock Setup
Port settings
Port: COM2
Com. settings
Baud rate: 19200
Data bits 8
Stop bits: 1
Parity: NONE
Input Formats
Position
None
GGK
GGA
GGA_RTK
SIMRAD90
Attitude
ZDA Clock
HDT Heading
SKR82 Heading
MK39 Mod2 Attitude, no heave
DBS Depth
DPT Depth
EA500 Depth
ROV. depth
Height, special purpose only

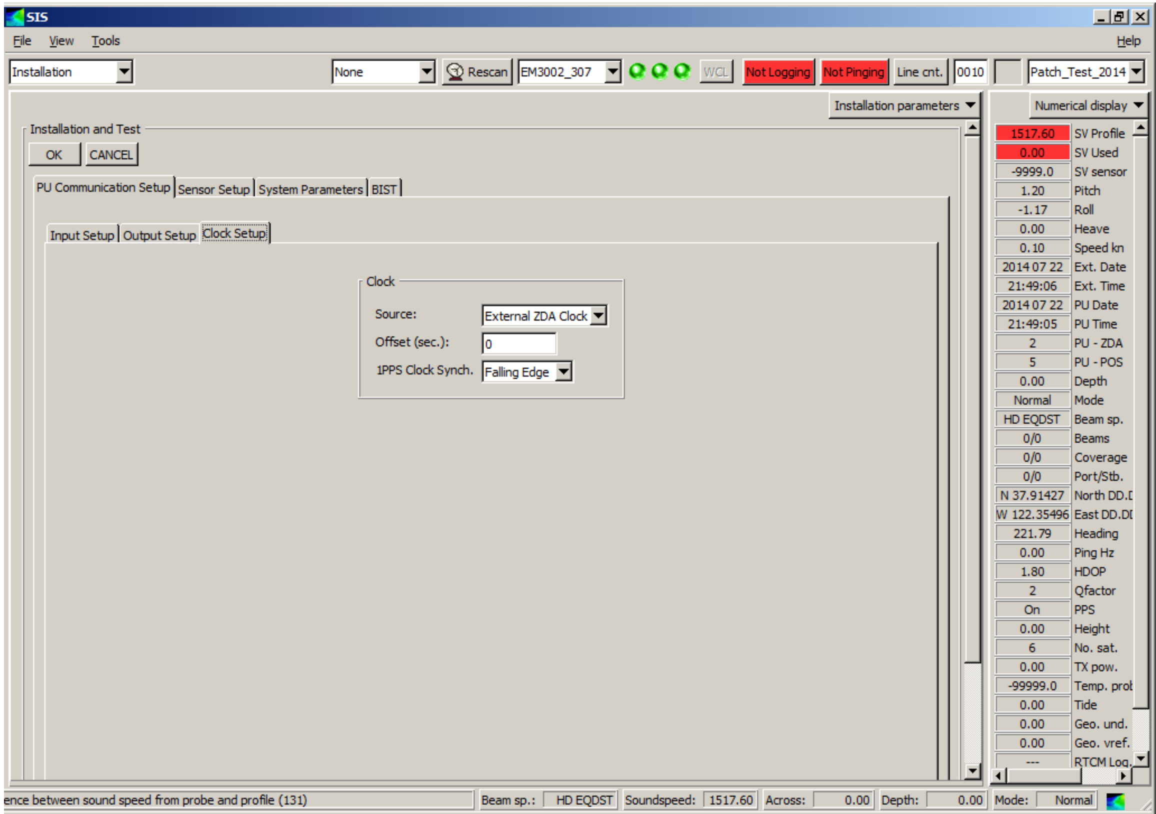


Output Setup

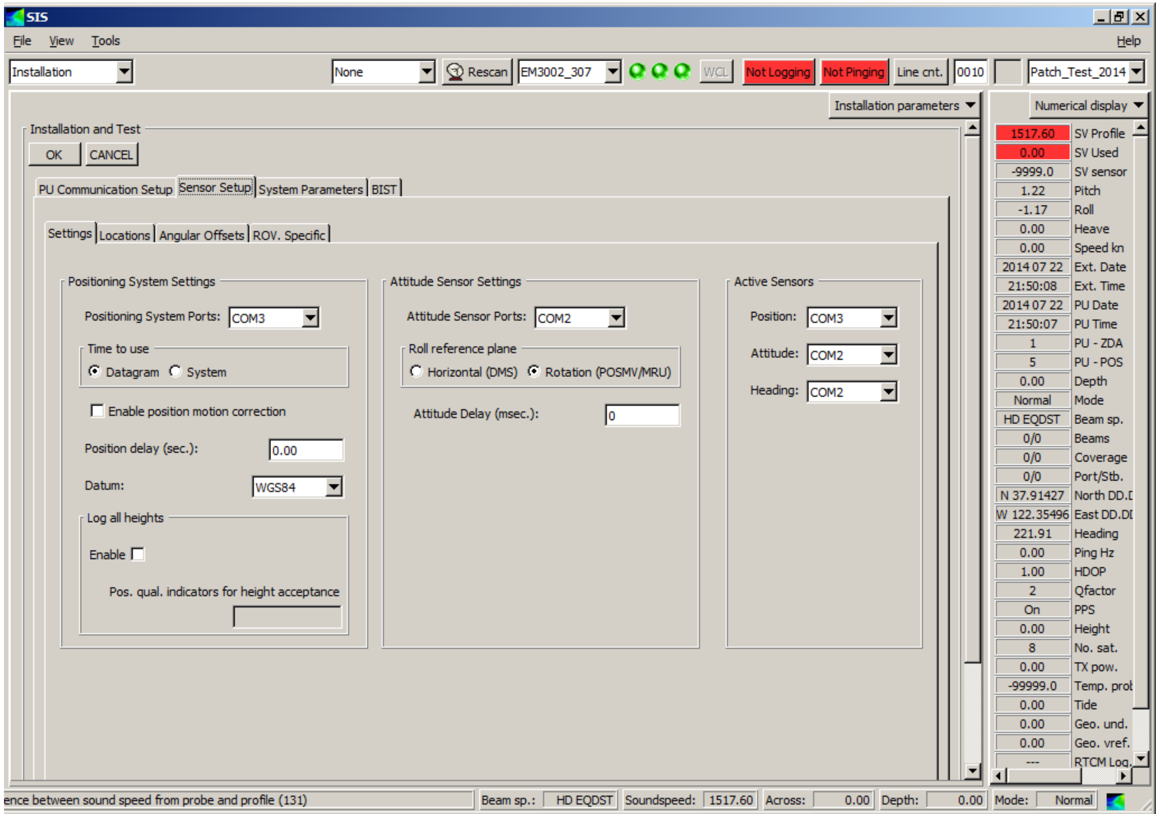

SIS
File View Tools
Help
Installation
None
Rescan
EM3002_307
WCL
Not Logging
Not Pinging
Line cnt.
0010
Patch_Test_2014
Installation parameters
Numerical display
Installation and Test
OK
CANCEL
PU Communication Setup
Sensor Setup
System Parameters
BIST
Input Setup
Output Setup
Clock Setup
UDP Host Port:
SIS Logging
Port addr.:
16101
Log watercolumn to separate file
PU broadcast enable (on port 1999)
Datagram subscription
Depth
Raw range and beam angle
Seabed Image
Central Beams
Position
Attitude
Heading
Height
Clock
Single beam echosounder depth
Sound Speed Profile
Runtime Parameters
Installation Parameters
BIST Reply
Status parameters
PU Broadcast
ROV depth
Detection quality
Internal, Scope Data
1517.60 SV Profile
0.00 SV Used
-9999.0 SV sensor
1.21 Pitch
-1.16 Roll
0.00 Heave
0.00 Speed kn
2014 07 22 Ext. Date
21:47:22 Ext. Time
2014 07 22 PU Date
21:47:22 PU Time
2 PU - ZDA
6 PU - POS
0.00 Depth
Normal Mode
HD EQDST Beam sp.
0/0 Beams
0/0 Coverage
0/0 Port/Stb.
N 37.91427 North DD.D
W 122.35496 East DD.DI
221.78 Heading
0.00 Ping Hz
1.70 HDOP
2 Qfactor
On PPS
0.00 Height
6 No. sat.
0.00 TX pow.
-99999.0 Temp. prot
0.00 Tide
0.00 Geo. und.
0.00 Geo. vref.
--- RTCM Log.
ence between sound speed from probe and profile (131)
Beam sp.: HD EQDST
Soundspeed: 1517.60
Across: 0.00
Depth: 0.00
Mode: Normal


SIS
File View Tools Help
Installation
None
Rescan
EM3002_307
WCL
Not Logging
Not Pinging
Line cnt.
0010
Patch_Test_2014
Installation parameters
Numerical display
Installation and Test
OK
CANCEL
PU Communication Setup
Sensor Setup
System Parameters
BIST
Input Setup
Output Setup
Clock Setup
UDP Host Port:
User Defined
Port addr.:
16103
Log watercolumn to separate file
PU broadcast enable (on port 1999)
Datagram subscription
Depth
Raw range and beam angle
Seabed Image
Central Beams
Position
Attitude
Heading
Height
Clock
Single beam echosounder depth
Sound Speed Profile
Runtime Parameters
Installation Parameters
BIST Reply
Status parameters
PU Broadcast
ROV depth
Detection quality
Internal, Scope Data
1517.60 SV Profile
0.00 SV Used
-9999.0 SV sensor
1.21 Pitch
-1.17 Roll
0.00 Heave
0.10 Speed kn
2014 07 22 Ext. Date
21:48:18 Ext. Time
2014 07 22 PU Date
21:48:18 PU Time
1 PU - ZDA
6 PU - POS
0.00 Depth
Normal Mode
HD EQDST Beam sp.
0/0 Beams
0/0 Coverage
0/0 Port/Stb.
N 37.91427 North DD.D
W 122.35495 East DD.DD
221.79 Heading
0.00 Ping Hz
1.20 HDOP
2 Qfactor
On PPS
0.00 Height
7 No. sat.
0.00 TX pow.
-99999.0 Temp. prot
0.00 Tide
0.00 Geo. und.
0.00 Geo. vref.
--- RTCM Log.
ence between sound speed from probe and profile (131)
Beam sp.: HD EQDST
Soundspeed: 1517.60
Across: 0.00
Depth: 0.00
Mode: Normal

