

AquaMap™ SeaFloor

Operator's Manual



Version 1

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1. Introduction

AquaMap™ is a Long Baseline acoustic tracking system. Its principal function is to track a ROV, AUV, or any other underwater vehicles. AquaMap™ uses high frequency (34 kHz - 42 kHz) sound to track the Transponder. 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 uses.

Principal Components of the AquaMap™ System

- Most AquaMap™ configurations include three **baseline stations** (RBS-1) 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. The baseline stations are self-contained cylinders. Weighted at the bottom and floated at the top, these stations sit like antenna towers in the water.
- **The DiveBase SeaFloor** software will track any underwater vehicle that is equipped with a **ROV Transponder**. Several transponders are currently available. The miniature TLT transponders are designed for tracking small ROV to depths of 300 meters (1000 feet). The larger and more sophisticated VLT-1 transponder will track ROV to depths of 1000 meters (3000 feet). It is suitable for mid-size or larger ROV.

AquaMap™ 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.

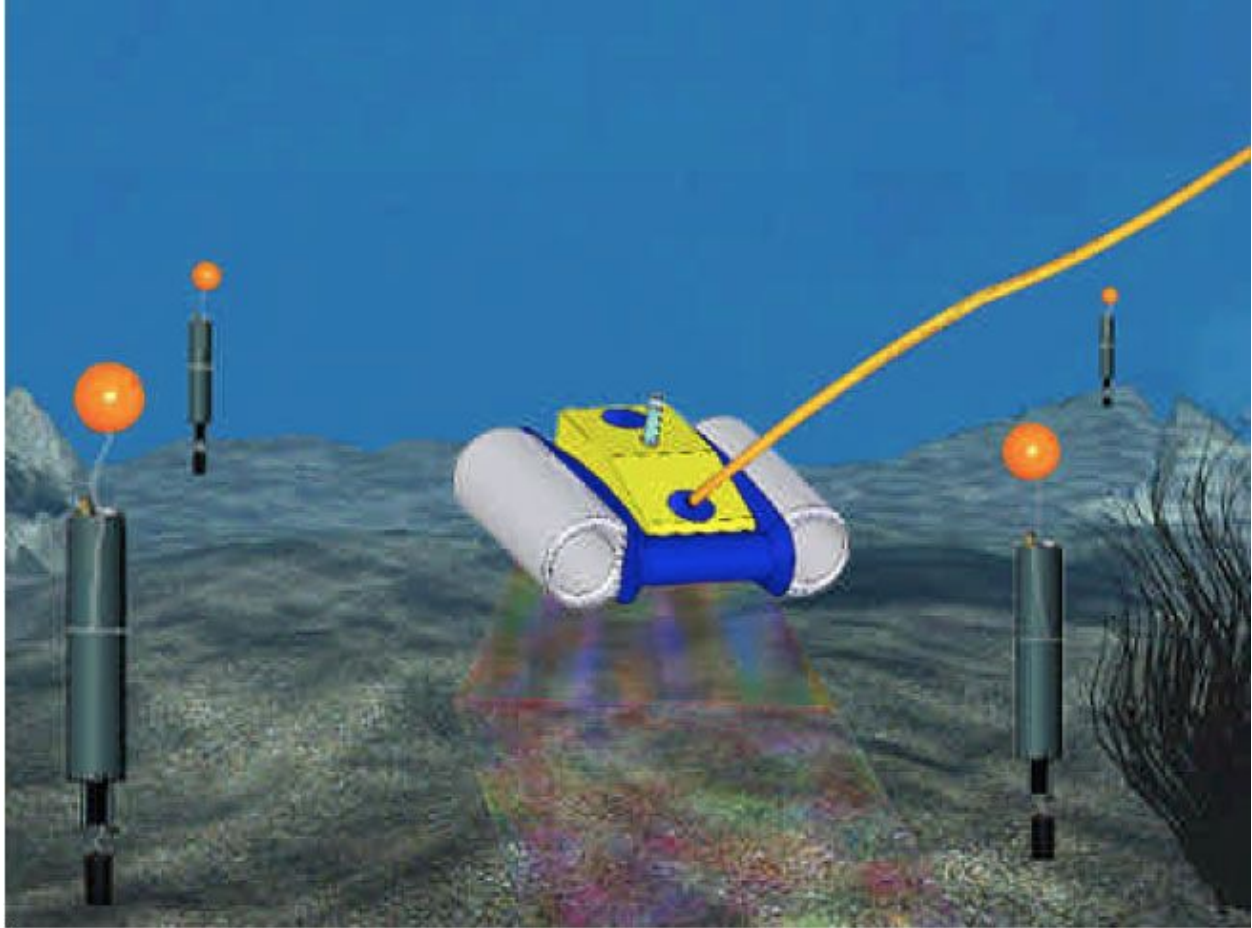


Figure 1: A Typical Survey site (TLT-3 on ROV)

