

# Southstar™ SeaFloor

*Operator's Manual*



**Version 1.00**

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## **1. Introduction**

Southstar™ is an acoustic tracking system; it is available in a wired version or a wireless version which uses RF transmitters. Its principal function is to track a ROV, AUV, or any other underwater vehicles with precision accuracy, sub-meter. Southstar™ uses high frequency (34 kHz - 42 kHz) pinger that transmits acoustically to the array of baseline stations. While light and most radio waves

are quickly absorbed in water, sound actually propagates not only significantly faster but also much further in water than it does in air. For this reason, sound is used in many underwater applications. Common examples include depth sounders, imaging sonar, and fish finders. This manual is intended for ROV, AUV, or diver uses with a special configuration.

### Principal Components of the AquaMap™ System

- Most Southstar™ configurations include at least three baseline stations (RBS-32) though some configurations will include four. The fourth station is for improved accuracy. The baseline stations serve as the reference points of a survey. They are typically deployed near the corners of a (rectangular) survey site, off the side of a moving vessel, or off a dock. The baseline stations are small, self-contained cylinders.
- The **Southstar** software will track any underwater vehicle that is equipped with a pinger. The **Southstar** software exports the positions to **DiveBase** which is used as the display software. Several transponders are currently available. The miniature TLT pingers are designed for tracking small ROV to depths of 300 meters (1000 feet). The larger and more sophisticated pingers will track ROV to depths of 1000 meters (3000 feet). It is suitable for mid-size or larger ROV.

Southstar™ determines the diver's position by means of 'sonar triangulation' - a method that is somewhat similar to taking sightings of land marks in order to fix your position at sea.

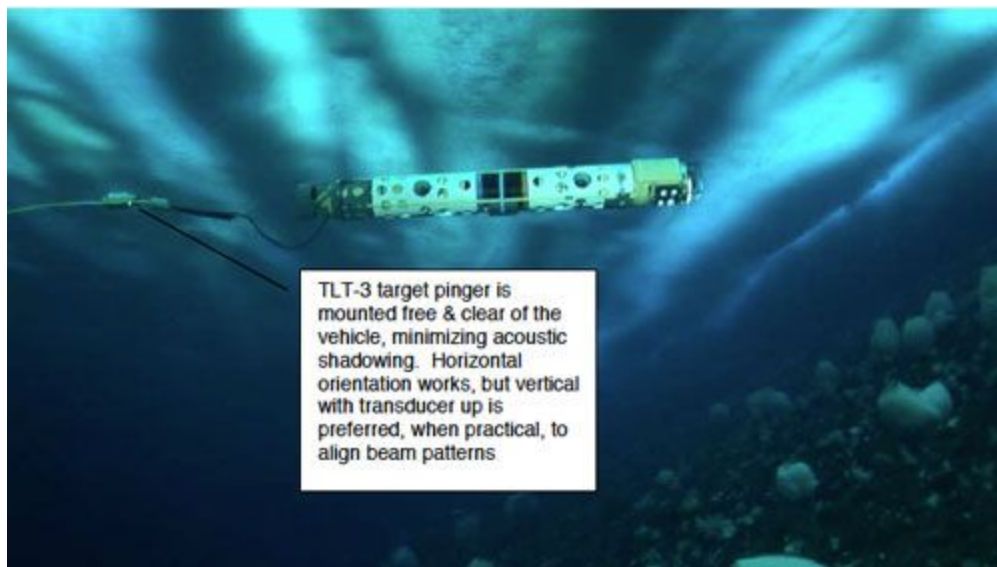


Figure 1: Pinger mounted on an ROV's umbilical

Three or four baseline stations are mounted near the corners of a (rectangular) survey area. The survey area could be a moving vessel, a dock, a barge, or anything similar. The pinger on the target transmits a brief sonar 'ping' (or a sonar code), which travels to all baseline stations. Upon receipt of a ping, each baseline station sends the time of time of they received the ping to the surface station.

The Southstar™ software receives the data from the baseline stations and then pipes it to DiveBase Seafloor™, which displays the location of the target. The update rate for the target is once every second.

### **Things to Keep in Mind**

AquaMap™ uses SONAR triangulation to determine position. It is important to understand the pitfalls of this method so that you can be aware of potential problems.

- **Line of Sight Is Important!** SONAR is a 'line of sight' technology. The sound signal must have a clear path from the transmitter to the receiver. Keep the baseline station transducers clear from obstructions that could block the signal. Make sure that terrain features such as boulders or a sloping sea floor don't obstruct the signal path. For best range, keep baseline station transducers at least two meters above the sea floor and no less than two meters below the surface.
- **Geometry Is Important!** Mount the baseline stations in three corners of a roughly rectangular survey area. Accuracy is best if two of the baseline stations appear at approximately a 90-degree angle as seen by the ROV. It is worst when the angle closes in on 0 degrees or 180 degrees.
- **Consider Baseline Station Spacing!** Don't make survey areas excessively small, as very small sonar paths will degrade performance. Best performance is achieved by using the entire length of the cable for deployment spacing.
- **Baseline Stations Must Be Stable!** The baseline stations serve as the reference points for navigation. If the stations move, data accuracy will be degraded accordingly. It is therefore necessary to ensure that baseline stations are not whipped about by surge, currents, or other conditions. The trawl float provides enough flotation for installation under low-surge, low-current conditions. When operating in high surge, add extra flotation to increase the tension on the station's anchor line.

**Warning** Mobile Stations (TLT-32's) must be powered up just under the water's surface to get accurate depth readings. The mobile stations zero out their pressure sensor reading when they are first turned on. If the mobile station isn't in the water then the temperature of the pressure sensor will change when it gets in the water and the depth reading will have its accuracy affected. If the mobile station is deeper than the surface of the water then the accuracy of the depth sensor will also be negatively affected because it will think its current depth is 0m. Stations are powered up when the surface station is turned on so make sure to hold all mobile stations in the water before powering on the surface box so they can adjust to the temperature of the water.

## **2. Southstar™ System Components**

### **Southstar™ System Components**

- 1-8 Mobile Station(s): TLT-32

- 3-4 RBS-32 Baseline Stations
- JCT-4 Underwater Junction Bottle
- Surface station
- Southstar™ and DiveBase Seafloor™ software

*Not included in the Southstar™ components, but required for use*

- Windows PC running on Windows XP or newer with at least 256MB of RAM
- Additional mounting hardware (weights and floats)
- Virtual Serial Port software

**Table 2: Southstar Components**

## **3. Installing the Software**

### **SouthStar**

To install SouthStar Copy the SouthStar directory from the install CD to your hard drive. Next, if you don't already have a virtual serial port pair installed then install a virtual serial port program of your choice besides com0com(it doesn't work with DiveBase).

### **DiveBase**

Run the DiveBase installer from the DiveBase directory on the CD. After this install finishes then copy the DiveBase\_Seafloor\_v181.exe to the directory you installed DiveBase if you wish to track multiple targets.