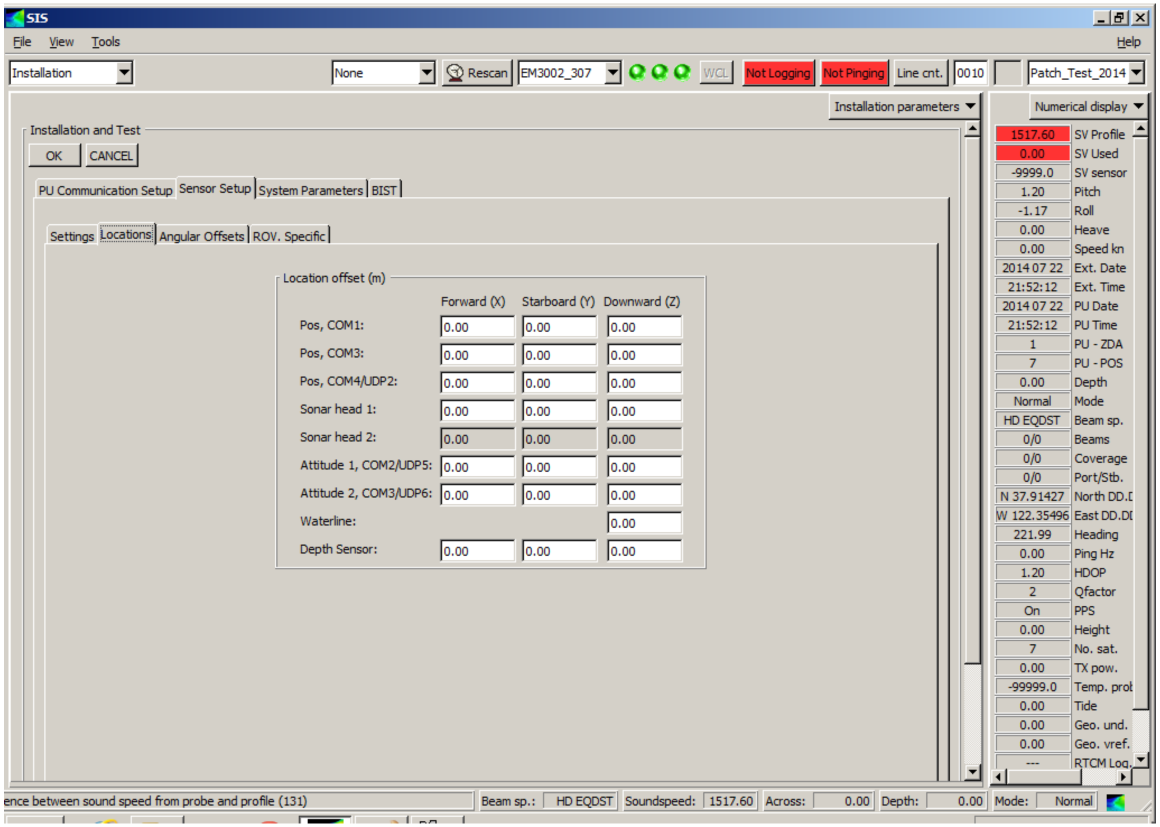
Clock Setup

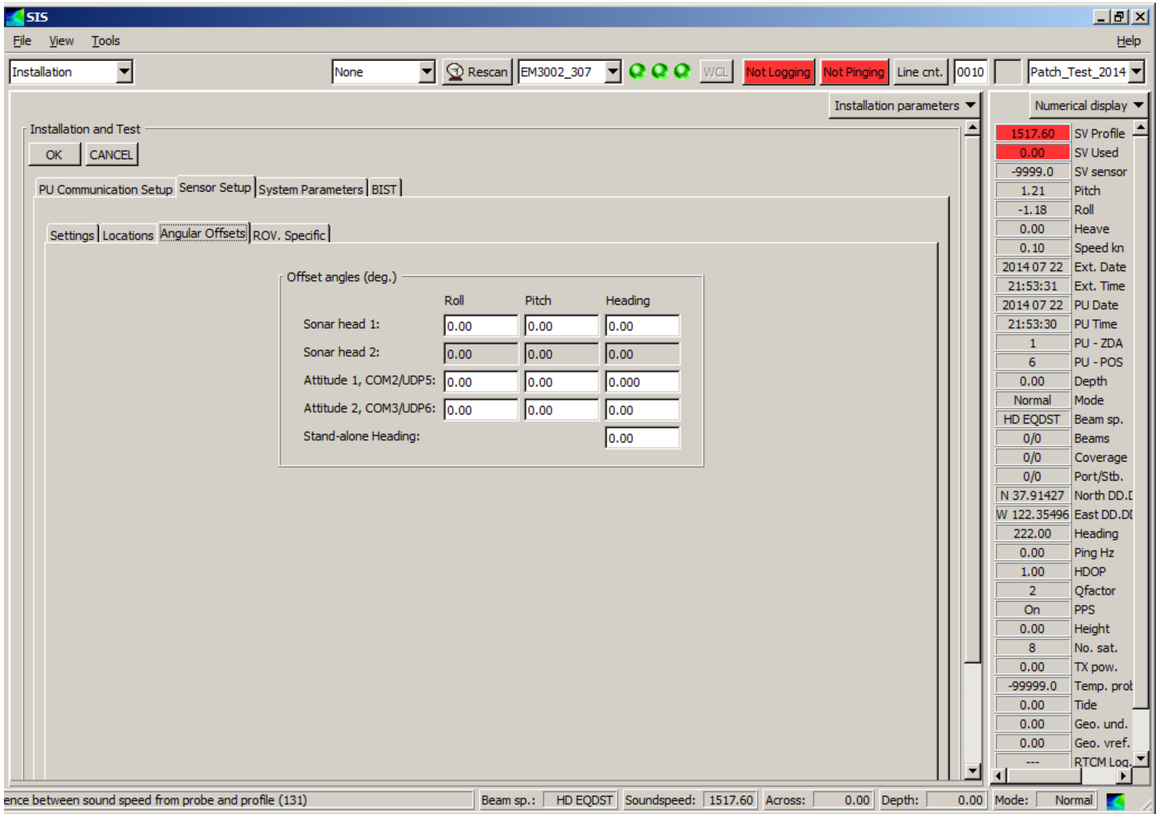


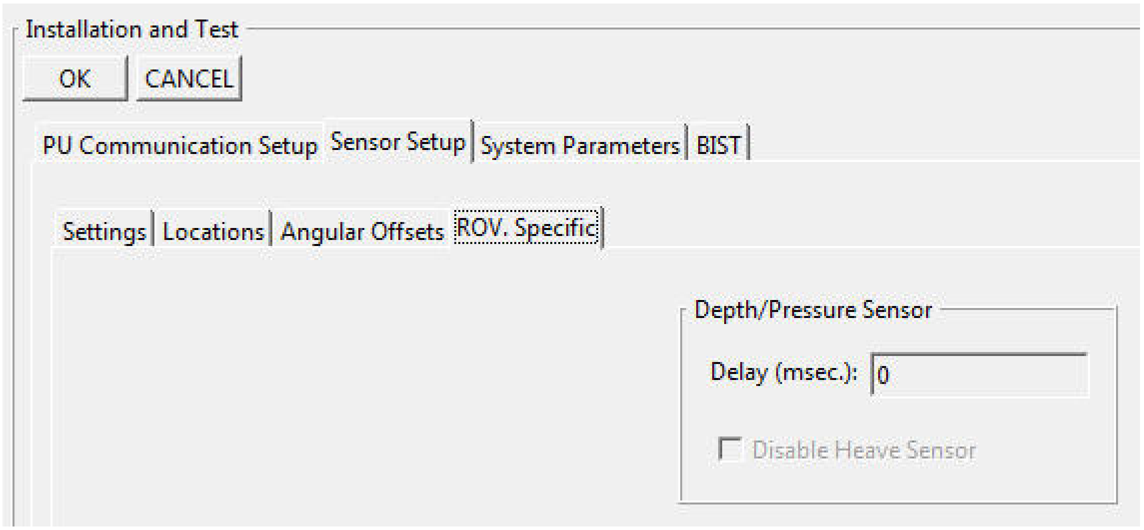
Installation Sensors and Settings

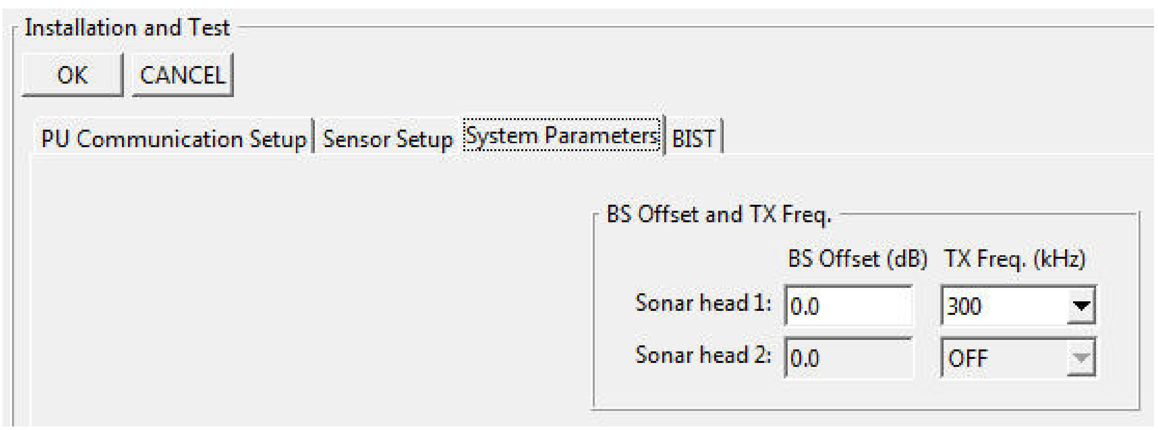


COM2 receives attitude data from the POS MV.
COM3 is used to receive navigation and timing from the POS MV.

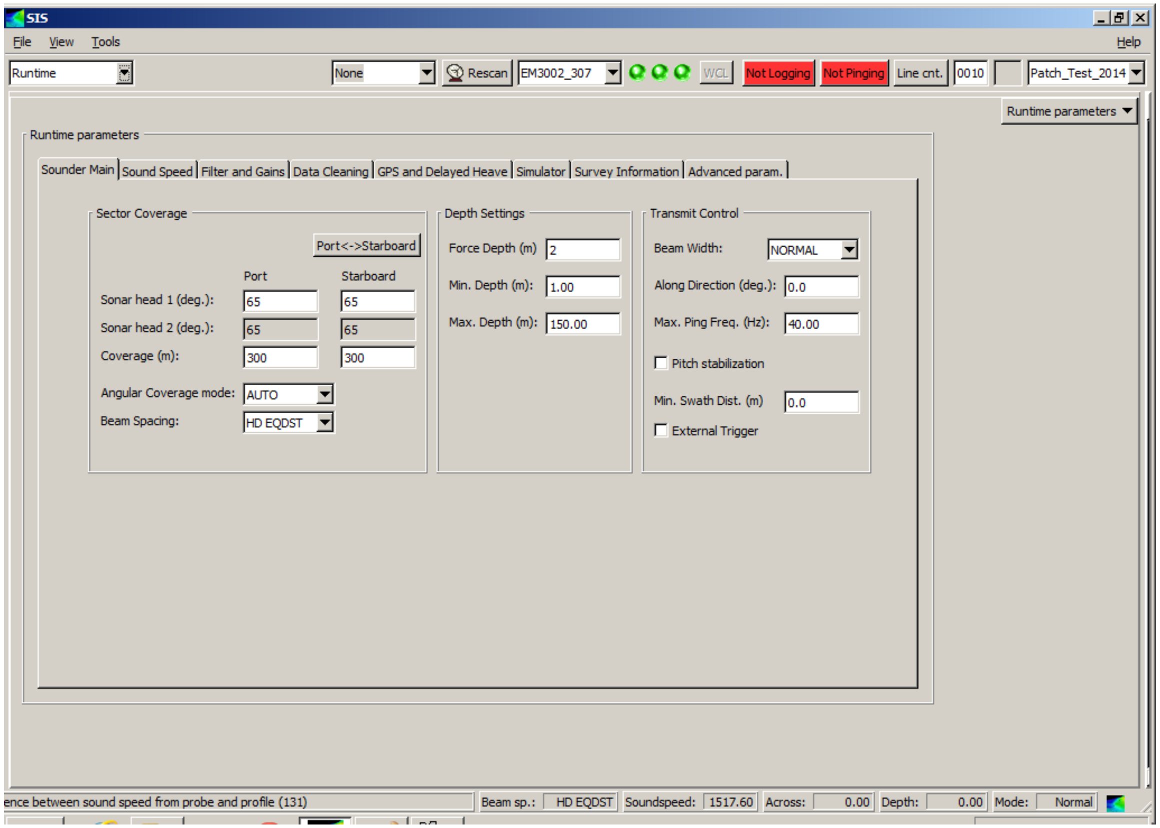

SIS
File View Tools Help
Installation
None
Rescan
EM3002_307
WCL
Not Logging
Not Pinging
Line cnt.
0010
Patch_Test_2014
Installation parameters
Numerical display
Installation and Test
OK
CANCEL
PU Communication Setup
Sensor Setup
System Parameters
BIST
Settings
Locations
Angular Offsets
ROV. Specific
Location offset (m)
Forward (X)
Starboard (Y)
Downward (Z)
Pos, COM1:
Pos, COM3:
Pos, COM4/UDP2:
Sonar head 1:
Sonar head 2:
Attitude 1, COM2/UDP5:
Attitude 2, COM3/UDP6:
Waterline:
Depth Sensor:
1517.60 SV Profile
0.00 SV Used
-9999.0 SV sensor
1.20 Pitch
-1.17 Roll
0.00 Heave
0.00 Speed kn
2014 07 22 Ext. Date
21:52:12 Ext. Time
2014 07 22 PU Date
21:52:12 PU Time
1 PU - ZDA
7 PU - POS
0.00 Depth
Normal Mode
HD EQDST Beam sp.
0/0 Beams
0/0 Coverage
0/0 Port/Stb.
N 37.91427 North DD.D
W 122.35496 East DD.DD
221.99 Heading
0.00 Ping Hz
1.20 HDOP
2 Qfactor
On PPS
0.00 Height
7 No. sat.
0.00 TX pow.
-99999.0 Temp. prob
0.00 Tide
0.00 Geo. und.
0.00 Geo. vref.
--- RTCM Log.
ence between sound speed from probe and profile (131)
Beam sp.: HD EQDST
Soundspeed: 1517.60
Across: 0.00
Depth: 0.00
Mode: Normal