Three or four baseline stations are mounted near the corners of a (rectangular) survey area. The transponder transmits a brief sonar 'ping' (or a sonar code), which travels to all baseline stations. Upon receipt of a ping, each baseline station transmits a reply. The reply pings travel back to the transponder. The transponder measures the time delay between the transmit of the interrogate ping and the receipt of the reply from each baseline station. This information is then sent through an umbilical cable to the surface.

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 large, as very long sonar paths will degrade performance. Best performance (0.15-meter accuracy) is achieved at ranges up to about 150 meters, though sub-meter accuracy is available to ranges of 500 meters and more.
- **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.

2. AquaMap™ System Components

AquaMap™ System Components

- Mobile Station: VLT or TLT
- 3-4 RBS-1 Baseline Stations

Baseline Station Components

- Trawl Float per station
- Connector Adapter per station
- MCU-5 (Charges 5 units at once, doubles as data cable)
- Dummy Plug per station for utility connector
- DiveBase SeaFloor software

Not Included in the AquaMap components, but required for use

- Windows PC running on Windows XP or newer with at least 256MB of RAM
- Additional mounting hardware

3. List of Operational Tasks

The five sections of the installation and operation process contain the following steps.

Installing

1. Charge the batteries if necessary

2. Install software
3. Mount the mobile station
4. Conduct noise test

Preparing

1. Charge the batteries

Deploying

1. Activate and deploy the mobile station
2. Mount baseline stations
3. Enter baseline positions in software
4. Check and enter visibility
5. Conduct a noise test

Operation

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

Reporting

1. Replay the survey record
2. Save images of the survey record
3. Create the report document

4. Installing the System

These tasks should be done when you first receive the AquaMap™ system. The first operation should be at an inactive test vessel in a quiet location – allow a day to install and learn how to use it.

Installation Tasks

1. Charge the batteries
2. Prepare the stations
3. Install software
4. Mount the Mobile station
5. Test the noise levels

Charge the Batteries

The Baseline Stations and VLT transponders are both equipped with rechargeable batteries. The TLT series transponders use replaceable 9v alkaline batteries.

Plug each station into the wall with the provided charging units, and turn them on (**they will not charge unless they are on**). The red LED light on the end of each station equipped with batteries should settle into a blink pattern of one second on and one second off. When it is done charging the pattern will change to one second on and three seconds off.

If the batteries were completely dead they should require about 3.5 hours to finish charging. If any other LED blink patterns occur please see the hardware manual (for the RBS-1) for the table of blink patterns that will tell you what it means.

Always try to charge the batteries a day or two before a mission. The nickel cadmium batteries in the baseline stations slowly discharge themselves over a period of 6 months, even if they're not being used. The batteries provide about 20 hours of continuous use.

Prepare the Stations

The stations should be operational after you have charged them. These are the tasks to complete before they're ready to put in the water.

1. **Check blink patterns:** Check that each station turns on and settles into the appropriate blink pattern of a single **short** blink once per second. If any other blink pattern occurs please see the blink pattern table below and/or the hardware manual for the RBS-1 transponder to troubleshoot it.
2. **Check dummy plugs:** Check to make sure that a dummy plug is plugged into each exposed waterproof connector on the stations. VLT series transponders require a dummy plug if the external connector is not being used during in water operations.
3. **Prepare mounting lines, anchors, and any floatation devices used.**

Blink Pattern	Station Status
One short blink per second	Ready to go, standby
Triple blink once per second	Hardware error
Double-blink	It received an interrogate or reply
One sec on, 1 sec off	Charge

One sec on, 3 sec off	Charge done
Rapid blink	Low battery
No blink	Station off or battery dead

Install the Software

The software should install itself when you insert the CD into the computer, if it doesn't do this you can click on the setup.exe file in the CD directory to initiate the auto-install program.

Mount the Mobile Station

The station must be placed properly. Keep the transducer away from ROV thrusters or other sources of noise. Ideally the transducer should be "free and clear", i.e. the near space around it should not have anything in it that will obstruct or reflect the sound waves used by the system.

For an ROV: hose clamps can be used to mount a VLT or TLT, or some other adhesive.