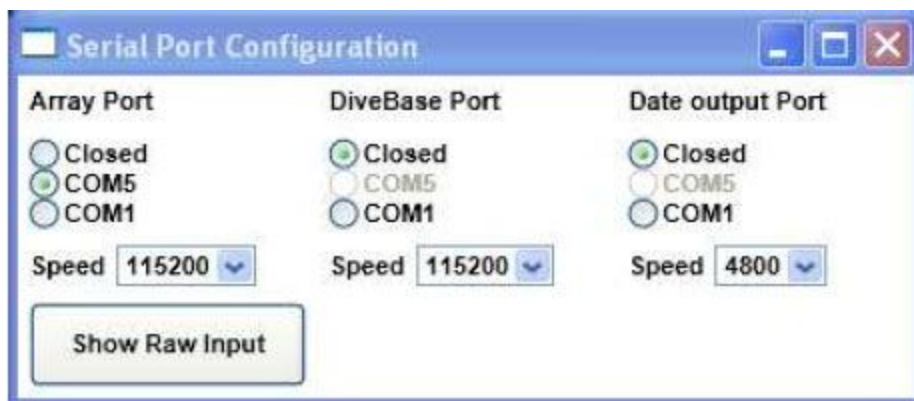
## **4. Using the SouthStar Software**



### **Software Function & Connections**

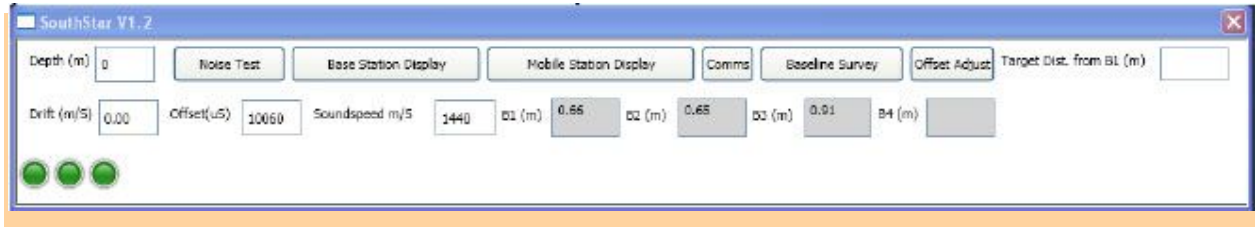
Southstar software controls the acoustic array, performs an acoustic baseline self-survey, obtains target range data and forwards it via a COM port to the DiveBase tracking software. Select an array COM port, DiveBase COM port and a data output port if you wish to have distances, depths, temperatures, and accelerometer data sent out.

DiveBase accepts the target range and depth data from Southstar. Baseline survey results must be hand-transferred from Southstar prior to start of tracking. DiveBase computes, filters and displays target positions.



### Typical COM port configuration

**Note:** You may have to reset the software after changing the Data Output or Divebase ports to ensure that data is sent to these ports.



### Main SouthStar Window

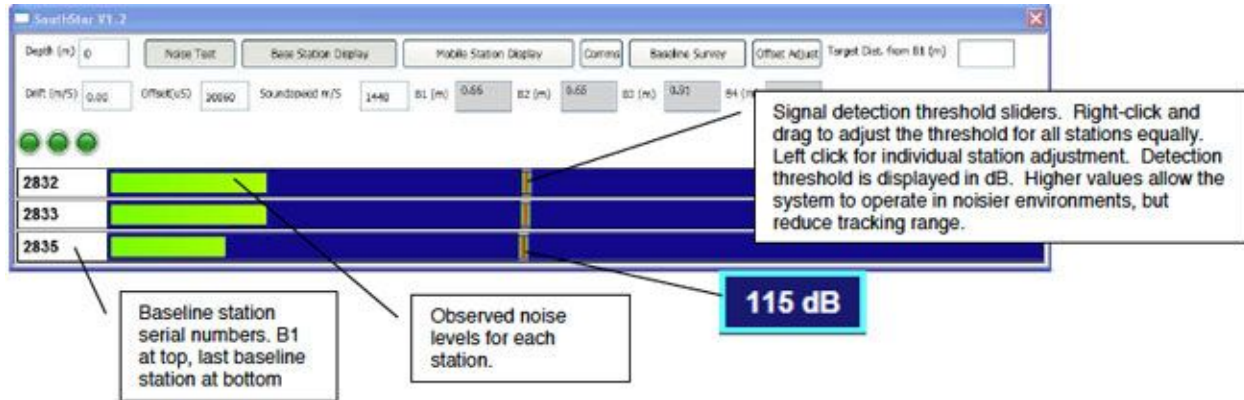
Southstar Function	Explanation
Depth	Depth display. Depth is received automatically from PC-PILOT and shown in this field. You can also hand-enter depth if automatic depth should fail.
Noise Test	Click to measure underwater noise levels and set the signal detection thresholds for the baseline stations (see section #3).
Base Station Display	Click to display/hide the signal strength display.
Mobile Station Display	Click to show mobile station management screen with distances and sensor data.
Comms	Click to set COM ports for data input from the array and output to DiveBase. Use 115200 baud for the array port, and 4800 baud for the RangeNav (DiveBase) port. The data output and DiveBase ports are optional and SouthStar will display raw distance and sensor data without them.
Baseline Survey	Click to self-survey the baseline station network prior to tracking



Target Distance from B1 display, Offset Adjust Button, Offset display	To synchronize the pinger to the array, place at a known distance from baseline station B1, enter that distance and click the Offset Adjust button. The ping time in microseconds from the start of a GPS second is now displayed.
Drift	Enter the pinger clock drift relative to the GPS standard based on an observation; to minimize position drift.
Status Lights	<p>Number of lights will be equivalent to the number of baseline stations defined in the Application_Settings.Config file. From left to right: B1, B2, B3, B4</p> <p><b>Red:</b> Cannot talk to TLT-32 acoustic baseline station. Check link via antenna, FRF-2 pair and cabling. Make sure TLT-32 is blinking. NOTE: All station symbols remaining red can indicate a failed FRF-2 USB connection to the PC. Re-launch Southstar and re-connect the FRF-2 via USB.</p> <p><b>Yellow:</b> Communication with acoustic baseline station OK, but station does not detect acoustic signals. Normal status when target pinger is not yet in the water, or is shielded or out of range.</p> <p><b>Green:</b> Target pinger signal detected. Normal status when target pinger is in the water. If target pinger is out of the water, green means noise triggers the receiver. If this happens frequently (once every five seconds or faster on a indicator), increase the detection threshold.</p>
Sound speed	Enter the sound speed here. Accurate number required for accurate measurements. Default is 1440 meters/sec, for -2 deg C water with 35 ppm salinity (typical Antarctica condition).
Distance fields	Shows the target distance from the baseline stations. These numbers will only be accurate after pinger synchronization (section #5)

## 5. Conducting a Noise Test

Prior to baseline surveying or tracking, conduct a noise test and set the signal detection threshold for the baseline stations.



## Noise Test Procedure

1. Click **Noise Test** button
2. Observe noise bars for ten seconds or more
3. Right-click on detection threshold slider to adjust the thresholds for all stations to just above the prevalent noise levels. If infrequent (every five seconds or less) noise spikes occur, they can be ignored. If one baseline station sees more noise, its threshold can be individually adjusted. As the noise test tends to be more sensitive than the tracking mode, you can also adjust the detection threshold by up to about 6dB below the noise level. See the advise below for details.
4. Click on the **Noise Test** button to end the test and accept the new detection thresholds.
5. Software bug: Due to an apparent software bug in Southstar, you must now start and end Noise test once more (click the noise test button twice, with a 1 sec or more pause in between clicks). Otherwise, the new detection thresholds may not be accepted by the array.