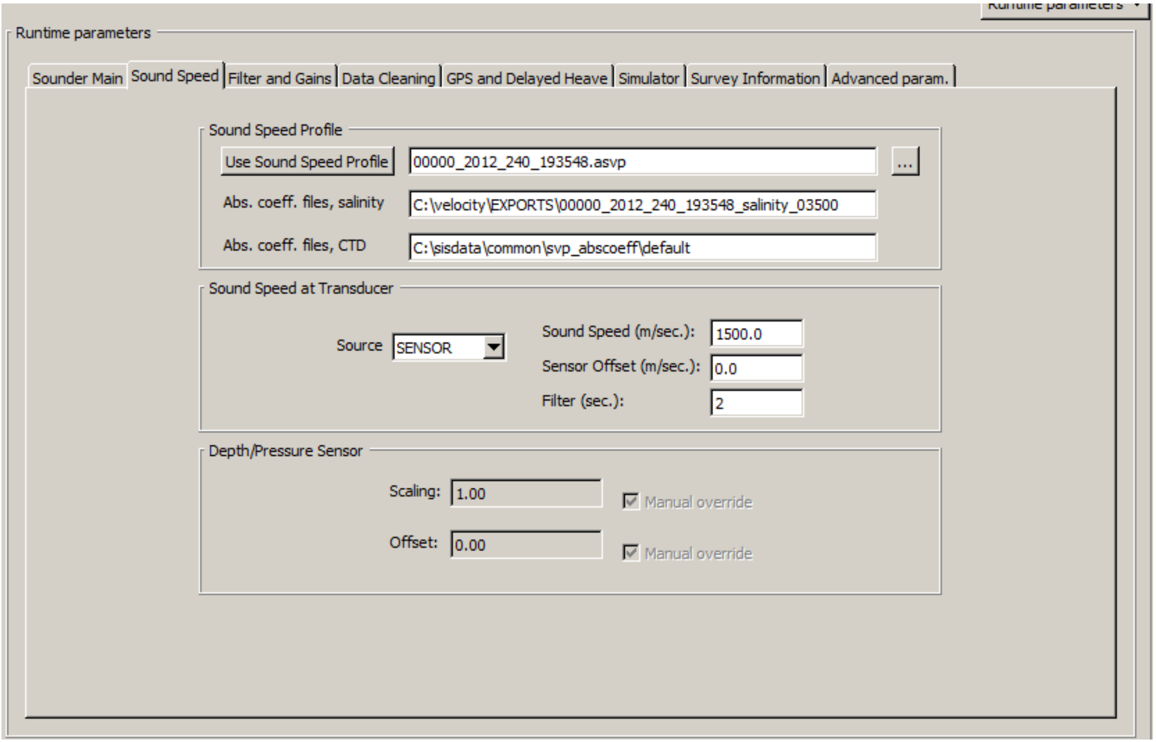

SIS
File View Tools Help
Installation
None
Rescan
EM3002_307
Not Logging
Not Pinging
Line cnt.
0010
Patch_Test_2014
Installation parameters
Numerical display
Installation and Test
OK CANCEL
PU Communication Setup | Sensor Setup | System Parameters | BIST
Settings | Locations | Angular Offsets | ROV. Specific
Offset angles (deg.)
Roll Pitch Heading
Sonar head 1: 0.00 0.00 0.00
Sonar head 2: 0.00 0.00 0.00
Attitude 1, COM2/UDP5: 0.00 0.00 0.000
Attitude 2, COM3/UDP6: 0.00 0.00 0.00
Stand-alone Heading: 0.00
1517.60 SV Profile
0.00 SV Used
-9999.0 SV sensor
1.21 Pitch
-1.18 Roll
0.00 Heave
0.10 Speed kn
2014 07 22 Ext. Date
21:53:31 Ext. Time
2014 07 22 PU Date
21:53:30 PU Time
1 PU - ZDA
6 PU - POS
0.00 Depth
Normal Mode
HD EQDST Beam sp.
0/0 Beams
0/0 Coverage
0/0 Port/Stb.
N 37.91427 North DD.
W 122.35496 East DD.
222.00 Heading
0.00 Ping Hz
1.00 HDOP
2 Qfactor
On PPS
0.00 Height
8 No. sat.
0.00 TX pow.
-99999.0 Temp. prob
0.00 Tide
0.00 Geo. und.
0.00 Geo. vref.
--- RTCM Log.
ence between sound speed from probe and profile (131)
Beam sp.: HD EQDST Soundspeed: 1517.60 Across: 0.00 Depth: 0.00 Mode: Normal

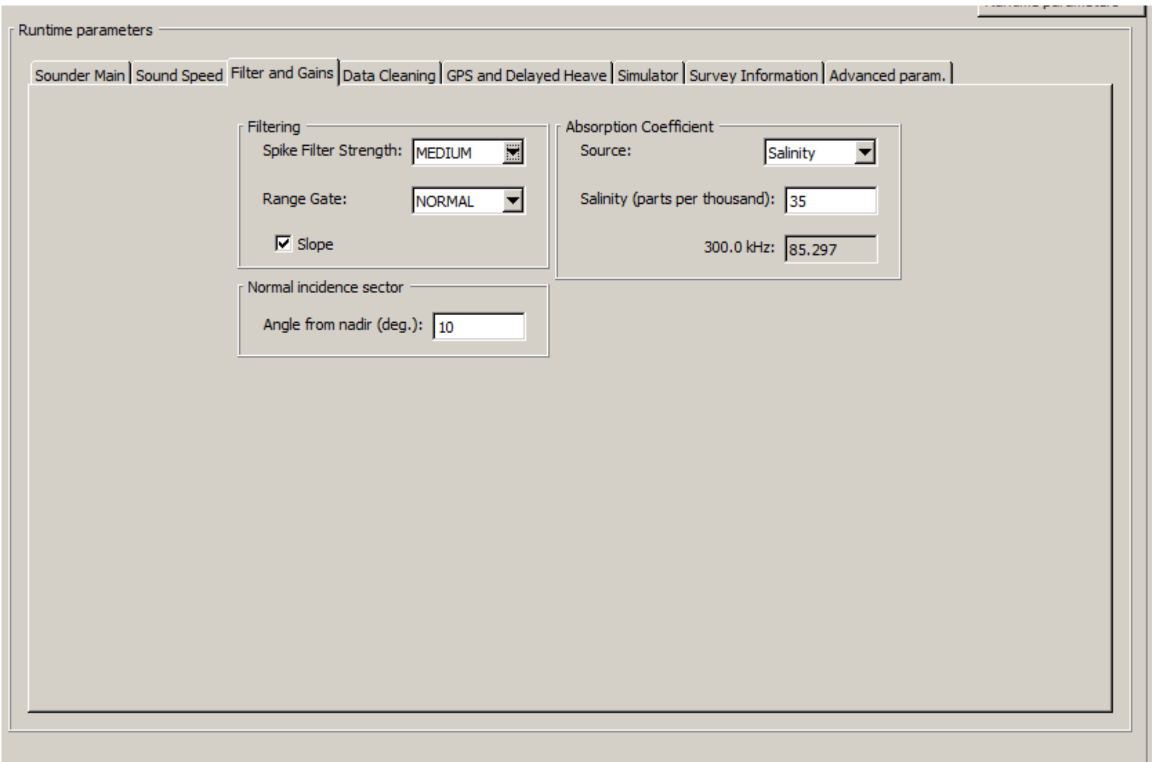




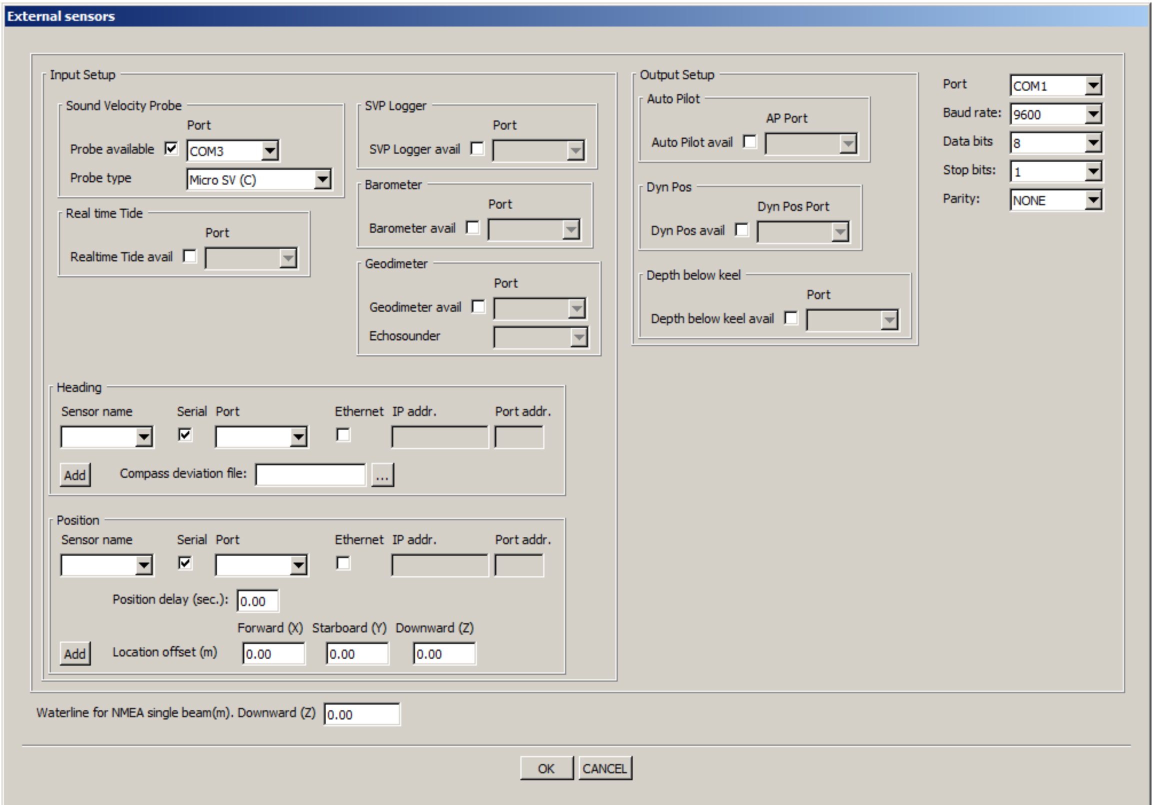
Runtime Parameters


SIS
File View Tools
Help
Runtime
None
Rescan
EM3002_307
WCL
Not Logging
Not Pinging
Line cnt.
0010
Patch_Test_2014
Runtime parameters
Runtime parameters
Sounder Main
Sound Speed
Filter and Gains
Data Cleaning
GPS and Delayed Heave
Simulator
Survey Information
Advanced param.
Sector Coverage
Port<->Starboard
Port
Starboard
Sonar head 1 (deg.):
65
65
Sonar head 2 (deg.):
65
65
Coverage (m):
300
300
Angular Coverage mode:
AUTO
Beam Spacing:
HD EQDST
Depth Settings
Force Depth (m)
2
Min. Depth (m):
1.00
Max. Depth (m):
150.00
Transmit Control
Beam Width:
NORMAL
Along Direction (deg.):
0.0
Max. Ping Freq. (Hz):
40.00
Pitch stabilization
Min. Swath Dist. (m)
0.0
External Trigger
ence between sound speed from probe and profile (131)
Beam sp.:
HD EQDST
Soundspeed:
1517.60
Across:
0.00
Depth:
0.00
Mode:
Normal


Runtime parameters
Sounder Main
Sound Speed
Filter and Gains
Data Cleaning
GPS and Delayed Heave
Simulator
Survey Information
Advanced param.
Sound Speed Profile
Use Sound Speed Profile
00000_2012_240_193548.asvp
Abs. coeff. files, salinity
C:\velocity\EXPORTS\00000_2012_240_193548_salinity_03500
Abs. coeff. files, CTD
C:\sisdata\common\svp_abscoeff\default
Sound Speed at Transducer
Source
SENSOR
Sound Speed (m/sec.):
1500.0
Sensor Offset (m/sec.):
0.0
Filter (sec.):
2
Depth/Pressure Sensor
Scaling:
1.00
Manual override
Offset:
0.00
Manual override