Test the Noise Levels

All ROV's emit noise and must be tested to be sure the noise is within acceptable levels for system operation.

1. Place the ROV into the water, start tracking and invoke the noise test feature. (Chapter 4)
2. Monitor noise levels as the ROV thrusters and other loads are activation.

Make sure the noise never exceed the maximum permissible amount of 120 dB. If it does, selectively switch all the ROV loads off until the noise level drops. Try moving the mounting position of the mobile station away from the noise generating device. If that also does not work, contact Desert Star of the ROV manufacturer for advice.



Figure 3: ROV with TLT-3 mounted toward the rear

DiveBase SeaFloor Display

The screenshot shows the DiveBase SeaFloor Display software interface. The window title is "DiveBase SeaFloor SBL - Oceaneo Demo.sbr". The main display area shows a sonar scan of the seafloor with a depth of 0.3 m. The X coordinate is -4.126 m and the Y coordinate is 2.326 m. A "Current Error Reading" of 0.47 meters is displayed at the bottom. The interface includes a toolbar on the left with tools like Pick tool, Translate tool, Zoom tool, View annotations, View Way Points, View Graticule, Add Annotation, Add Way Point, and Set Graticule. On the right, there are labels for "Last time since fix", "Trace", "Annotation", and "Target". At the bottom, there are labels for "Current Error Reading" and "Sonar Transducer".

Figure 4: DiveBase SeaFloor display

5. Deploying the System

Overview: This section explains how to mount the baseline stations in their correct places, tell the DiveBase software where they are. Following deployment of the baseline stations, activate and deploy the ROV letting it sink to the sea floor. Then activate the baseline stations to get the ROV's position. At this point you hit the button Calibrate Stations only if you have not hand entered their positions.

Deployment Tasks

1. Activate and deploy baseline stations
2. Calibrate baseline station positions in software
3. Check and enter visibility
4. Conduct a noise test

Good Station Mounting Is Key To Optimizing Performance

The sonar transducers of the baseline stations are the receivers of your mobile station. It is important that the stations are mounted stable. The quality of station location and mounting will directly affect the accuracy of AquaMap. We strongly urge you to read, and understand, the information in this section.

6. Further Setup

The positions of the surface station transducers are entered into DiveBase using the ***Register and Calibrates*** screen.

Important Note: The system only works in meters so any measurements in feet must first be converted to meters. **To convert feet to meters multiply the number of feet by 0.3048. Quick Conversion: 10 feet = 3 meters (approximately).** To convert meters back to feet (if you ever need to) multiply the number of meters by 3.2808.

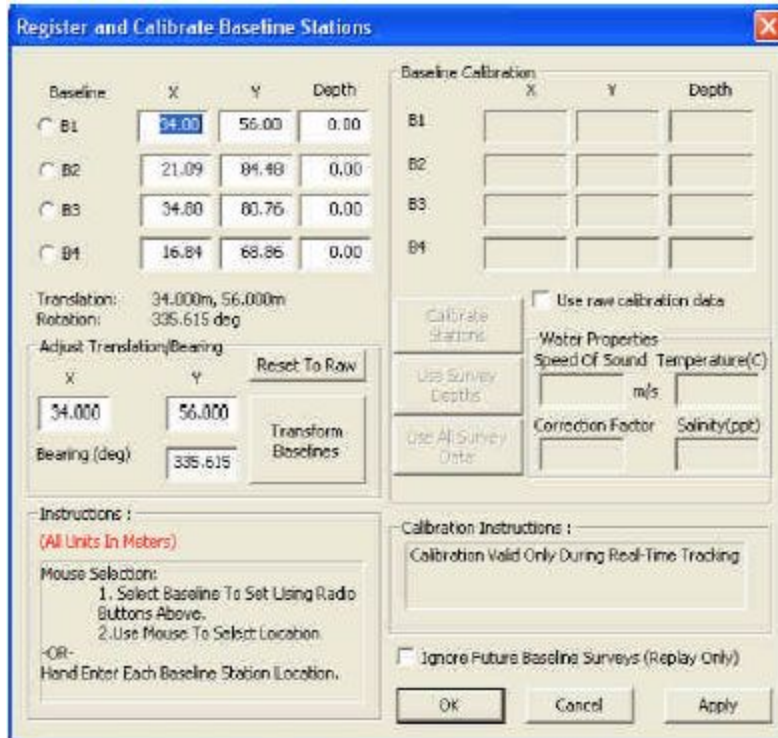


Figure 5: Register and Calibrate Screen

1. Start the DiveBase SeaFloor program.
2. Select **Register and Calibrate Baseline Stations** from the **Action** menu.
3. The window that pops up has places to enter all of the numbers, in meters. These numbers can be entered manually or you can the stations can do a self-survey. Entering the numbers manually is basic, you just plug in the numbers to the corresponding location (i.e. B1, B2, etc). If you do not enter manually then you simply click **Calibrate Stations** and the stations acquire their own positions relative to each other.