## Advise on setting detection thresholds

**Noise rejection:** Higher detection thresholds are required for noisier environments, but they also reduce the effective tracking range. If you experience too much signal loss, try reducing the detection thresholds even below the level indicated by the noise test. Next, watch the ranging displays and status lights. If no pinger is in the water, you are OK as long as the status lights stay normally yellow and the distance indicators remain at 0.00m. If a target pinger is active, you are OK as long as the indicated target distances for the most part steadily show the correct target distance. If the indicators jump a lot, then you are probably picking up noise and need to increase the detection threshold.

**Echo rejection:** Target pinger signals may bounce-off reflective surfaces such as the sea-floor, sea-surface, rocks or ice bergs. Echoes may be the cause if you frequently see an obviously wrong but consistent distance indicator. You can increase the detection threshold which may reject an echo if it is weak. Using four baseline stations will also help in high-echo environments, as the software will reject an outlier range but still obtain positions.



## **Effective Tracking Range**

The following are observation values for the Southstar system performance in Antarctica, 2009 (wireless system):

At Arrival Heights, in about 25m to 65m of water, reliable operation up to about 330m from baseline stations with 120 dB detection threshold, and no signal detects with 130 dB detection thresholds.

Near Tent Island in 300m of water or more. Pinger lowered to 300m, baseline station at 9m depth.

- No signal with 110 dB at 1000m
- Good signal with 105 dB at 850m
- Reliable detection at 475m with 110dB detection threshold and pinger at 30m and 60m depth.

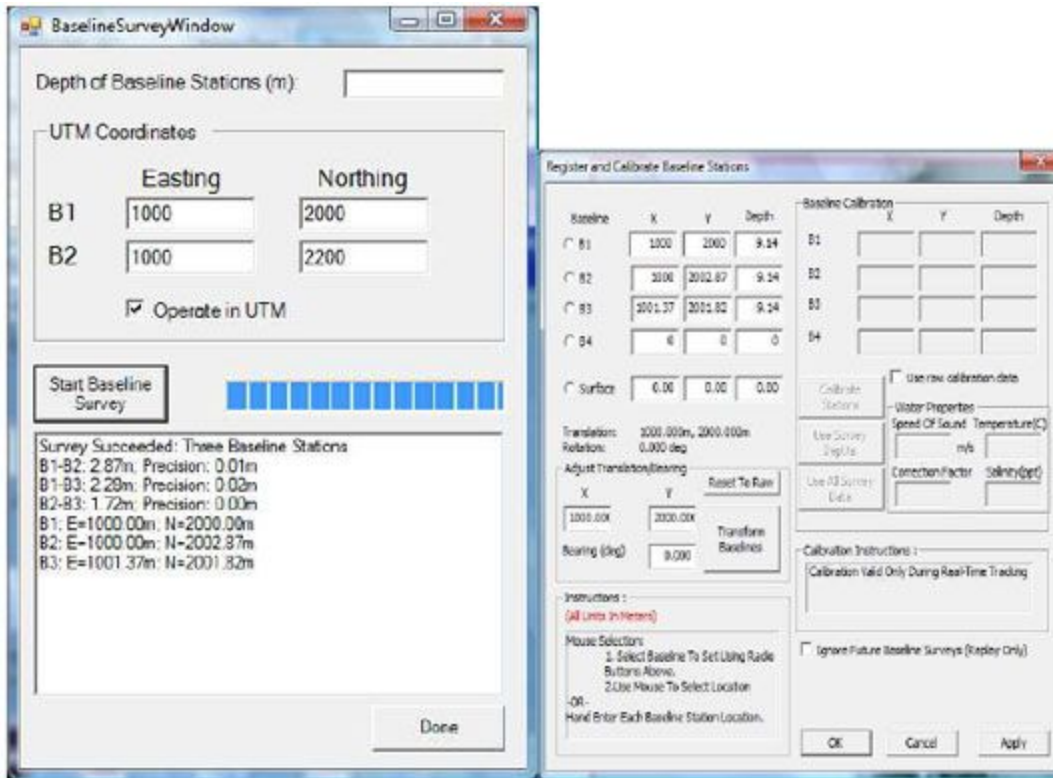
Bay of Sails Noise and Echo Evaluation at iceberg BS1 in 32m of water

- Noise around 95dB – 100dB
- Reliable signal detection at 100dB to 130 dB for a pinger lowered to the sea floor.
- Apparent echoes indicated by jump to approx. 118m for about 20% of the ranges. Seemed to get marginally better at higher detection thresholds.

## **6. Conducting a Baseline Survey**

Do a baseline survey to establish the relative location of the baseline stations, and then convert them to UTM (if desired).

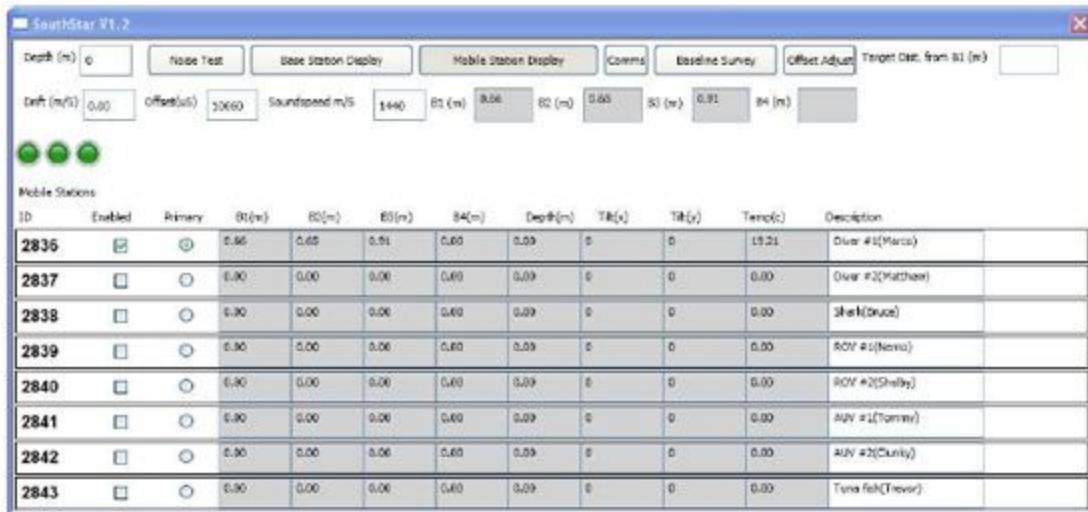
### **Procedure**



1. Click the **Baseline Survey** button in SouthStar to call up the baseline survey window.
2. Enter the depth of your baseline stations in meters.
3. For UTM operation, enter the Easting and Northing coordinates of B1 and B2 as established by a GPS receiver or other means (matching to a point on Google Earth, etc.), and check **Operate in UTM**.
4. Click the **Start the Baseline Survey** button. The baseline survey can take up to 40 seconds, progress indicated by bar.
5. Read the results. Baseline station distances are indicated first. The Precision shows how much the measurement from station A to B varied from B to A. It should be a few centimeters or less. If precision is poor then the survey results are probably poor. If a distance measurement is not available, then a path blockage or excess baseline station range may be the problem.
6. Re-try a poor survey to see if it improves. If no improvement is available, move the baseline station closer, deeper or away from a suspected blockage.
7. Now manually transfer baseline survey results into DiveBase. In DiveBase, select **Action**→**Register and Calibrate Baseline Stations**.
  1. Enter the Easting coordinates of the baseline stations into the 'X' fields in Divebase.
  2. Enter the Northing coordinates of the baseline stations into the 'Y' fields in DiveBase
  3. Enter the actual baseline station depths into the Depth field in DiveBase. (The Depth field in Navbridge is not currently used and can be left open).
  4. Click the **OK** button in DiveBase