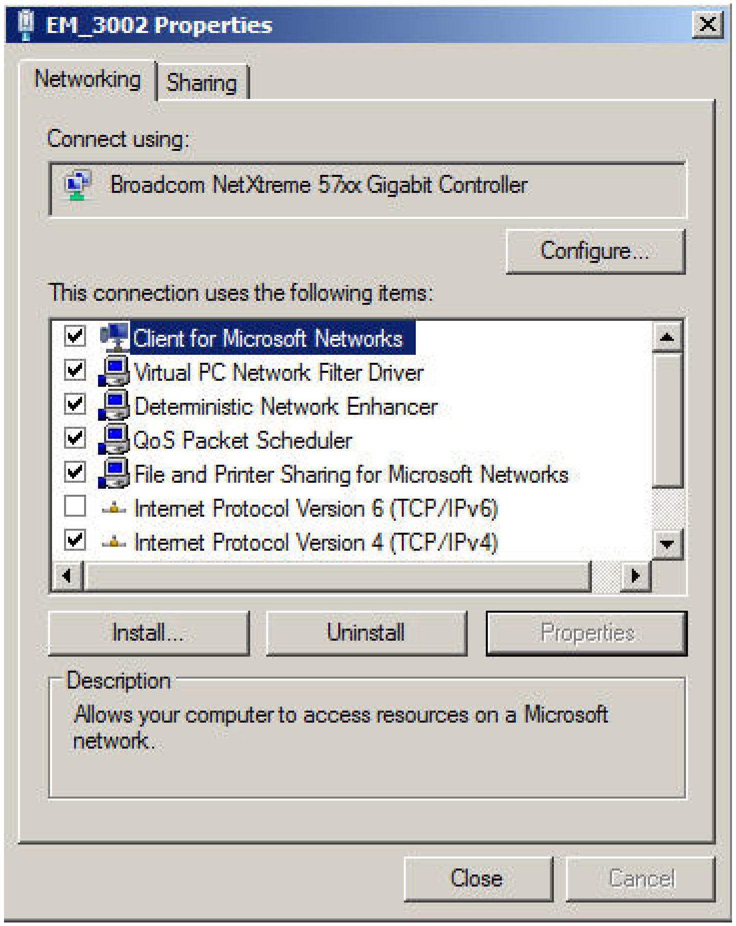
External Sensors


External sensors
Input Setup
Sound Velocity Probe
Port
Probe available
COM3
Probe type
Micro SV (C)
SVP Logger
Port
SVP Logger avail
Barometer
Port
Barometer avail
Geodimeter
Port
Geodimeter avail
Echosounder
Real time Tide
Port
Realtime Tide avail
Heading
Sensor name
Serial
Port
Ethernet
IP addr.
Port addr.
Add
Compass deviation file:
...
Position
Sensor name
Serial
Port
Ethernet
IP addr.
Port addr.
Position delay (sec.):
0.00
Forward (X)
Starboard (Y)
Downward (Z)
Add
Location offset (m)
0.00
0.00
0.00
Output Setup
Auto Pilot
AP Port
Auto Pilot avail
Dyn Pos
Dyn Pos Port
Dyn Pos avail
Depth below keel
Port
Depth below keel avail
Port
COM1
Baud rate:
9600
Data bits
8
Stop bits:
1
Parity:
NONE
Waterline for NMEA single beam(m). Downward (Z)
0.00
OK
CANCEL

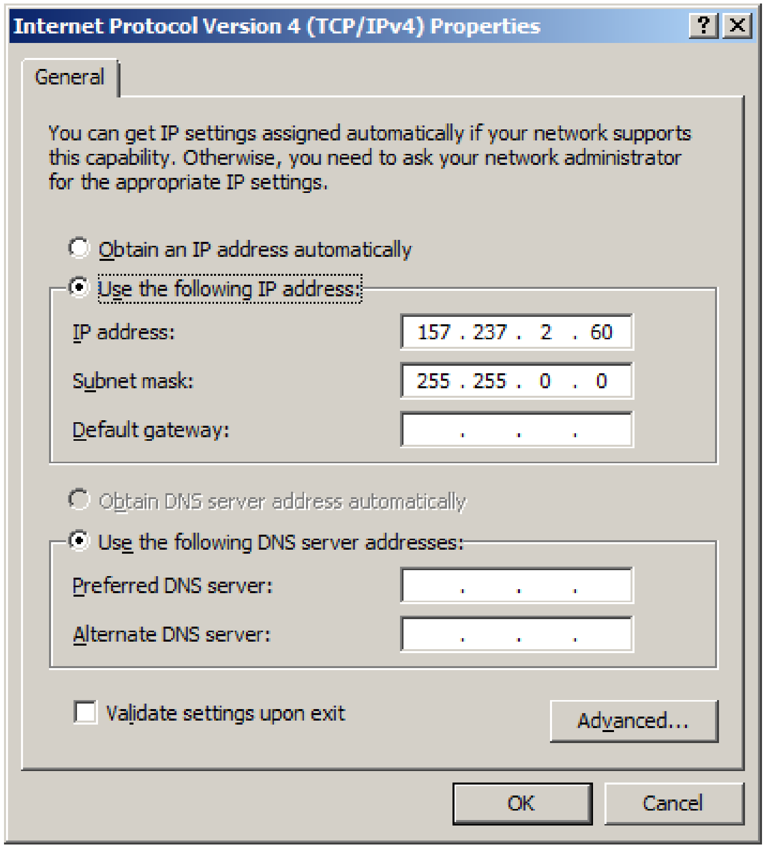
Additional Screengrabs

Network IP Settings

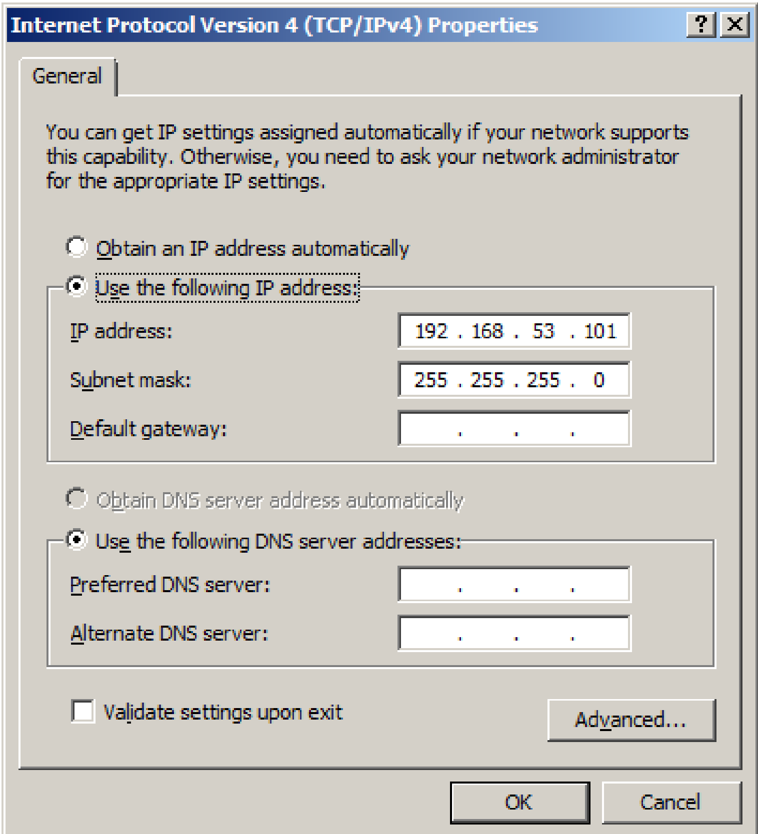
Simrad EM3002



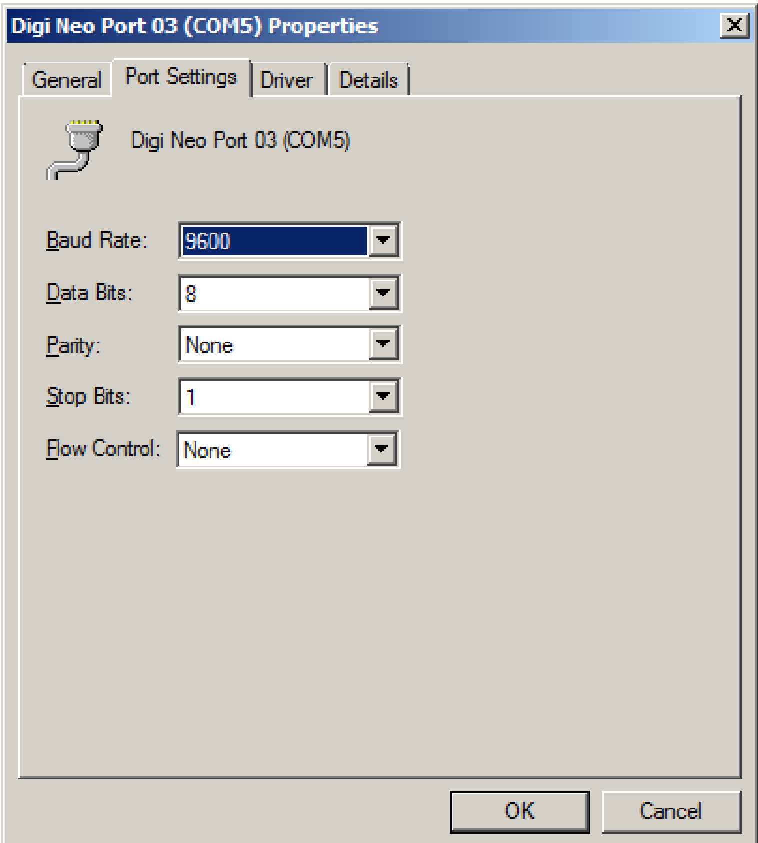
Uncheck IP v6


Internet Protocol Version 4 (TCP/IPv4) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address: 157 . 237 . 2 . 60
Subnet mask: 255 . 255 . 0 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

PosMV


Internet Protocol Version 4 (TCP/IPv4) Properties
General
You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.
Obtain an IP address automatically
Use the following IP address:
IP address:
192 . 168 . 53 . 101
Subnet mask:
255 . 255 . 255 . 0
Default gateway:
Obtain DNS server address automatically
Use the following DNS server addresses:
Preferred DNS server:
Alternate DNS server:
Validate settings upon exit
Advanced...
OK
Cancel

Velocipy COM port Setup



Appendix 5: Hydrographic Systems Inventory

drographic Vessel Inventory

Field Unit: NOAA NRT 6

Effective Date: September 2012

Updated Through: September 2014

SURVEY VESSELS	
Vessel Name	S3003
Hull Number	S3003
Call Letters	N/A
Manufacturer	SeaArk
Year of Construction	2003
Type of Construction	Aluminum Hull
Length Overall	30’
Beam	8'
Draft	18"
Date of Effective Full Vessel Static Offset Survey	11-Mar-2009

Organization which Conducted the Effective Full Offset Survey	National Geodetic Survey
Date of Last Partial Survey or Offset Verification & Methods Used	
Date of Last Static Draft Determination & Method Used	
Date of Last Settlement and Squat Measurements & Method Used	07/07/2011, PPK

Hydrographic Hardware Inventory

Field Unit: NRT 6

Effective Date: 9/2012

Updated Through: 9/2012

SONAR & SOUNDING EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Date of last Calibration	Date of last Service	Additional Information
Multibeam Echosounder	Kongsberg	Simrad EM 3002	1684	SIS v.3.9.2	7/2014			
Multibeam Echosounder	Kongsberg	Simrad EM 3000 (Back up)	1518	EM 3000 Controller v1.0.91				
Side Scan Sonar	Edgetech	System 4125	40426	Discover II v2012	7/2014			
Single Beam Echosounder	Odom	Echotrac CV	23042					

POSITIONING & ATTITUDE EQUIPMENT

Equipment Type	Manufacturer	Model	Serial Number	Firmware and/or Software Version	Version Install Date	Date of last Calibration	Date of last Service	Additional Information
GPS Aided Inertial Navigation	Applanix	POS/MV V5	5926		7/2013			
DGPS Receiver	Trimble	SPS361	5332k63852					

SOUND SPEED MEASUREMENT EQUIPMENT								
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Version Install Date**	**Date of last Calibration**	**Date of last Service**	**Additional Information**
Sound Speed Profiler	Sea-Bird	SeaCat 19+	19P37217-4676			8/14/2012		
Sound Speed Probe	Odom	Digibar Pro	98213			6/13/2012		spare
Sound Speed Probe	Oceanographic AML	Micro-X	10312			8/30/2012		
TIDES & LEVELING EQUIPMENT								
Equipment Type	**Manufacturer**	**Model**	**Serial Number**	**Firmware and/or Software Version**	**Version Install Date**	**Date of last Calibration**	**Date of last Service**	**Additional Information**
Trimble handheld GPS	Trimble	GeoXH	4928419525					

Hydrographic Software Inventory

Field Unit: NRT6

Effective Date: 9/01/2012

Updated Through: 9/1/2012

COMPUTERS

Machine Name	NRT6 ADMIN	NRT6-Laura	DELL Laptop	Edgetech PU	Hypack PC CD…576	Hypack PC NRT6-1 (backup)		
Location	Office	Office	Office	Launch	Launch	Launch		
Make/Model	Dell Precision T3500	Dell Precision T3400	DELL Latitude e6530	Edgetech PU	Dell DCTA	Dell Precision 3500		
Date Purchased	2013	2/2009	2013	?	?	8/19/11		
Date of Last Rebuild	N/A	N/A	n/a	N/A	N/A	N/A		
Processor	XNON 3.01 ghz	Intel Core2 Quad	I5-3360M cpu 2.8 ghz	?	Intel Core2 Duo 2.39 ghz	Intel Xeon		
RAM	6 GB	3.25 GB	8 GB	?	12.0 GB	6GB		
Video Card	Nvidea Quadro NVS 420	Nvidea Quadro FX1700	NVIDIA NVS 5200m	?	Nvidia QuadroN VS 420	Nvidea Quadro NVS420		