Check and Enter Visibility

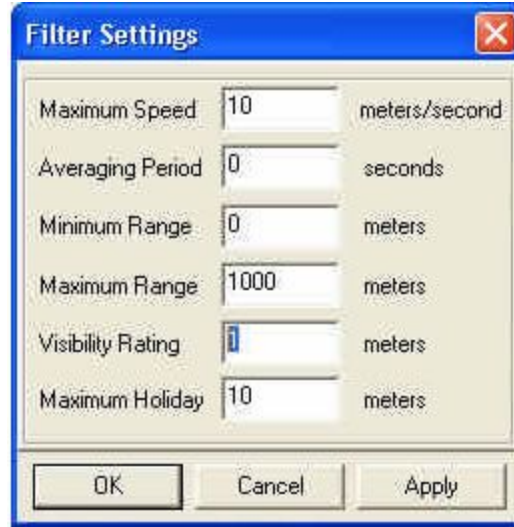


Figure 6: Entering Visibility

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.

Activate and Deploy the Mobile Station

1. Activate the mobile station. Make sure you get the 'ready' blink pattern (one second on and three seconds off).
2. Select **Start Real-Time Tracking** from the **Action** menu.
3. Wait for the timer to start advancing in the upper right corner of the screen. This means that DiveBase is recording position data. If communication to the mobile station is not available, an error message will appear after about ten seconds. Check all stations power levels to make sure they battery is not exhausted on them.
4. Make sure that the mobile station is in the ON position and ready for tracking
5. Check that the mobile station appears as a green square on the screen in the correct place, relative to the map of the ship.
6. Navigate around to make sure that the track is corresponding to where you are moving the ROV.

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.



Figure 7: The noise test display

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.

7. 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 8: 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.

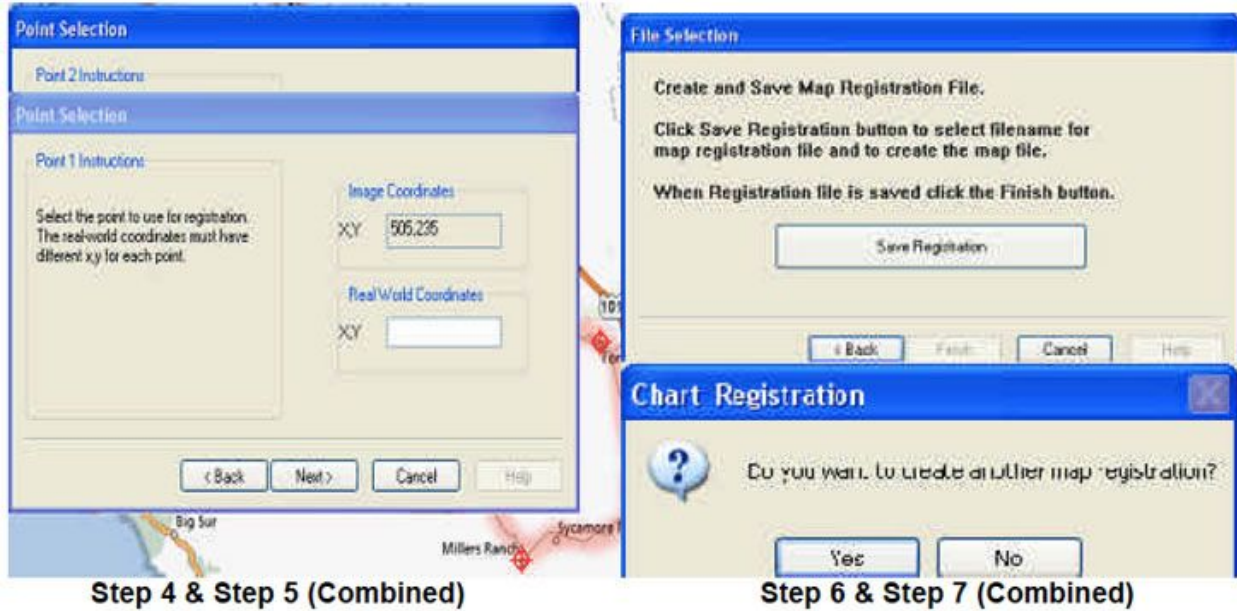
To register an image for use as a chart, you will be asked for two points to reference. So you will need the coordinates of two separate points. The better precision that you can achieve with these points, the better the overall accuracy will be. For example, if you use a hand-held GPS device to find 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.