- In DiveBase, select File→Save Current Record and select a name representative of the dive site such as **BayOfSailsIceberg1.shr**

## 7. Managing and Monitoring Mobile Stations



Mobile Station Display Panel

### Initial configuration

The Mobile Station display panel allows you to monitor and manage multiple mobile stations. The first step in setting up your mobile stations is to enter their mobile ID's in the far left boxes by double clicking an ID number to edit it and making sure to press enter after entering an ID number. If you own multiple mobile stations then you should enter all of their ID's at once and write in a description for each in the description box on the far right. When you're going to deploy the system you should uncheck the "Enabled" box for each of the mobile stations you're not going to be using. The more stations that are enabled the lower the refresh rate you're going to get for position and sensor data. One station may be set as the "Primary", which will cause its distance data to be displayed in the main window after the Mobile Station Display is hidden.

All of the data you enter for mobile stations(along with the rest of the application settings) are stored in the file "Application\_settings.config" in your SouthStar program directory in a clean text format using xml.

### During deployment

When the system is deployed and in the water you will see the distance data for enabled and connected mobile stations update along with the sensor data. There is currently no indicator for

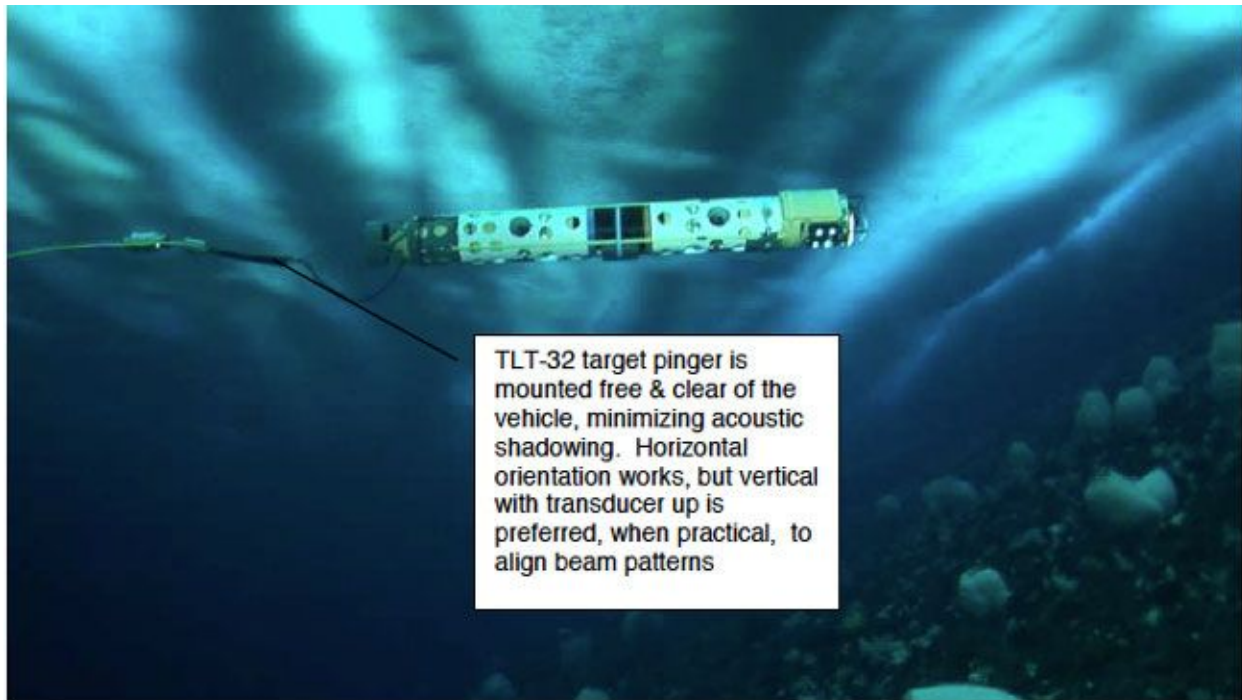
mobile station communications but fluctuations in the temperature sensor field along with green lights for the base station status indicators can serve the same function.

### **Data Output Format**

If a "Data Output" port is selected in the Comms screen then the distance and sensor data for all enabled and connected mobile stations will be output during system operation. The data format is as follows: \$Mobile ID, Temperature(Celsius), Depth(Meters), Rotation X, Rotation Y, Distance to base 1(Meters), Distance to base 2(meters), ..., Distance to base n(meters) The number of distances at the end of the string depends on the number of base stations that are in your system.

Example output string using three base stations and a mobile station without a depth sensor or accelerometer : \$2836,19.30,0,0,0,0.65,0.61,0.74

## **8. Mounting, Activating, and Synchronizing the Pinger**



1. Mount the target pinger on the vehicle such as to minimize shadowing by components of the vehicle. An unobstructed line-of-sight to the baseline stations must be maintained. Ideally, the pinger should be mounted vertical, with transducer end up.
2. Insert 9V battery. Alkaline battery will run approx. 5 hours; Ultralife lithium battery approx. 12 hours. Smooth insertion promotes a good power-up reset. If contact bounces occur, processor may crash indicate by LED constantly ON or OFF. In that case, wait 2- 5 minutes with battery removed and re-try.

3. Switch pinger ON prior to deployment by swiping the magnetic switch with a magnet.

### **Pinger Synchronization Procedure**

The pinger must be synchronized to the baseline stations (GPS time signal) in order to obtain valid ranges.

1. Place pinger submerged a known distance from baseline station #1, such as 0.1m. Ideally, the pinger and the baseline station will already be at ambient water temperature.
2. In Southstar, enter that distance into Target Dist. from B1 (m)
3. Make sure B1 sees the pinger, and distance readings are consistent (although wrong, typically several hundred meters).
4. Click the Offset Adjust button. Southstar will now compute and display the ping offset. The distance reading to B1 should now be within a few centimeters of the value entered in step two. Pinger distance from other baseline stations (if available) will now also be correct.
5. Compensate for clock drift by observing how much the indicated B1 distance changes over an observation period such as two or five minutes. Convert that number to meters per sec and enter in the Drift (m/s) field.
6. Observe B1 to verify that the distance to the pinger is correctly indicated, and the drift over time is minimal.