Video RAM	256 MB	512 MB	n/a	128 MB	256 MB	512 MB	
Comments	Processing PC	Processing PC	SSS laptop				

SOFTWARE LICENSES									
Software Package		**License Numbers**							
Acquisition	Discovery II	no license #							
	HYPACK MAX KEY	199984							
Processing	CARIS KEY 1	CK9606876							
	CARIS KEY 2	CW9604220							
Support	CARIS Bathydatabase	CK9606722							
OPERATING SYSTEM PACKAGE:									
Machine Name		NRT6ADMIN	NRT6-Laura						
System Installations & Updates	Windows 7	4/1/2010	2/2009						
	Windows 7								
ACQUISITION SOFTWARE PACKAGE: Hypack2011, SIS									
Machine Name		Hypack PC Backup	Hypack PC NRT - 1						

re Installa tions & Update s	Hypack 2014	7/2014							
re Installa tions & Update s	SIS		07/2014						
ACQUISITION SOFTWARE PACKAGE: Discovery II									
Machine Name		Dell Laptop							
Inst alla tion s & Upd ate	Discovery II	7/2014							
PROCESSING SOFTWARE PACKAGE: CARIS HIPS/SIPS									
Machine Name		NRT6ADMIN	NRT6-Laura						
Softwar e Installat ions & Updates (date)	CARIS 8	7/2014	7/2014						
	Hotfixes	7/2014	7/2014						
PROCESSING SOFTWARE PACKAGE: Pydro									
Machine Name		NRT6ADMIN	NRT6-Laura						
Software Installations & Updates (date)	v14.4	7/2014	7/2014						
PROCESSING SOFTWARE PACKAGE: MapInfo									
Machine Name		NRT6ADMIN	NRT6-Laura						

Softwar e Installat ions & Updates (date)	MapInfo 10.5	3/2012	3/2012						
	MapInfo 11.0								
SUPPORT SOFTWARE PACKAGE: MS Office									
Machine Name		NRT6ADMIN	NRT6-Laura						
Inst alla tion s & Upd ate	Office 2007	3/2009	3/2009						
	Office 2010								
SUPPORT SOFTWARE PACKAGE: Adobe Acrobat Professional									
Machine Name		NRT6ADMIN	NRT6-Laura						
are Install ations & Updat es	Acrobat v9	3/2009	3/2009						
	Acrobat X Pro v10								

Hydrographic Personnel Roster

Field Unit: **NOAA NRT6**

Effective Date: **March-31**

Updated Through: **12/31/12**

SURVEY DEPARTMENT

Name and Rate	Current Position	Years of Hydrographic Experience	Notes
Laura Pagano	Physical Scientist Tech	9	Acting Team Lead
Edmund Wernicke	Physical Scientist Tech	25	
Ian Colvert	Physical Scientist Tech	9	

NOTES:	Laura has been an Acting Team Lead for over 5 years.

Appendix 6: Sound Velocity Instrument Calibrations

AML OCEANOGRAPHIC
Xchange your old ideas

Certificate of Calibration

Customer:	NOAA Navigation Response Branch
Asset Serial Number:	203521
Asset Product Type:	SV•Xchange™ Calibrated Sensor
Calibration Type:	Sound Velocity
Calibration Range:	1375 to 1625 m/s
Calibration RMS Error:	.031
Calibration ID:	203521 888888 203521 030914 075448
Installed On:	

Coefficient A:	0.000000E+0	Coefficient H:	1.945919E-7
Coefficient B:	0.000000E+0	Coefficient I:	0.000000E+0
Coefficient C:	8.491916E-7	Coefficient J:	0.000000E+0
Coefficient D:	1.946381E-7	Coefficient K:	0.000000E+0
Coefficient E:	-1.778826E-5	Coefficient L:	0.000000E+0
Coefficient F:	1.953164E-7	Coefficient M:	0.000000E+0
Coefficient G:	1.059088E-6	Coefficient N:	0.000000E+0

Calibration Date (dd/mm/yyyy): 3/9/2014

Certified By:

AML Oceanographic

Robert Haydock

President, AML Oceanographic

AML Oceanographic certifies that the asset described above has been calibrated or recalibrated with equipment referenced to traceable standards. Please note that Xchange™ sensor-heads may be installed on assets other than the one listed above; this calibration certificate will still be valid when used on other such assets. If this instrument or sensor has been recalibrated, please be sure to update your records. Please also ensure that you update the instrument's coefficient values in any post-processing software that you use, if necessary. Older generation instruments may require configuration files, which are available for download at our Customer Centre at www.AMLoceanographic.com/support

AML Oceanographic
2071 Malaview Avenue, Sidney B.C. V8L 5X6 CANADA
T: +1-250-656-0771 F: +1-250-655-3655 Email: service@AMLoceanographic.com

SBE SEA-BIRD ELECTRONICS, INC.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Service Report

RMA Number 80916

Customer Information:

Company	NOAA/NRT6	Date	8/21/2014
Contact	Ed Wernicke		
PO Number	080714		

Serial Number	05M0687
Model Number	SBE 05M

Services Requested:

1. Evaluate/Repair Instrumentation.

Problems Found:

Services Performed:

1. Performed initial diagnostic evaluation.

Special Notes:

Thursday, August 21, 2014 Page 1 of 2

SEA-BIRD ELECTRONICS, INC.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Service Report

RMA Number: 80916

Customer Information:

Company	NOAA/NRT6	Date	8/21/2014
Contact	Ed Wernicke		
PO Number	080714		

Serial Number	19P37217-4676
Model Number	SBE 19Plus

Services Requested:

1. Evaluate/Repair Instrumentation.
2. Perform Routine Calibration Service.

Problems Found:

Services Performed:

1. Performed initial diagnostic evaluation.
2. Calibrated the pressure sensor.
3. Performed "Post Cruise" calibration of the temperature & conductivity sensors.
4. Performed complete system check and full diagnostic evaluation.

Special Notes:

Thursday, August 21, 2014 Page 2 of 2

Sea-Bird Electronics, Inc.
13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4676
CALIBRATION DATE: 19-Aug-14

SBE 19plus CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -1.044823e+000
h = 1.333448e-001
i = -7.918440e-005
j = 2.358445e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006

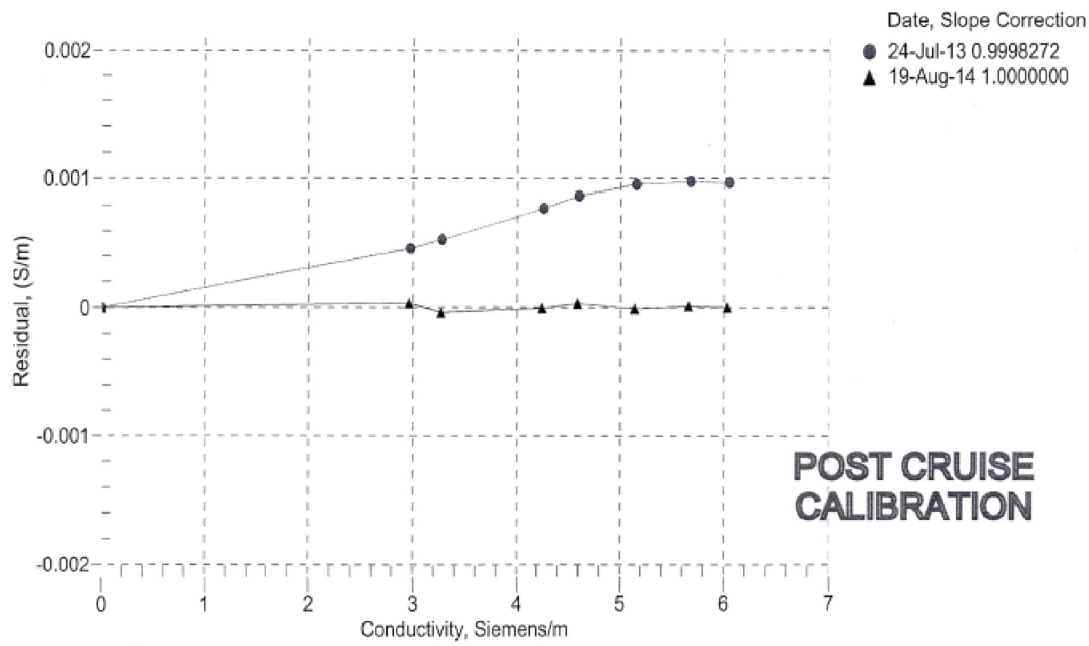
BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2799.58	0.0000	0.00000
1.0000	34.6370	2.96210	5476.14	2.9621	0.00003
4.5000	34.6186	3.26790	5680.44	3.2679	-0.00004
15.0000	34.5760	4.24524	6288.45	4.2452	-0.00001
18.4999	34.5663	4.58876	6488.39	4.5888	0.00003
24.0000	34.5555	5.14410	6798.87	5.1441	-0.00001
29.0000	34.5478	5.66327	7076.53	5.6633	0.00001
32.5000	34.5396	6.03317	7267.71	6.0332	-0.00000

f = INST FREQ / 1000.0

Conductivity = $(g + h * f^2 + i * f^3 + j * f^4) / (1 + \delta * t + \varepsilon * p)$ Siemens / meter

t = temperatur e[°C)]; p = pressure[decibars]; δ = CTcor; ε = CPcor;

Residual = instrument conductivity - bath conductivity



SBE SEA-BIRD ELECTRONICS, INC.
13431 NE 20th Street Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Conductivity Calibration Report

Customer:	NOAA/NRT6		
Job Number:	80916	Date of Report:	8/19/2014
Model Number	SBE 19Plus	Serial Number:	19P37217-4676

Conductivity sensors are normally calibrated 'as received', without cleaning or adjustments, allowing a determination of sensor drift. If the calibration identifies a problem or indicates cell cleaning is necessary, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing the coefficients used to convert sensor frequency to conductivity. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'slope' allows small corrections for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair or cleaning apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 8/19/2014 Drift since last cal: -0.00040 PSU/month*

Comments:

'CALIBRATION AFTER CLEANING & REPLATINIZING' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: PSU/month*

Comments:

**Measured at 3.0 S/m*

Cell cleaning and electrode replatinizing tend to 'reset' the conductivity sensor to its original condition. Lack of drift in post-cleaning-calibration indicates geometric stability of the cell and electrical stability of the sensor circuit.

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Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4676
CALIBRATION DATE: 19-Aug-14

SBE 19plus TEMPERATURE CALIBRATION DATA
ITS-90 TEMPERATURE SCALE

COEFFICIENTS:
a0 = 1.261076e-003
a1 = 2.606964e-004
a2 = 2.942629e-007
a3 = 1.399298e-007

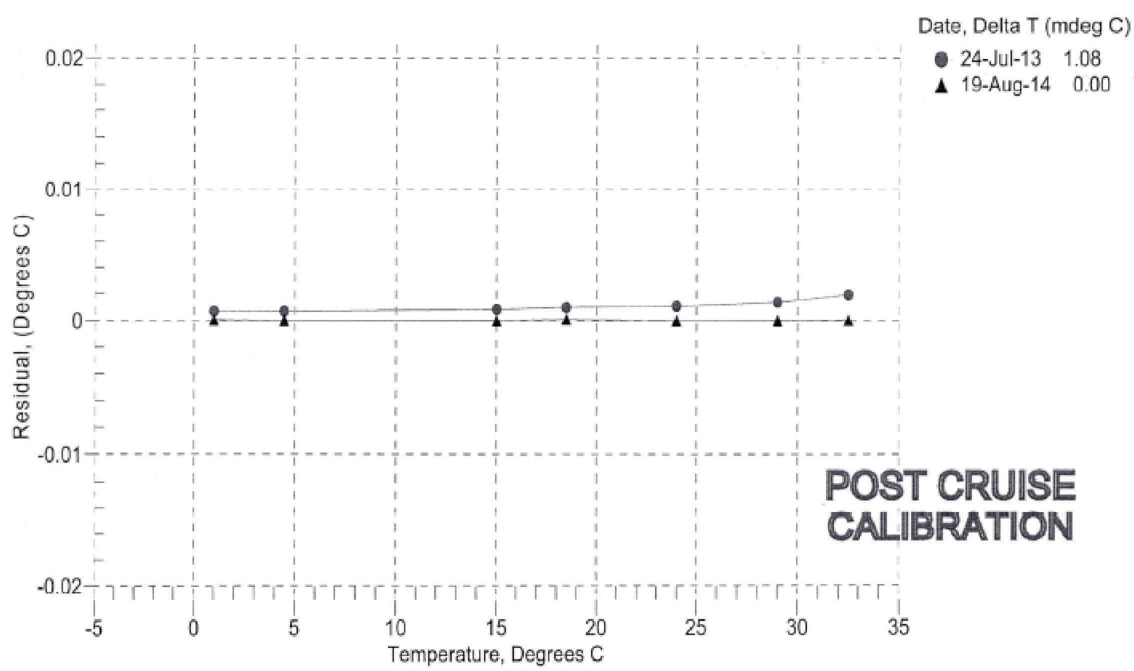
BATH TEMP (ITS-90)	INSTRUMENT OUTPUT	INST TEMP (ITS-90)	RESIDUAL (ITS-90)
1.0000	610712.661	1.0000	0.0000
4.5000	542010.814	4.5000	-0.0000
15.0000	371841.441	15.0000	-0.0000
18.4999	326223.169	18.5000	0.0001
24.0000	264335.576	24.0000	-0.0000
29.0000	217255.458	29.0000	-0.0000
32.5000	188828.661	32.5000	0.0000