Step 2



Step 3



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)
<u>File</u>		
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
<u>Action</u>		

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
<u>View</u>		
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 Visibility 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		



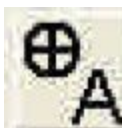

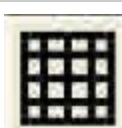
Keystrokes (Listed by Functional Group)	Function
<u>Deployment</u>	
T	Start Realtime Tracking
C	Launch Baseline Register/Calibration Dialog
CTRL+F	Launch Filter Dialog (where you enter Visibility)
N	Launch Noise Test Dialog (only active during realtime tracking)
Up Arrow	Pan Up
Down Arrow	Pan Down
Right 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
<u>Reporting</u>	
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
<u>Others</u>	
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

Button	Name	Description
	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>	
Problem	Reason/Solution
Acoustic noise	Move transducer away from thrusters or hydraulics

<p>Electrical noise (May be radio interference through the air/water or electrical interference through noise on-power supply lines)</p>	<p>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 transponder away from the ROV to locate radio interference, then mount in a location where radio interference is minimized.</p>
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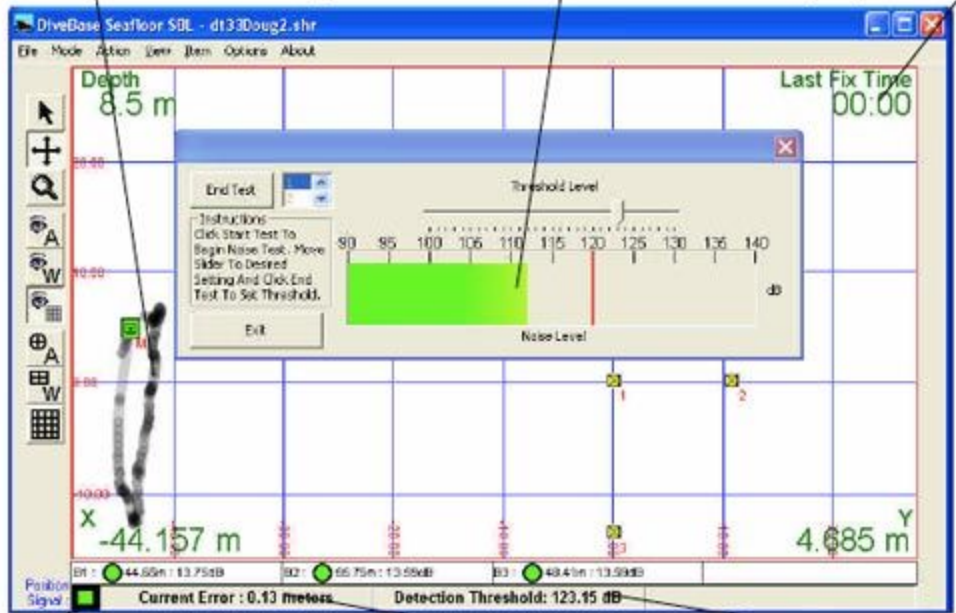
<u>System Status Indicators</u>	
Problem	Reason/Solution
<i>Baseline Range Indicator</i>	
Constantly Displays Red Circle	<ul style="list-style-type: none"> • Possible loss of power to baseline station. Check power switch on baseline station.
	<ul style="list-style-type: none"> • During side surveys the hull may block the opposite side baseline stations. This will cause them to report red, but the position signal should still report good positions.
	<ul style="list-style-type: none"> • 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.
<i>Position Indicator</i>	
Constantly Large Errors	<ul style="list-style-type: none"> • A persistently large error indicates that the baseline survey is incorrect.
	<ul style="list-style-type: none"> • If the number turns red, the system is not showing positions because the error exceeds the 'maximum error' defined in the filter settings.
Constantly Displays Red	<ul style="list-style-type: none"> • Communications problem. Cable has been disconnected on mobile station. Check cable connection to mobile station.

(Real-Time Only)	<ul style="list-style-type: none"> • Power loss. Mobile station has lost power. Check power connection (external power) or battery charge.
	<ul style="list-style-type: none"> • Transducer is out of range or in a shadowed area.
	<ul style="list-style-type: none"> • Transponder or Transducer has a dead battery.

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.