### **Drift Observation Numbers for SCINI Southstar System (wireless RF Southstar)**

Distance error at 2.5 hrs after start of test:

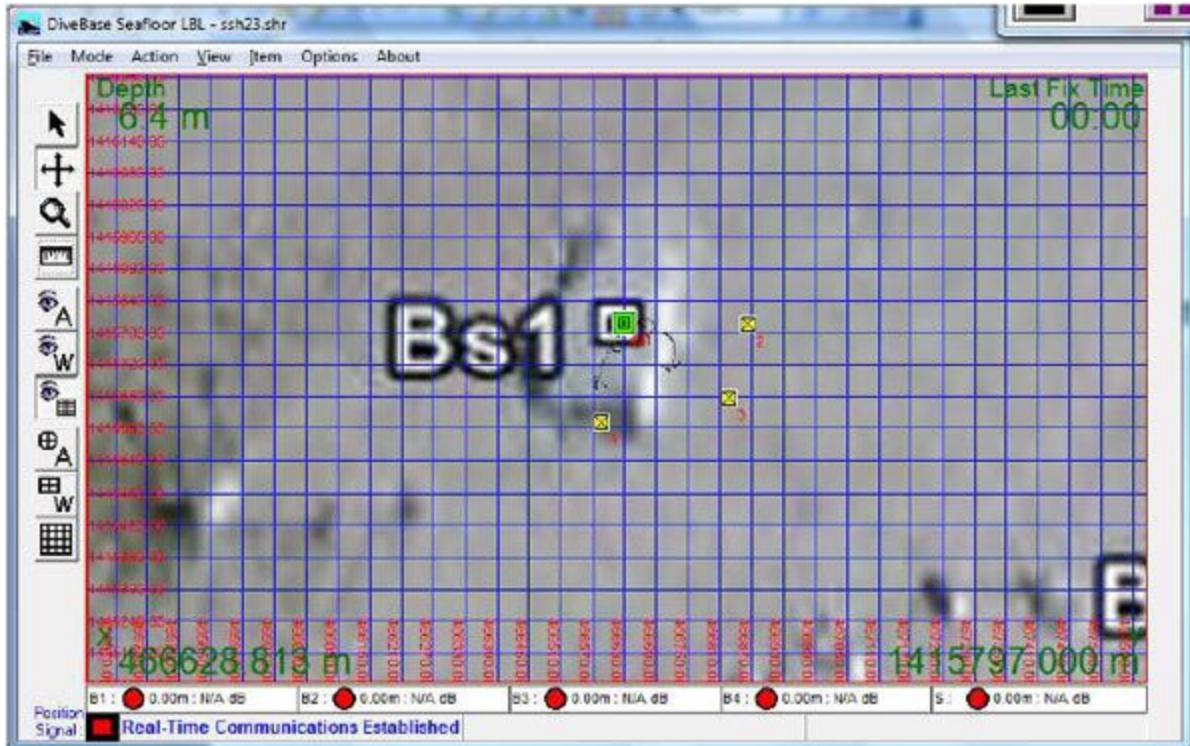
With no drift compensation: 23.18m

With 5-minute initial observation: 0.83m

With 30-minute observation: 0.3m

With 1 hr observation: 0.16m

## **9. Target Tracking**



Tracking is done with the DiveBase Seafloor software. Operate the software as described in the DiveBase manual, except that baseline surveys are done in Southstar rather than directly in DiveBase.

Here is some general guidance for tracking and DiveBase use:

- Use **Item**→**Filter** settings to set position filter or processing parameters as appropriate:
  - Set an averaging period of 3-10 seconds to smooth the trace. More averaging → smoother trace → more position lag.
  - Set the visibility rating to influence the width of the position trace. Set to camera or sensory range to visualize search coverage.
  - Set the **Maximum Error** in 1m to 3m range to remove poor quality position fixes.
  - Set the **Maximum Holiday** higher to show more severe position jumps in the ROV track, or lower to leave a gap when successive positions are too far apart.
- Set **Options**→**Acoustic Navigation Com** port to point to the data source from Southstar
- Define **Options**→**Serial Output Com Port**, **Options**→**Serial Output Baudrate** to pipe position data to another computer or application (such as Hyperterm) to export position data in real-time or replay operations. Can be captured with Hyperterm to generate a text file for use in ARCGIS. Recommended **Options**→**Output Format** is **DSS (XYD)**
- Use the Chart Registration utility in the Seafloor folder to register an image for use as a chart background in DiveBase.



- Watch the **Current Error** at the bottom of the tracking screen to QC the quality of positioning. A smaller error means the system is more precise.
- Watch the **Last Fix Time** up-counter to see how long it has been since the last position fix. There is a position fix opportunity once a second.

### Diagnosing when DiveBase Does Not Track (no positions)

1. View the baseline status lights in Southstar and DiveBase. At least three green lights (available range measurements) are required to obtain a position fix, except when operating with two baseline stations and clicking **Options**→**Allow 2 Range Position Fixes**
2. View the **Position Signal** light in the lower left corner of the DiveBase screen. If red but enough ranges have been received, then the range data could not be converted into a position fix of sufficient quality:
  1. If the **Current Error** indicator is red, then the resulting position does have an error exceeding the value set in **Items**→**Filter Settings, Maximum Error**. This can be the result of poor quality ranging data due to acoustic conditions (such as noise causing many outliers – raise the detection threshold). It will also happen if a baseline station position is significantly incorrect, i.e by a few meters or more.
  2. Well working navigation is indicated by current errors of <0.5m. 0.5m-1m is reasonable, above 1m is poor and above 3m should almost always be ignored.
  3. It is also possible that a range is outside the boundaries specified by **Minimum Range** and **Maximum Range**. Verify these settings.

## 10. Procedure for Operating with Charts and Data Post-Processing

### To establish the original dive site information, including chart and baseline survey data

1. Operate Southstar in UTM coordinates. Following a baseline survey in Southstar, transfer the UTM coordinates of the baseline stations into DiveBase (see section #4).
2. Use the **Chart Registration** utility to register your original map or chart image for the site. Chart Registration accepts .BMP files.
3. Add the registered chart to DiveBase by selecting **File**→**Load Map File**.
4. Save your site plan, including the baseline station locations and the background chart: **File**→**Save Current Record**. Give the file the name of your dive site. This generates a .SHR index text file that contains references to the map image and its registration information, the baseline survey data and other items.

### Just Prior to a dive

The last map and baseline station information appears when you launch DiveBase. DiveBase gets this information from the mission.shr file, which it automatically generates. You can also choose any previous .shr file for use on the next dive by selecting **File**→**Load Record**. This process loads chart, baseline survey, waypoint and annotation information. It does not re-load the actual track data that might already be associated with the .shr file of a particular dive.

You can now start tracking by selecting **Action**→**Start Real-Time Tracking** (see section #6).

### **ARCGIS Processing of the Data Following a Dive**

Following a dive, you may want to export the track file to ARCGIS in order to establish a coverage map. You can also get bathymetry by associating depth with colors, for periods where SCINI was cruising the sea floor. All this data can now be combined into an updated background chart, containing coverage and bathymetry, for use on the next dive. Follow this procedure.

1. Outlier removal and filtering: Load and replay the record of the last dive by selecting **Action**→**Replay Survey**. Take a first look at it, by fast-forwarding through the record. It will show up once fast-forward is completed, or when you switch to play mode. Apply any smoothing and filtering as desired by selecting **Item**→**Filter Settings** and then replaying the record again. Note that the original tracking data, which is in a .rec file will never be modified by filtering. So, you can adjust filters as you like and see the results without compromising the original track data. In fact, the .rec file is never modified by DiveBase following its original recording.
2. Track data export to a text file:
  1. Establish a link to HyperTerm via a virtual COM port pair. In DiveBase, select **Options**→**Serial Output COM Port** to select one port of the pair. Select the DSS (XYD) data output format **Options**→**Output Format**→**DSS (XYD)**. If using real instead of virtual COM ports (such as by piping the data to another computer, select a common baud rate for DiveBase and Hyperterm, such as 115200 baud. **Options**→**Serial Output Baud Rate**→**115200**. (Virtual ports by default don't use baud rate, so this step is not needed.)
  2. In HyperTerm, select the other port of the pair. Select data logging.
  3. Rewind and then start replaying the record in DiveBase. You will see the track data in HyperTerm, expressed as Easting (E or X), Northing (N or Y) and Depth, with all units in meters. Replay to the end to obtain all data, or fast forward to any point and then replay if you just want a section.
  4. End logging in HyperTerm to save the text record of the track.
3. Import the track record into ARCGIS, and process as appropriate to establish coverage, bathymetry and other information. Note that you can also import the DiveBase annotation and waypoint files, which can be found in the shipfiles/annotations and shipfiles/waypoints folders.