MV = (n - 524288) / 1.6e+007

R = (MV * 2.900e+009 + 1.024e+008) / (2.048e+004 - MV * 2.0e+005)

Temperature ITS-90 = $1/\{a0 + a1[ln(R)] + a2[ln^2(R)] + a3[ln^3(R)]\} - 273.15$ (°C)

Residual = instrument temperature - bath temperature



SBE SEA-BIRD ELECTRONICS, INC.
13431 NE 20th St. Bellevue, Washington 98005 USA
Phone: (425) 643-9866 Fax: (425) 643-9954 www.seabird.com

Temperature Calibration Report

Customer:	NOAA/NRT6		
Job Number:	80916	**Date of Report:**	8/19/2014
Model Number	SBE 19Plus	**Serial Number:**	19P37217-4676

Temperature sensors are normally calibrated 'as received', without adjustments, allowing a determination sensor drift. If the calibration identifies a problem, then a second calibration is performed after work is completed. The 'as received' calibration is not performed if the sensor is damaged or non-functional, or by customer request.

An 'as received' calibration certificate is provided, listing coefficients to convert sensor frequency to temperature. Users must choose whether the 'as received' calibration or the previous calibration better represents the sensor condition during deployment. In SEASOFT enter the chosen coefficients. The coefficient 'offset' allows a small correction for drift between calibrations (consult the SEASOFT manual). Calibration coefficients obtained after a repair apply only to subsequent data.

'AS RECEIVED CALIBRATION' ☑ Performed ☐ Not Performed

Date: 8/19/2014 Drift since last cal: -0.00101 Degrees Celsius/year

Comments:

'CALIBRATION AFTER REPAIR' ☐ Performed ☑ Not Performed

Date: Drift since Last cal: Degrees Celsius/year

Comments:

Sea-Bird Electronics, Inc.
13431 NE 20th Street, Bellevue, WA 98005-2010 USA
Phone: (+1) 425-643-9866 Fax (+1) 425-643-9954 Email: seabird@seabird.com

SENSOR SERIAL NUMBER: 4676
CALIBRATION DATE: 14-Aug-14

SBE 19plus PRESSURE CALIBRATION DATA
FSR: 508 psia S/N 6134

COEFFICIENTS:

PA0 =	6.307514e-002	PTCA0 =	5.153294e+005
PA1 =	1.545046e-003	PTCA1 =	4.207988e+000
PA2 =	7.876802e-012	PTCA2 =	-1.200048e-001
PTEMPA0 =	-7.687406e+001	PTCB0 =	2.441038e+001
PTEMPA1 =	4.880752e+001	PTCB1 =	-1.925000e-003
PTEMPA2 =	-4.556480e-001	PTCB2 =	0.000000e+000

PRESSURE SPAN CALIBRATION

PRESSURE PSIA	INST OUTPUT	THERMISTOR OUTPUT	COMPUTED PRESSURE	ERROR %FS
14.61	524756.0	2.1	14.60	-0.00
104.87	583047.0	2.1	104.87	-0.00
204.87	647572.0	2.1	204.85	-0.00
304.87	712079.0	2.1	304.86	-0.00
404.87	776532.0	2.1	404.86	-0.00
504.87	840946.0	2.1	504.87	-0.00
404.88	776553.0	2.1	404.90	0.00
304.89	712098.0	2.1	304.90	0.00
204.89	647606.0	2.1	204.90	0.00
104.89	583068.0	2.1	104.90	0.00
14.60	524756.0	2.1	14.60	0.00

THERMAL CORRECTION

TEMP ITS90	THERMISTOR OUTPUT	INST OUTPUT
32.50	2.29	524901.81
29.00	2.21	524913.74
24.00	2.11	524924.54
18.50	1.99	524929.68
15.00	1.92	524927.65
4.50	1.69	524908.12
1.00	1.62	524897.01

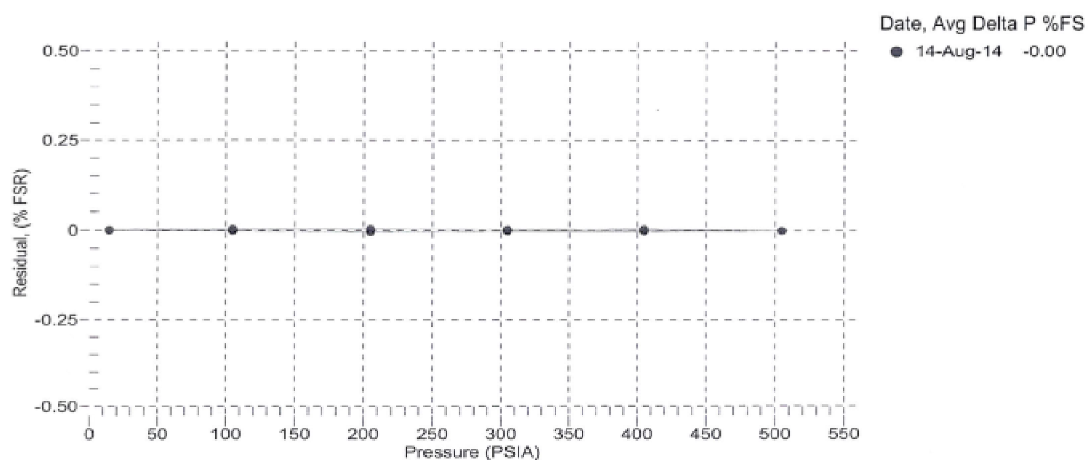
TEMP(ITS90)	SPAN(mV)
-5.00	24.42
35.00	24.34

y = thermistor output; $t = PTEMPA0 + PTEMPA1 * y + PTEMPA2 * y^2$

$x = \text{pressure output} - PTCA0 - PTCA1 * t - PTCA2 * t^2$

$n = x * PTCB0 / (PTCB0 + PTCB1 * t + PTCB2 * t^2)$

$\text{pressure (psia)} = PA0 + PA1 * n + PA2 * n^2$



Date:
Aug 30, 2012

Serial #:
98206-083012

DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5555.74	1421.71	0.09
4.50	1423.90	5564.07	1423.92	0.02
5.00	1426.15	5572.37	1426.13	-0.03
5.50	1428.38	5580.69	1428.33	-0.04
6.00	1430.58	5588.67	1430.45	-0.13
6.50	1432.75	5597.46	1432.78	0.03
7.00	1434.90	5604.76	1434.72	-0.18
7.50	1437.02	5612.93	1436.89	-0.13
8.00	1439.12	5621.25	1439.10	-0.02
8.50	1441.19	5628.85	1441.11	-0.07
9.00	1443.23	5636.59	1443.17	-0.07
9.50	1445.25	5643.80	1445.08	-0.17
10.00	1447.25	5651.65	1447.16	-0.09
10.50	1449.22	5659.27	1449.19	-0.04
11.00	1451.17	5665.97	1450.96	-0.21
11.50	1453.09	5673.32	1452.92	-0.18
12.00	1454.99	5680.87	1454.92	-0.08
12.50	1456.87	5687.50	1456.68	-0.19
13.00	1458.72	5694.77	1458.61	-0.12
13.50	1460.55	5701.24	1460.32	-0.23
14.00	1462.36	5708.62	1462.28	-0.08
14.50	1464.14	5715.18	1464.02	-0.12
15.00	1465.91	5721.82	1465.79	-0.12
15.50	1467.65	5728.42	1467.54	-0.11
16.00	1469.36	5734.96	1469.27	-0.09
16.50	1471.06	5741.20	1470.93	-0.13
17.00	1472.73	5747.58	1472.62	-0.11

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
17.50	1474.38	5753.91	1474.30	-0.08
18.00	1476.01	5760.45	1476.04	0.03
18.50	1477.62	5766.74	1477.71	0.09
19.00	1479.21	5772.46	1479.22	0.02
19.50	1480.77	5778.19	1480.74	-0.03
20.00	1482.32	5783.87	1482.25	-0.06
20.50	1483.84	5789.63	1483.78	-0.06
21.00	1485.35	5795.46	1485.33	-0.02
21.50	1486.83	5801.31	1486.88	0.05
22.00	1488.29	5806.31	1488.21	-0.09
22.50	1489.74	5812.04	1489.73	-0.01
23.00	1491.16	5817.19	1491.09	-0.07
23.50	1492.56	5822.68	1492.55	-0.01
24.00	1493.95	5827.92	1493.94	-0.01
24.50	1495.32	5833.50	1495.42	0.11
25.00	1496.66	5838.35	1496.71	0.05
25.50	1497.99	5843.48	1498.07	0.08
26.00	1499.30	5847.82	1499.22	-0.07
26.50	1500.59	5853.57	1500.75	0.16
27.00	1501.86	5857.72	1501.85	-0.01
27.50	1503.11	5862.55	1503.13	0.02
28.00	1504.35	5867.52	1504.45	0.10
28.50	1505.56	5871.90	1505.61	0.05
29.00	1506.76	5877.09	1506.99	0.23
29.50	1507.94	5880.87	1507.99	0.05
30.00	1509.10	5885.40	1509.19	0.09

Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Date:
Jun 13, 2012

Serial #:
98213-061312

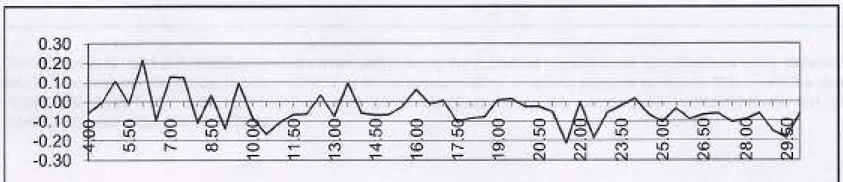
DIGIBAR CALIBRATION REPORT

version 1.0 (c) 2004

ODOM HYDROGRAPHIC SYSTEMS, Inc.