### **Creating an updated map for the next dive**

1. Create a map in ARCGIS as desired. Save it as a .BMP file.

2. Register the map for DiveBase, using the **Chart Registration** utility.
3. Load the map in DiveBase using **File→Load Map File**
4. Save the updates dive information, including the baseline positions previously established by selecting **File→Save Current Record**

### DiveBase SeaFloor Display



Figure 3: DiveBase SeaFloor display

## 11. Additional DiveBase Functions

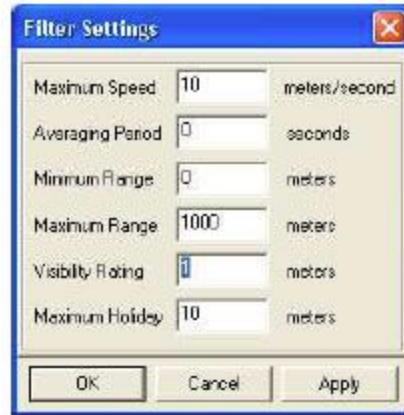


Figure 5: Entering Visibility

### Check and Enter Visibility

To take account of the **visibility** in the water at the time of the inspection you must enter it into the software. The visibility number determines the width of the trace. For example, for a 1- meter visibility the trace will be 2 meters wide (one meter to the left, one meter to the right). The trace is used to 'paint' the seafloor, i.e. show the ground you have covered. Good visibility (or an acoustic (sonar) imaging system) will allow you to 'paint' a wider swath. Choose **Filter Settings** from the **Item** menu and enter the approximate visibility in the appropriate box.

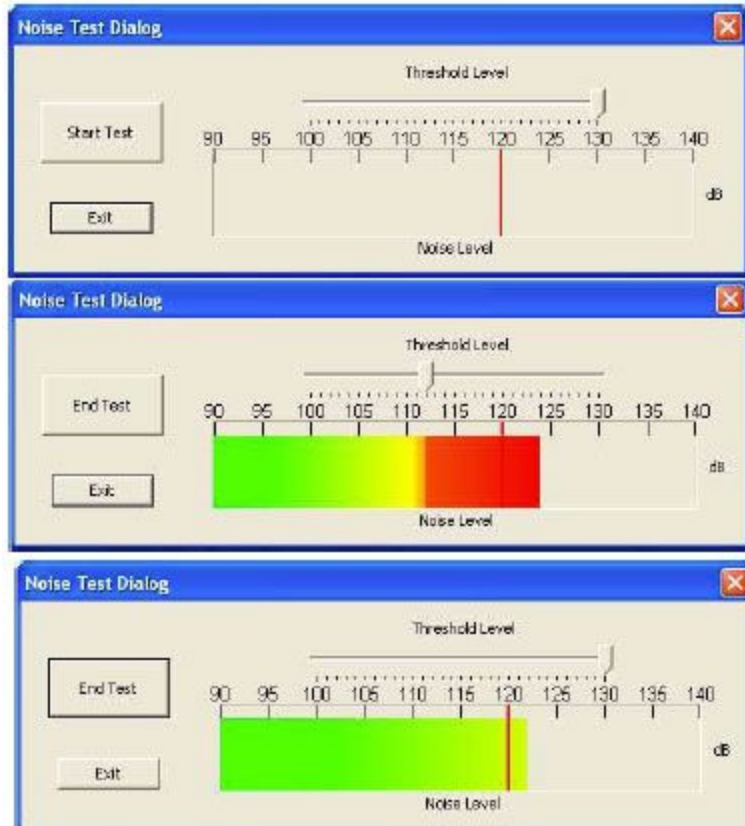


Figure 6: The noise test display

### Perform a Noise Test

Common sources of noise include running engines and snapping shrimp (or other biological noise). A noise test will tell you if this background noise will interfere with system operation. If the noise level is too high, look for sources of noise that can be turned off, such as engines. You can also reduce sensitivity by raising the signal **Threshold Level**, with the slider. However, this will reduce range. In these cases, baseline station distance may have to be reduced.

1. Insure that the baseline stations are in the water and select **Noise Test** from the **Action** menu.
2. Set the Threshold Level slider to 120 dB (the recommended noise limit) and press the Start Test button
3. Test for 30 seconds to a minute. If the noise crosses the threshold every five seconds or more then you should adjust the threshold slider **upwards**. If there is very little noise you can move it downward to increase the range of the system.

## 12. Operation

**Overview:** This section explains how to perform the tracking operations with AquaMap™

## Survey Tasks

1. Start tracking
2. Adjust the display
3. Record annotations
4. Retrieve the system

## Start Tracking

Select **Action/Start Real-Time** tracking from the menu bar. The system will now communicate with the mobile station and initiate tracking operations. If there is a communication error a message box will appear.

## System Status Indicators

During real-time surveying and replay mode, the System Status Indicators (bottom of the main screen) report system status. The System Status Indicator group is made up of a Position Signal Indicator and three or four baseline station Range Indicators, one for each station. The baseline station Range Indicators have **two** possible states, red or green. Successful operation is indicated by a green circle and reported range (in meters), and an unsuccessful operation is indicated with a red circle and zero reported range. Using the Range Indicators it is possible to know if there are any problems with the baseline stations themselves.


The Position Signal Indicator has **three** possible states, green, orange and red. Green indicates a good calculated position fix, orange indicates a bad calculated position fix and red indicates no position fix with possible loss of communications. During replay mode only the green and orange signals are reported. See **Appendix 4: Troubleshooting** if problems occur.

## Adjust the Display

### Turning on and off graticules, annotations, waypoints

Each of these layers can be toggled on and off in the **View** menu or by using the control bar buttons.

### Panning and zooming

The vertical toolbar on the left side of the display has buttons for selecting panning and zooming tools. The panning tool (or Translate Tool)  can be used to click and drag the active view of the seafloor or you can use the arrow keys for panning.




The zoom tool  allows three types of zooming control. Left click to zoom in, right click to zoom out, and click-and-drag a box around any desired area to zoom with precise control. You can also use the hot-keys: O for zooming out and I for zooming in.



Figure 7: DiveBase with Chart Overlay

### Other display controls

The other buttons in the toolbar can be identified by placing the mouse pointer over them, callouts will indicate their functions. They are also pictured and labeled with their functions in the Display section as well as in **Appendix 3: Toolbar Buttons**.

## Appendix A: Additions to DiveBase SeaFloor

These are the differences between DiveBase PILOT and DiveBase SeaFloor; for the benefit of users who already know DiveBase PILOT.

Seafloor Features	Their Use in Seafloor
Picture Annotation	This allows you to snap a picture with an on-board camera leaving, on screen, an annotation where the picture was captured. This later can be used to know exactly where something is in relation to a live map (BMP image).

Chart Overlay	This allows you to overlay a BMP image file. The main goal with this feature is that it gives the ability to place a real world map in the background so that you will know in relation to the actual place, where your transponder is.
Geo-Referenced Operation	DiveBase Seafloor can operate in the georeferenced UTM coordinate system, to provide results that are compatible with industry standard survey methods. The UTM coordinate system precisely specifies the location of any spot on the surface of the earth.
GPS Integration (only used in PILOT SBL mode)	By connecting a GPS receiver and a heading sensor to the surface station PC, DiveBase can determine the geo-referenced (UTM) position of your target. This capability is only used in short baseline (PILOT) mode. See the PILOT manual for details. You are now capable of using GPS to coordinate the location of your stations during the chart overlay and the chart/map registration. During Chart Registration you take two reference points from a “real world” map.
Position Data Export	This allows you to export the data to another charting system such as Hypak or another computer using a dedicated serial (com) port.
Multi-Target Tracking	With the provided DiveBase Level 2 software (FREE OF CHARGE) you are also capable of tracking up to 10 target at the same time. Therefore you can, generally, get a job completed quicker and cover more area while doing so. Refer to the DiveBase Level 2 manual for details.

## Picture Annotation

To enter an annotation into the survey record choose Add Annotation from the Item menu, or hit the space bar, and fill in the appropriate information when the Annotation Window pops up. For quick annotations use the “spacebar”. Another method of entering an annotation is to right click, with the mouse, on the image where you would like to place the annotation and enter your text.

DiveBase automatically saves annotations in a text file with the extension “txt”. This will create an annotation file with the same name as the “.shr” file but with ANN added to the name. Example: spruance.shr will have a spruanceANN.txt for annotations.

## Chart Overlay and Chart Registration

DiveBase Seafloor lets you navigate or track a target against the background of a chart. This could be a nautical chart, but also a sidescan sonar plot or perhaps an engineering map showing pipelines owned by an oil company. In either case, you start with a .BMP image. The chart registration

process defines the scale of the image, as well as its location on the surface of the earth as expressed in UTM coordinates (see below).

These are two different subjects that relate to each other. Chart Overlay is just having the function to have a mapped area in DiveBase SeaFloor. Chart Registration is software that comes with DiveBase SeaFloor allowing you to register the chart (map image) to later use in SeaFloor.

Here are the steps to follow when using the Chart Registration software. First pull up and run the software, which you can find in the same location as DiveBase SeaFloor. **Step 1: Select *File— Start Single Image Wizard*** and a window will pop up walking you through the process of registering an image (**Step 2 & 3**). A key note that you will want to remember while using this wizard is that it uses UTM coordinates, not latitude/longitude. The Universal Transversal Mercator (UTM) system divides the world into UTM grid squares and then specifies the location of any point within that grid as an offset in meters north (northing) and east (easting) of the southwest corner of the grid square. UTM is commonly used by surveyors, and virtually all GPS receivers can be configured to operate in UTM. Latitudes and longitudes can be converted to UTM using free web calculators, if UTM coordinates are not directly available.

To register an image for use as a chart, you will be asked for two points to reference. So you will need the coordinates of two separate points. The better precision that you can achieve with these points, the better the overall accuracy will be. For example, if you use a hand-held GPS device to find the location of the two reference points, but the GPS has an error of 10 Meters then your overall error will be worse. You do not want your reference points to be on the same x or y axis.





In these Screen dumps it shows each step except the **File** command. In steps 4-7 the corresponding screens have been combined. In **Step 4 and 5** each has its own “Point Selection” screen and once you select for Point 1 it will flow into a second screen for Point 2. As well, in **Step 6 and 7** after you hit “Save Registration” it will pop up with the “Chart Registration yes/no box” before you can proceed. Once clicked “No” Chart Registration will be dismissed automatically.

Then you go into DiveBase SeaFloor and select **File—Load Map File**, point yourself to the correct folder and load the map file you have just created. After the “map” file has been selected it will show up as a Chart Overlay.

### Rotating an image for north alignment prior to registration

There are a few other key notes to take into factor when registering an image. If it is north and south aligned then you will register it as such, but if it is not you have a few options. One of your options is to first rotate the picture using a photo editing software, or you can just reference any point north and any point east. If you chose the second of the two your task can be made out much easier. For example, if you were working on a dock in a harbor you can make one end “north” and another “east” so that when the image is overlaid in SeaFloor the dock forms a right angle. By doing so, this gives the user a simple way of explaining to someone in the water where he is or needs to be.

### GPS Integration

In DiveBase SeaFloor we use the GPS integration and a heading sensor to get geo coordinates rather than just baseline relative positions. That just means that you have the ability to reference your trace to “Real World” coordinates rather than just your baseline survey; therefore, SeaFloor can be used in any application that the goal is to reference an area to an actual map of the area itself. By defining the area with the Chart Registration you can further understand the overall value of GPS

Integration because you can see its effects. Remove the map and your reference is only to the baseline survey, but add the map and your reference changes to a “Real World” survey.

## Position Data Export

You have the utility available to export the position data into another charting software. There are four different methods available, but the most common one is serial output. This is by far the most commonly used, and is the standard method for connecting to another piece of software, such as Hypack or Winfrog. When doing so you must select a com port and baud rate from the Options **Menu** on the main menu bar. The output format used depends upon what you are doing with it. The other thing you have to do is select an output format, we currently support 6 formats.

## Appendix B: Hot Keys (Keyboard Shortcuts)

Menu Command	Hot Key(s)	Function (if it's not self-explanatory)
<b><u>File</u></b>		
Load Record File	Ctrl+L	Loads a record
Load Annotations	Ctrl+A	Loads an annotation file
Load Waypoints	Ctrl+W	Loads a way point file
Save Screen Image		Saves currently selected screen image
Save Annotations		Saves the current annotation file
Save Waypoints		Saves the current way point file
Clear Data / Screen	Ctrl+C	Clear all stored data from screen
Close	Ctrl+Q	Closes Application

<b><u>Action</u></b>		
Start Real-Time Tracking	T	Starts tracking of the mobile station, a new record.
Register And Calibrate Baseline Stations Dialog	C	Launches baseline registration and calibration dialog
End Real-Time Tracking	E	Ends tracking of the mobile station, closes record
Replay A Record	R	
Generate Survey Report Image	Ctrl+S	Saves full DiveBase image currently selected loaded
Noise Test	N	Launch Noise Test Dialog
<b><u>View</u></b>		
Graticule	G	Toggles graticules (grid) on and off
Annotations	A	Toggles Annotations on and off
Status Info		Toggles Status Info on and off
Waypoints	W	Toggles Waypoints on and off
Replay Control		Displays Replay Control Bar



<u>Item</u>		
Graticule Settings	Ctrl+G	Allows changing of graticule (grid) settings
Filter Settings	Ctrl+F	Allows adjustment of <b>Visibility</b> and other settings
Add Annotation		
Remove Annotation	Delete Key	If An Annotation is selected Delete Key with remove it.
Remove All Annotations		
Add Way Point		
Remove Way Point	Delete Key	If A Waypoint is selected Delete Key with remove it.
Remove All Way Points		

<b>Keystrokes (Listed by Functional Group)</b>	<b>Function</b>
<u><b>Deployment</b></u>	
“T”	START REALTIME TRACKING
“C”	Launch Baseline Register/Calibration Dialog
CTRL+F	Launch Filter Dialog (where you enter Visibility)