STANDARD DEL GROSSO H^2O

TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL	TEMP	VELOCITY	MEASURED FREQUENCY	RES_VEL	OBS-CAL
4.00	1421.62	5546.29	1421.56	-0.06	17.50	1474.38	5744.48	1474.28	-0.10
4.50	1423.90	5555.07	1423.90	0.00	18.00	1476.01	5750.68	1475.93	-0.08
5.00	1426.15	5563.95	1426.26	0.11	18.50	1477.62	5756.75	1477.54	-0.08
5.50	1428.38	5571.88	1428.37	-0.01	19.00	1479.21	5763.04	1479.21	0.01
6.00	1430.58	5580.99	1430.79	0.21	19.50	1480.77	5768.95	1480.78	0.01
6.50	1432.75	5588.00	1432.66	-0.09	20.00	1482.32	5774.61	1482.29	-0.03
7.00	1434.90	5596.91	1435.03	0.13	20.50	1483.84	5780.35	1483.82	-0.02
7.50	1437.02	5604.88	1437.15	0.13	21.00	1485.35	5785.90	1485.29	-0.05
8.00	1439.12	5611.88	1439.01	-0.11	21.50	1486.83	5790.87	1486.61	-0.21
8.50	1441.19	5620.20	1441.22	0.03	22.00	1488.29	5797.17	1488.29	0.00
9.00	1443.23	5627.24	1443.09	-0.14	22.50	1489.74	5801.90	1489.55	-0.19
9.50	1445.25	5635.73	1445.35	0.10	23.00	1491.16	5807.75	1491.10	-0.06
10.00	1447.25	5642.56	1447.17	-0.08	23.50	1492.56	5813.16	1492.54	-0.02
10.50	1449.22	5649.66	1449.06	-0.17	24.00	1493.95	5818.51	1493.97	0.02
11.00	1451.17	5657.21	1451.06	-0.11	24.50	1495.32	5823.34	1495.25	-0.06
11.50	1453.09	5664.59	1453.03	-0.07	25.00	1496.66	5828.25	1496.56	-0.10
12.00	1454.99	5671.75	1454.93	-0.06	25.50	1497.99	5833.50	1497.95	-0.04
12.50	1456.87	5679.17	1456.91	0.03	26.00	1499.30	5838.22	1499.21	-0.09
13.00	1458.72	5685.73	1458.65	-0.07	26.50	1500.59	5843.15	1500.52	-0.07
13.50	1460.55	5693.25	1460.65	0.10	27.00	1501.86	5847.95	1501.80	-0.06
14.00	1462.36	5699.46	1462.30	-0.06	27.50	1503.11	5852.50	1503.01	-0.10
14.50	1464.14	5706.13	1464.08	-0.07	28.00	1504.35	5857.19	1504.25	-0.09
15.00	1465.91	5712.76	1465.84	-0.07	28.50	1505.56	5861.88	1505.50	-0.06
15.50	1467.65	5719.46	1467.62	-0.02	29.00	1506.76	5866.04	1506.61	-0.15
16.00	1469.36	5726.24	1469.42	0.06	29.50	1507.94	5870.35	1507.75	-0.19
16.50	1471.06	5732.33	1471.04	-0.01	30.00	1509.10	5875.20	1509.04	-0.06
17.00	1472.73	5738.69	1472.74	0.01					



Odom Hydrographic Systems, Inc.
1450 SeaBoard Avenue, Baton Rouge, Louisiana 70810-6261, USA
Telephone: (225)-769-3051, Facsimile: (225)-766-5122
E-mail: email@odomhydrographic.com, HTTP: www.odomhydrographic.com

Appendix 7: 2012 Sounding System Comparison

Sounding Systems Comparison

Field Unit: **NRT6**

Date & Time	**Location** (Lat, Lon)	**Sounding System Models & Serial Numbers**	**Processed Depth** (m)	**System Operator**	**Comments**
7/31/2014	Lat: 37° 54' 32.00", Long: 122° 21' 50.27"	Ser#1518 Leadline	9.5	Laura Pagano	Annual Systems Certification comparison. Sea conditions calm No corrections necessary. (Bottom type = Soft Mud)
7/31/2014	Lat: 37° 54' 32.00", Long: 122° 21' 50.27"	Simrad EM3002	9.3	Laura Pagano	Annual Systems Certification comparison. Sea conditions calm No corrections necessary. (Bottom type = Soft Mud)

Appendix 8: S3003 Patch Test Report

Sonar Mounting Configuration: Hull Mounted

Date of Current Vessel Offset Measurement / Verification: 2009

Description of Positioning System: POS/MV V5

Date of Most Recent Positioning System Calibration: July 2014

TEST INFORMATION

Test Date(s) / DN(s): 07/17/2014 DN198_2014

System Operator(s): Pagano, Colvert, Wernicke

Wind / Seas / Sky: 5-10, 0-1' , clear

Locality: SF Bay, CA

Sub-Locality: Richmond Harbor

Bottom Type: Mud, Sand

Approximate Average Water Depth: 10 Meters

DATA ACQUISITION INFORMATION

Line Number	Heading	Speed
Yaw: 007	s	5 kts
Yaw: 008	s	5 kts
Roll: 002	n	5 kts
Roll: 003	s	5 kts
Pitch: 005	s	4.5 kts
Pitch: 006	n	4.5 kts
Timing: 010	e	6 kts
Timing: 011	e	3 kts

TEST RESULTS

Navigation Timing Error: 0 ms

Pitch Timing Error: 0 ms

Roll Timing Error: 0 ms

Pitch Bias: -1.4

Roll Bias: .20

Heading Bias: 0.450

Resulting CARIS HIPS HVF File Name: NRT6_S3003_EM3002_2014

NARRATIVE

This patch test was conducted for the 2014 HSRR. NRT6 found the patch numbers for 2014 unfavorable after processed data was compared to 2013 results. Therefore, 2013 patch values will be used.

Appendix 9: Side Scan Calibration Report

Side Scan Calibration Report
Navigation Response Team 6

NRT6 Edgetech 4125 failed initial calibration test conducted 7/15/2014. NRB are currently working on a solution. As a result, NRT6 Edgetech 4125 will be used for emergency response operations only.

Appendix 10: CARIS HVF TPU Review

NRT6 CARIS HVF TPU Review
Current as of October 2^{nd}, 2012

The purpose of this document is to thoroughly examine the Total Propagated Uncertainty (TPU) values used by NRT6 in its HIPS Vessel File for the Simrad EM3002 multibeam echosounder. TPU is used during the creation of Combined Uncertainty and Bathymetry Estimate surfaces. The current values in the Offsets and StdDev sections are listed and detailed below. These values supersede those detailed in the 2011 HSRR.

Please note that NRT6 uses a reference point that is not the IMU, but located close to the center of the vessel.

NRT6_S3003_EM3002

Offsets

MRU to Trans X (m) -0.001 m

This value is derived from the 2008 NGS surveyed performed on S3003. It is the measurement from the IMU to the MB transducer.

MRU to Trans Y (m) .006 m

This value is derived from the 2008 NGS surveyed performed on S3003.

MRU to Trans Z (m) 0.416 m

This value is derived from the 2008 NGS surveyed performed on S3003.

Nav to Trans X (m) 0.754 m

This value is derived from the 2008 NGS surveyed performed on S3003.

Nav to Trans Y (m) -3.149 m

This value is derived from the 2008 NGS surveyed performed on S3003.

Nav to Trans Z (m) 2.993 m

This value is derived from the 2008 NGS surveyed performed on S3003. The original measurement from NGS did not include a correction for the phase center, but measured to the top of the antenna. Engineering drawings place the phase center .053 m above the base of the antenna. The measured height of the antenna from base to top is .063 m, placing the phase center 0.01 m below the measured value of the NGS survey.

The measured values (from the reference point) are 2.520 (RP to antennae) + .483 (RP to MB Transducer) = 3.003 m. The absolute values of these two offsets are used, since we are measuring the total distance from above the RP, to the transducer below the RP. Z-axis values from the NGS survey were positive in the up direction. We subtract 0.01 m from the measured value, since the phase center reduces the total distance. The final offset value is 2.993 m. This value will also be updated in the POS controller software offset section.

Trans Roll (deg): 0.000 deg

StdDev

Motion Gyro (deg): 0.020 deg

This value is given as the manufacturer's recommended value for the Applanix POS/MV 320, as specified in HSTD 2007-10.

Heave % Amp 5.000%

This value is given as the manufacturer's recommended value for the Applanix POS/MV 320, as specified in HSTD 2007-10.

Heave (m) 0.050 m

This value is given as the manufacturer's recommended value for the Applanix POS/MV 320, as specified in HSTD 2007-10.

Roll (deg) 0.020 m

This value is given as the manufacturer's recommended value for the Applanix POS/MV 320, as specified in HSTD 2007-10.

Pitch (deg) .020 m

This value is given as the manufacturer's recommended value for the Applanix POS/MV 320, as specified in HSTD 2007-10.

Position Nav (m) 1.000 m

This value is given as the manufacturer's recommended value for the Applanix POS/MV 320, as specified in HSTD 2007-10.

This value is subject to change based on the quality of the differential signal during acquisition. The NRT6 working area for 2011-2012 is the central California coast from Monterey to San Francisco Bay, and should have good coverage. HSTD 2007-10 recommends values from 0.5m to 2m. 1m is the default value, and is used for NRT6.

Timing Trans (s) 0.005s

No default is given for this value in HSTD 2007-10, but uncertainty values for attitude timing, using an Ethernet setup, are listed as .005 seconds. This value has been used, as the connection between the Simrad EM3000 and the host PC is a crossover Ethernet connection.

Nav Timing (s) 0.005s

This is the recommended value for installations using Ethernet connections to send attitude data from the POS/MV to the host PC.

Gyro Timing (s) 0.005s

This is the recommended value for installations using Ethernet connections to send attitude data from the POS/MV to the host PC.

Heave Timing (s) 0.005s

This is the recommended value for installations using Ethernet connections to send attitude data from the POS/MV to the host PC.

Pitch Timing (s) 0.005s

This is the recommended value for installations using Ethernet connections to send attitude data from the POS/MV to the host PC.

Roll Timing (s) 0.005s

This is the recommended value for installations using Ethernet connections to send attitude data from the POS/MV to the host PC.

Offset X (m) 0.003m

A full survey of the vessel sensors was performed by members of NOAA's National Geodetic Survey. A level was used to "shoot" points around the vessel, and, to estimate error, the points were shot in reverse. The difference was then calculated between the forward and reverse values. The average difference in the horizontal measurements was 0.003m.

Offset Y (m) 0.003m

A full survey of the vessel sensors was performed by members of NOAA's National Geodetic Survey. A level was used to "shoot" points around the vessel, and, to estimate error, the points were shot in reverse. The difference was then calculated between the forward and reverse values. The average difference in the horizontal measurements was 0.003m.

Offset Z (m) 0.001m

The average difference in vertical measurement in the forward and reverse directions was less than 0.001m, however the instrument precision was given as 0.001m, so that value is used.

Vessel Speed (m/s) 0.03 + Average current speed for the survey area

This value will change for each survey, and is dependent on the average current in the area. Most NRT6 surveys during 2010 will take place in San Francisco Bay, which has relatively swift currents. This may result in large values for this uncertainty.

Loading (m) 0.011 m

Survey personnel marked the vessel waterline with a nearly empty fuel tank, and then filled the fuel tank. The waterline was then remarked, and the vessel was hauled out of the water. The difference between the average difference between the marks (marks were placed on the port and starboard sides) was 0.011 m.

Draft (m) 0.02 m

Measurement to the waterline was not performed by NGS during their survey, but during an offset survey performed by NRT6 personnel in 2009. The methods used during that survey resulted in values with 1cm of the NGS values. However, the measurement to the waterline was performed by taking a measurement to the "scum" line while the vessel was on the trailer. This line is not distinct and has a thickness of about .02m, This value will be used as the draft uncertainty.

Delta Draft (m) 0.09 m

Taken from the 2012 Settlement and Squat test, this uncertainty value was taken from the 2 STD value of approximately 0.09 found in the Figure 2 Pydro Plot (see appendix 2) and entered in the HVF under the TPU StdDev entry Delta Draft.

MRU Align StdDev gyro 0.250 deg

Standard deviation for multiple yaw patch test values given a standard deviation of 0.25 degree.

MRU Align StdDev Roll/Pitch 0.1 deg

Standard deviation for multiple pitch/roll patch test values given a standard deviation of 0.1 degree.

Appendix 11: CARIS HVF Vessel Report

Vessel Name: NRT6_S3003_EM3002_2014
Vessel created: August 27, 2014

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2005-143 00:00

Comments: RP to SWMB XDCR
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: 1.450
Roll Offset: 0.090
Azimuth Offset: 3.600

DeltaX: 1.332
DeltaY: 3.014
DeltaZ: 1.232

Manufacturer: Simrad
Model: em3000
Serial Number: 1518

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2005-143 00:01

Comments: RP to SWMB XDCR
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.590
Roll Offset: 0.060
Azimuth Offset: 0.000

DeltaX: 1.332
DeltaY: 3.014
DeltaZ: 1.232

Manufacturer: Simrad
Model: em3000
Serial Number: 1518

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2008-201 00:00

Comments: Refit to Hull Mount
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.250
Roll Offset: 0.250
Azimuth Offset: -1.800

DeltaX: 0.001
DeltaY: -1.915
DeltaZ: 0.490

Manufacturer: Simrad
Model: em3000
Serial Number: 1518

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2009-080 00:00

Comments: NGS offsets
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.250
Roll Offset: 0.250
Azimuth Offset: -1.800

DeltaX: 0.010
DeltaY: -1.909
DeltaZ: 0.483

Manufacturer: Simrad
Model: em3000

Serial Number: 1518

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2010-073 00:00

Comments: 2010 HSRR patch
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.250
Roll Offset: 0.050
Azimuth Offset: -0.600

DeltaX: 0.010
DeltaY: -1.909
DeltaZ: 0.483

Manufacturer: Simrad
Model: em3000
Serial Number: 1518

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2011-188 00:00

Comments: 2011 HSRR Patch
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.150
Roll Offset: 0.220
Azimuth Offset: -1.000

DeltaX: 0.010
DeltaY: -1.909
DeltaZ: 0.483

Manufacturer: Simard
Model: em3000
Serial Number: 1518

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2012-276 00:00

Comments: 2012 HSRR Patch. Patch offsets now inserted into SIS.
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Simrad
Model: em3002
Serial Number: 1684