"N"	Launch Noise Test Dialog (only active during realtime tracking)
Up Arrow	Pan Up
Down Arrow	Pan Down
Right Arrow	Pan right
Left arrow	Pan left
"I"	ZOOM IN
"O"	ZOOM OUT
SPACE BAR	Add annotation at mobile station location, allows free text entering
F5	Add Quick Annotation ("1")
F6	Add Quick Annotation ("2")
F7	Add Quick Annotation ("3")
F8	Add Quick Annotation ("4")
DELETE KEY	DELETE Selected Annotation or WayPoint
"E"	END TRACKING

<b><u>Reporting</u></b>	
"R"	Replay Record
CTRL+R	Generate full report image (saves all items displayed)
Ctrl+C	CLEAR SCREEN
CTRL+A	LOAD ANNOTATIONS from file
CTRL+W	LOAD WAYPOINTS from file
CTRL+L	LOAD a RECORD
<b><u>Others</u></b>	
CTRL+ATL+Q	CLOSE/Quit APPLICATION
CTRL+G	Launch GRATICULE SETTINGS dialog
"G"	VIEW/Hide GRATICULE
"A"	VIEW/Hide ANNOTATIONS
"W"	VIEW/Hide WAYPOINTS

## Appendix C: Toolbar Buttons



**Pointer:** Allows selection of annotations and waypoints.



**Translation/Panning Tool:** Allows fine control over positioning of ship plan in display.

Click and drag to move image.



**Zoom Tool:** Allows fine control over zooming, click and drag a box to zoom to that box.

Right click = zoom in, left click = zoom out.



**Shows annotations.**



**Shows Waypoints**



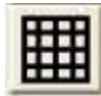
**Shows Graticule layer**



Inserts Annotation



Inserts Waypoint



**Graticule Setting Adjustment:** Calls up Graticule Setting Dialog window for adjusting the values of the graticule.

## Appendix D: Troubleshooting

### Noise Problems

Acoustic or electric noise in the tracking environment will interfere with the signals used by the system. There are many sources of noise, including biological (snapping shrimp, etc...), ship engines, ROV motors, diver's regulators, AC power lines, low quality inverters, etc... The best way to locate controllable noise is to use the noise test feature in the tracking software to monitor noise levels as you turn on and off the possible sources of noise.

<u>ROV noise</u>	
<b>Problem</b>	<b>Reason/Solution</b>
<b>Acoustic noise</b>	Move transducer away from thrusters or hydraulics
<b>Electrical noise</b> (May be radio interference through the air/water or electrical interference through	Test for power line noise by removing both the ROV transponder and the PC from AC power. Test for radio interference by shutting off all ROV systems. Use battery power, a good generator or a true sine wave inverter if power line noise is a problem. Move the ROV

noise on power supply lines)	transponder away from the ROV to locate radio interference, then mount in a location where radio interference is minimized.
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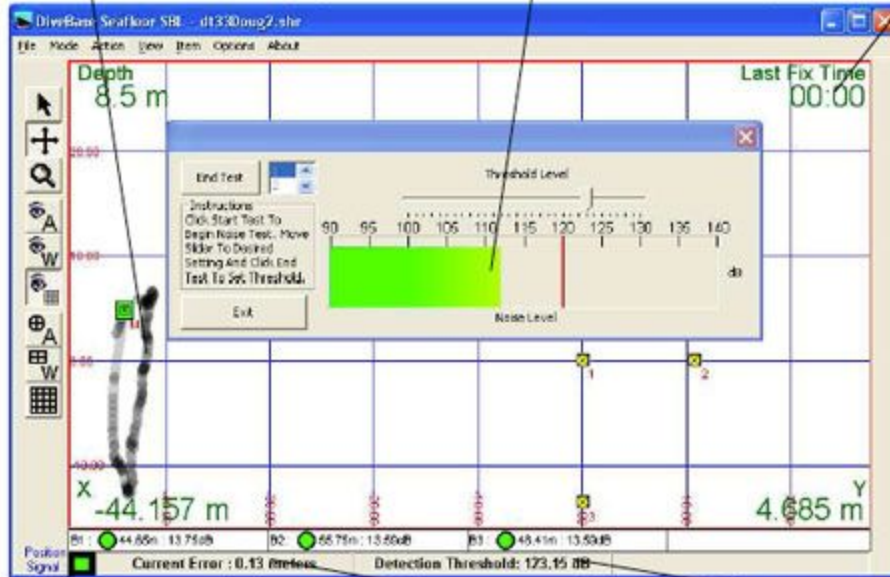
## System Status Indicators

Problem	Reason/Solution
<b><u>Baseline Range Indicator</u></b>	
Constantly Displays Red Circle	<ul style="list-style-type: none"> <li>• Possible loss of power to baseline station. Check power switch on baseline station.</li> </ul>
	<ul style="list-style-type: none"> <li>• During side surveys the hull may block the opposite side baseline stations. This will cause them to report red, but the position signal should still report good positions.</li> </ul>
	<ul style="list-style-type: none"> <li>• During bottom surveys indicator may change to red if the mobile station raises above the keel line creating another block in the line-of-site. Lower your depth so that all four baseline stations are in view of the mobile station.</li> </ul>
<b><u>Position Indicator</u></b>	
Constantly Large Errors	<ul style="list-style-type: none"> <li>• A persistently large error indicates that the baseline survey is incorrect.</li> </ul>
	<ul style="list-style-type: none"> <li>• If the number turns red, the system is not showing positions because the error exceeds the 'maximum error' defined in the filter settings.</li> </ul>
Constantly Displays Red (Real-Time Only)	<ul style="list-style-type: none"> <li>• Communications problem. Cable has been disconnected on mobile station. Check cable connection to mobile station.</li> </ul>
	<ul style="list-style-type: none"> <li>• Power loss. Mobile station has lost power. Check power connection (external power) or battery charge.</li> </ul>
	<ul style="list-style-type: none"> <li>• Transducer is out of range or in a shadowed area.</li> </ul>
	<ul style="list-style-type: none"> <li>• Transponder or Transducer has a dead battery.</li> </ul>

**Position Trace:** The trace is painted only if the position fixes meet the quality standards defined in the position filter settings. If you see frequent gaps in the trace, then check your filter settings; the other indicators on the screen to determine the cause.

**Noise Test & Detection Threshold Slider:** Use this test to evaluate vehicle and environmental noise. More noise means less system range, so make changes to reduce any noise under your control and test again. Use the slider to set the detection threshold above the prevalent noise to avoid noise-induced errors.

Check the time since last position fix to make sure your data is up to date.



Green is OK, but a red light indicates that station is out of range, shielded from view or not operating. Are the lights almost consistently green? If not, reduce baseline station spacing and/or avoid obstructions to obtain better system reliability.

For good position quality, the error should be below 1 meter or even 0.5m. A persistently large error indicates that the baseline survey is incorrect, while changing errors indicate unstable baseline station mounting or obstructions in the water. If the number turns red, the system is not showing positions because the error exceeds the "maximum error" you defined in the filter settings (quality control).

Signal strength above detection threshold: If you see only a few dB, you are near the limit of range. Check the numbers just after baseline station deployment to verify your array is not too large for conditions. Monitor them during ops to get an early warning of an approaching out-of-range condition. CAUTION: A persistently weak signal from one baseline station or sonar transducer may indicate the baseline station transmitter or surface station sonar transducer is not working properly. Replace it.