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2013-091 00:00

Comments: 2013 HSRR Patch. Patch numbers now zero in SIS, inserted back into .hvf
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.200
Roll Offset: 0.200
Azimuth Offset: -0.700

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Simrad
Model: em3002
Serial Number: 1684

Depth Sensor:

Sensor Class: Swath
Time Stamp: 2014-212 00:00

Comments: 2014 HSRR Patch. Patch numbers zero in SIS, inserted into .hvf instead. Used 2013 Patch numbers, not pleased with 2014 results.
Time Correction(s) 0.000

Transduer #1:

Pitch Offset: -0.200
Roll Offset: 0.200
Azimuth Offset: -0.700

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Simrad
Model: em3002
Serial Number: 1684

Navigation Sensor:

Time Stamp: 2005-143 00:00

Comments: RP to IMU
Time Correction(s) 0.760
DeltaX: 0.127
DeltaY: 0.310
DeltaZ: 0.118

Manufacturer: Applanix
Model: POSMV Ver. 3
Serial Number: 676

Time Stamp: 2005-143 00:01

Comments: RP to IMU
Time Correction(s) 0.040
DeltaX: 0.127
DeltaY: 0.310
DeltaZ: 0.118

Manufacturer: Applanix
Model: POSMV Ver. 3
Serial Number: 676

Time Stamp: 2008-201 00:00

Comments: Rp to IMU, relocated IMU to top of ducer
Time Correction(s) 0.000
DeltaX: 0.003
DeltaY: -1.908
DeltaZ: 0.063

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Time Stamp: 2009-080 00:00

Comments: RP to IMU, new NGS survey
Time Correction(s) 0.000
DeltaX: 0.004
DeltaY: -1.907
DeltaZ: 0.067

Manufacturer: Applanix
Model: POSMV 320 V4
Serial Number: 676(IMU#)

Time Stamp: 2012-276 00:00

Comments: IMU is reference point for EM3002
Time Correction(s) 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POSMV 320 V4
Serial Number: 676(IMU#)

Time Stamp: 2013-091 00:00

Comments: IMU is reference point for EM3002
Time Correction(s) 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Manufacturer: Applanix
Model: POSMV 320 V4
Serial Number: 676(IMU#)

Gyro Sensor:

Time Stamp: 2005-143 00:00

Comments:
Time Correction(s) 0.000

Heave Sensor:

Time Stamp: 2005-143 00:00

Comments: RP to IMU
Apply Yes
Time Correction(s) 0.000
DeltaX: 0.127
DeltaY: 0.310
DeltaZ: 0.118
Offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 3
Serial Number: 676

Time Stamp: 2008-201 00:00

Comments: Rp to IMU, relocated IMU to top of ducerRp to IMU, relocated IMU to top of ducer
Apply Yes
Time Correction(s) 0.000
DeltaX: 0.003
DeltaY: -1.908
DeltaZ: 0.063
Offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Time Stamp: 2009-080 00:00

Comments:
Apply Yes
Time Correction(s) 0.000
DeltaX: 0.004
DeltaY: -1.907
DeltaZ: 0.067
Offset: 0.000

Manufacturer: Applanix
Model: POSMV 320 V4
Serial Number: 676

Time Stamp: 2012-276 00:00

Comments: EM3002 Setting Change
Apply No
Time Correction(s) 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POSMV 320 V4
Serial Number: 676

Time Stamp: 2013-091 00:00

Comments: EM3002 Setting Change
Apply No
Time Correction(s) 0.000
DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000
Offset: 0.000

Manufacturer: Applanix
Model: POSMV 320 V4
Serial Number: 676

Pitch Sensor:

Time Stamp: 2005-143 00:00

Comments: (null)
Apply Yes
Time Correction(s) 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 3
Serial Number: 676

Time Stamp: 2008-201 00:00

Comments:
Apply Yes
Time Correction(s) 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Time Stamp: 2009-080 00:00

Comments:
Apply Yes
Time Correction(s) 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POSMV 320 Ver4.
Serial Number: 676

Time Stamp: 2012-276 00:00

Comments: EM3002 Setting Change

Apply No
Time Correction(s) 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POSMV 320 Ver4.
Serial Number: 676

Time Stamp: 2013-091 00:00

Comments: EM3002 Setting Change
Apply No
Time Correction(s) 0.000
Pitch offset: 0.000

Manufacturer: Applanix
Model: POSMV 320 Ver4.
Serial Number: 676

Roll Sensor:

Time Stamp: 2005-143 00:00

Comments: (null)
Apply Yes
Time Correction(s) 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 3
Serial Number: 676

Time Stamp: 2008-201 00:00

Comments:
Apply Yes
Time Correction(s) 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Time Stamp: 2009-080 00:00

Comments:
Apply Yes
Time Correction(s) 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Time Stamp: 2012-276 00:00

Comments: EM3002 Setting Change
Apply No
Time Correction(s) 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Time Stamp: 2013-091 00:00

Comments: EM3002 Setting Change
Apply No
Time Correction(s) 0.000
Roll offset: 0.000

Manufacturer: Applanix
Model: POSMV Ver. 4
Serial Number: 676

Draft Sensor:

Time Stamp: 2005-143 00:00

Apply Yes
Comments: (null)
Time Correction(s) 0.000

Entry 1) Draft: 0.000Speed: 0.000

Entry 2) Draft: 0.002Speed: 3.100
Entry 3) Draft: 0.010Speed: 3.899
Entry 4) Draft: 0.014Speed: 4.599
Entry 5) Draft: 0.020Speed: 5.301
Entry 6) Draft: 0.030Speed: 5.900
Entry 7) Draft: 0.035Speed: 6.500
Entry 8) Draft: 0.042Speed: 7.000
Entry 9) Draft: 0.044Speed: 7.400

Time Stamp: 2008-201 00:00

Apply Yes
Comments:
Time Correction(s) 0.000

Entry 1) Draft: 0.000Speed: 0.000
Entry 2) Draft: -0.010 Speed: 3.888
Entry 3) Draft: -0.025 Speed: 4.860
Entry 4) Draft: -0.030 Speed: 5.832
Entry 5) Draft: -0.070 Speed: 6.317
Entry 6) Draft: -0.055 Speed: 7.289
Entry 7) Draft: -0.060 Speed: 7.775

Time Stamp: 2009-001 00:00

Apply Yes
Comments: new DD, should be good from MB retrofit to present
Time Correction(s) 0.000

Entry 1) Draft: 0.000Speed: 0.000
Entry 2) Draft: -0.001 Speed: 2.235
Entry 3) Draft: -0.020 Speed: 3.888
Entry 4) Draft: -0.023 Speed: 4.529
Entry 5) Draft: -0.027 Speed: 5.093
Entry 6) Draft: -0.031 Speed: 6.045
Entry 7) Draft: -0.045 Speed: 6.648
Entry 8) Draft: -0.059 Speed: 7.348
Entry 9) Draft: -0.076 Speed: 7.814
Entry 10) Draft: -0.090 Speed: 8.378

Time Stamp: 2011-188 00:00

Apply Yes
Comments:
Time Correction(s) 0.000

Entry 1) Draft: 0.020Speed: 0.972
Entry 2) Draft: 0.010Speed: 1.944
Entry 3) Draft: 0.000Speed: 2.916
Entry 4) Draft: 0.010Speed: 3.888
Entry 5) Draft: 0.020Speed: 4.860
Entry 6) Draft: 0.050Speed: 5.832
Entry 7) Draft: 0.080Speed: 6.803
Entry 8) Draft: 0.100Speed: 7.775
Entry 9) Draft: 0.080Speed: 8.747
Entry 10) Draft: 0.000 Speed: 9.719

Time Stamp: 2012-276 00:00

Apply No
Comments: Being applied during SVP
Time Correction(s) 0.000

Entry 1) Draft: 0.000Speed: 0.972
Entry 2) Draft: 0.000Speed: 1.944
Entry 3) Draft: 0.010Speed: 2.916
Entry 4) Draft: 0.010Speed: 3.888
Entry 5) Draft: 0.020Speed: 4.860
Entry 6) Draft: 0.030Speed: 5.832
Entry 7) Draft: 0.040Speed: 6.803
Entry 8) Draft: 0.040Speed: 7.775
Entry 9) Draft: 0.040Speed: 8.747
Entry 10) Draft: 0.020 Speed: 9.719

Time Stamp: 2013-091 00:00

Apply Yes
Comments: Being applied during SVP
Time Correction(s) 0.000

Entry 1) Draft: 0.000Speed: 0.972
Entry 2) Draft: 0.000Speed: 1.944
Entry 3) Draft: 0.010Speed: 2.916
Entry 4) Draft: 0.010Speed: 3.888
Entry 5) Draft: 0.020Speed: 4.860
Entry 6) Draft: 0.030Speed: 5.832
Entry 7) Draft: 0.040Speed: 6.803
Entry 8) Draft: 0.060Speed: 7.775
Entry 9) Draft: 0.070Speed: 8.747
Entry 10) Draft: 0.030 Speed: 9.719

TPU

Time Stamp: 2005-143 00:00

Comments:
Offsets

Motion sensing unit to the transducer 1
X Head 1 -0.001
Y Head 1 0.006
Z Head 1 0.386
Motion sensing unit to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000
Navigation antenna to the transducer 1
X Head 1 0.754
Y Head 1 -3.149
Z Head 1 2.993
Navigation antenna to the transducer 2
X Head 2 0.000
Y Head 2 0.000
Z Head 2 0.000

Roll offset of transducer number 1 0.000
Roll offset of transducer number 2 0.000

Heave Error: 0.050 or 5.000'' of heave amplitude.
Measurement errors: 0.003
Motion sensing unit alignment errors
Gyro:0.250 Pitch:0.100 Roll:0.100
Gyro measurement error: 0.020
Roll measurement error: 0.020
Pitch measurement error: 0.020
Navigation measurement error: 1.000
Transducer timing error: 0.005
Navigation timing error: 0.005
Gyro timing error: 0.005
Heave timing error: 0.005
PitchTimingStdDev: 0.005
Roll timing error: 0.005
Sound Velocity speed measurement error: 0.500
Surface sound speed measurement error: 0.300
Tide measurement error: 0.010
Tide zoning error: 0.100
Speed over ground measurement error: 0.503
Dynamic loading measurement error: 0.011

Static draft measurement error: 0.020
Delta draft measurement error: 0.030
StDev Comment: (null)

Svp Sensor:

Time Stamp: 2005-143 00:00

Comments: RP to SV Probe
Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 1.332
DeltaY: 3.014
DeltaZ: 1.232

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2005-143 00:01

Comments:
Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 1.332
DeltaY: 3.014
DeltaZ: 1.232

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2008-201 00:00

Comments: (null)
Time Correction(s) 0.000

Svp #1:

Pitch Offset: -0.250
Roll Offset: 0.250
Azimuth Offset: -1.800

DeltaX: 0.001
DeltaY: -1.915
DeltaZ: 0.490

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2009-080 00:00

Comments: (null)
Time Correction(s) 0.000

Svp #1:

Pitch Offset: -0.250

Roll Offset: 0.250
Azimuth Offset: -1.800

DeltaX: 0.010
DeltaY: -1.909
DeltaZ: 0.483

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2010-073 00:00

Comments: (null)
Time Correction(s) 0.000

Svp #1:

Pitch Offset: -0.250
Roll Offset: 0.050
Azimuth Offset: -0.600

DeltaX: 0.010
DeltaY: -1.909
DeltaZ: 0.483

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2011-188 00:00

Comments: (null)
Time Correction(s) 0.000

Svp #1:

Pitch Offset: -0.150
Roll Offset: 0.220
Azimuth Offset: -1.000

DeltaX: 0.010
DeltaY: -1.909
DeltaZ: 0.483

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2012-276 00:00

Comments: RP is now IMU. IMU to transducer measurements inserted. This will be applied during SV correction.
Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.006
DeltaY: -0.001
DeltaZ: 0.416

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2013-091 00:00

Comments: RP is IMU
Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.006
DeltaY: -0.001
DeltaZ: 0.416

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

Time Stamp: 2014-212 00:00

Comments: RP is IMU. Z value changed with POSMV5 IMU upgrade.
Time Correction(s) 0.000

Svp #1:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.006
DeltaY: -0.001
DeltaZ: 0.386

SVP #2:

Pitch Offset: 0.000
Roll Offset: 0.000
Azimuth Offset: 0.000

DeltaX: 0.000
DeltaY: 0.000
DeltaZ: 0.000

WaterLine:

Time Stamp: 2005-143 00:00

Comments: RP to WL
Apply Yes
WaterLine -0.050

Time Stamp: 2009-080 00:00

Comments: RP to WL
Apply Yes
WaterLine -0.024

Time Stamp: 2012-276 00:00

Comments: RP to WL
Apply No
WaterLine -0.024
