

AquaMap™ Diver



Operator's Manual

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Desert Star Systems, LLC

3261 Imjin Rd • Marina, CA 93933

(831) 384-8000 (831) 384-8062 FAX

www.desertstar.com

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1. Introduction

AquaMap™ Diver is a Long Baseline acoustic precision navigation and surveying system. In many ways it can be compared to a GPS system, but for use underwater. As with a modern GPS receiver, the DS-3 diver terminal shows the diver's current position and track on a map display. And while GPS receivers measure positions by evaluating the signals received from multiple satellites, AquaMap™ Diver relies on a network of three or four underwater baseline stations to perform a similar job. However, while GPS does not require the individual user to launch his own satellites before he can use his receiver, no one has deployed an equivalent network of underwater baseline stations around the globe. And for this reason, the diver needs to mount and then survey these stations before operations can proceed. This is shown in figure 1, where the diver operates within a network of three baseline stations (B, C, D) mounted near the corners of a survey site. The sonar transducer of the diver station (A) interrogates these baseline stations, and after receiving the replies, the diver terminal (E) computes distance to each baseline station and from that triangulates the diver position for display.

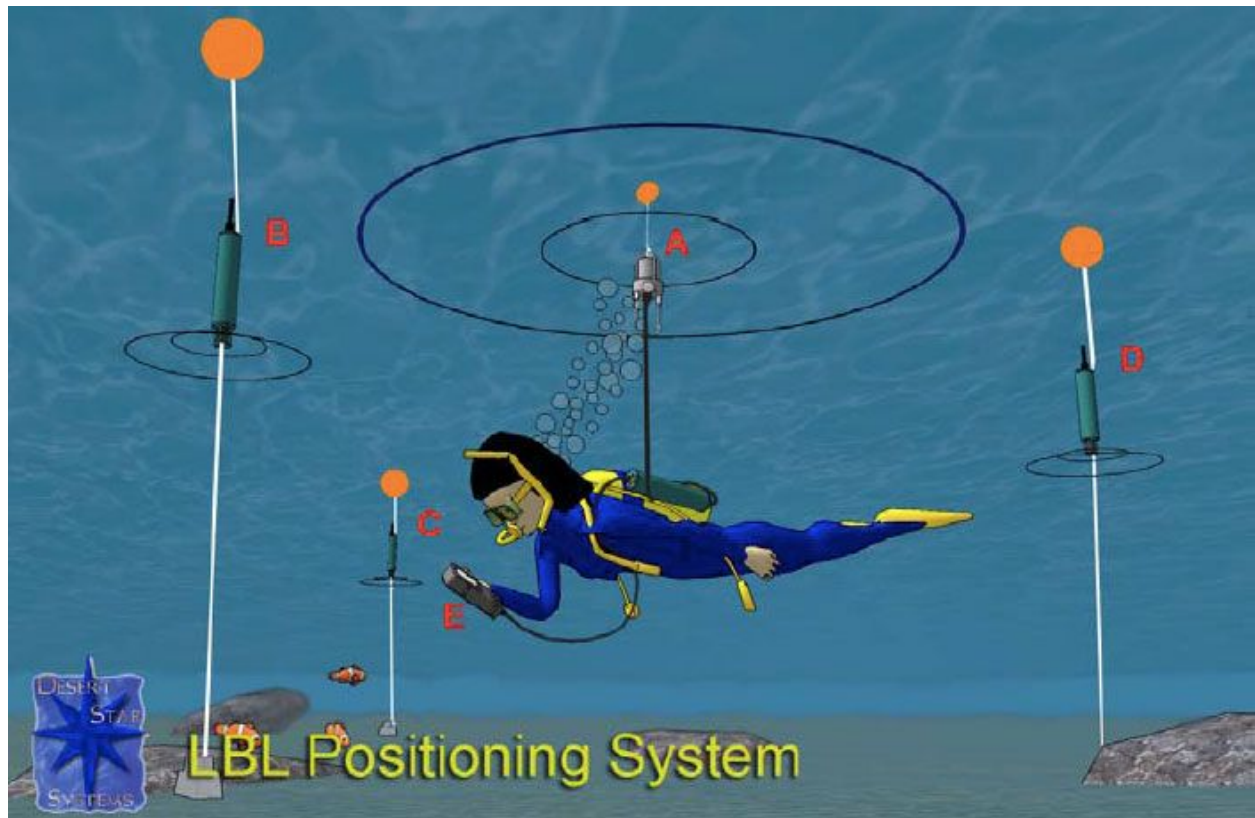


Figure 1: An AquaMap™ Diver system with three baseline stations

The Effective Range of the AquaMap™ Diver System

The lack of a pre-installed network of underwater baseline stations spanning the globe should come as no surprise; however: High frequency radio waves, which are the basis for GPS, do not propagate underwater. Therefore, AquaMap™ uses high frequency acoustic waves instead. And, while sound travels underwater much farther than does light or most radio waves, its reach is nonetheless limited. Standard AquaMap™ Diver systems operate in the frequency range of 34 kHz – 42 kHz, a range that both provides for conveniently small sonar transducers (the sonar transducers are the antennas of the system), and that allows distance measurements with a precision of just a few centimeters. Yet, at this frequency sound also gets absorbed by the salts in the sea water, which nicely warms the water but also limits the effective range to about 1000 meters. And it gets worse: The underwater realm is inhabited by all sorts of critters like the infamous snapping shrimp that snaps its tiny but powerful claw to create a vacuum bubble which upon collapsing onto itself creates temperatures of over a thousand degrees Celsius and a powerful shock wave that stuns its prey. Or humans with really, really fast speed boats that invariably like to drive in circles just above where you want to do your work underwater. And so, like a friend trying to talk to you in a noisy bar, AquaMap™ has to compete against all these sounds, and this limits range even further. For a high-power AquaMap™ system operating in the vicinity of snapping shrimp and humans with really, really fast speedboats noise limits the effective range to about 500m. For the regular power system it is 250m. (You can check if your system is high or regular power by looking on the station labels. High power systems use RBS-1H baseline stations and a VLT-1H diver transponder; while a regular power system will use the RBS-1 and VLT-1 models).

These 500m and 250m represent the upper limits that you should expect, and they often are available in deeper waters. But, there are other factors too. While ideally, sound would always travel in a straight line, in practice they rarely do. Old submarine skippers reading this will be well aware that water is often layered, and that sound will bounce off a layer of different temperature (thermocline) or salinity (halocline). And this is actually quite convenient, for it allows you to park your submarine in such a sonar shadow where the enemy can't detect it. But, it also means that a diver operating in a shadow will not get positions. And even when sound does not bounce off these layers, its path still gets slightly bent. So, eventually it will either hit the surface or the sea floor – and then may get absorbed or reflected away.

For this reason, it is a rule of thumb that effective range of the AquaMap™ Diver system is also limited by water depth. In practice, we have found that a reasonable limit (one that can be often reached) is 50x the water depth. So, if the water is only 2m deep, then you shouldn't operate more than 100m from any of the baseline stations. If you want to have your system operate very reliably, then limit the operating distance to 25x water depth.

But, keep in mind that acoustic conditions can be drastically different from site to site and just change over time too. Similar to conditions on land, where rain or fog or smog or mountains or buildings in your way can cut visibility from many kilometers to just a few meters in extreme cases, so can often unknown acoustic conditions have a strong detrimental impact.

Finally, the AquaMap™ operating range is limited by the settings in its configuration file (.PAR file). You can specify a larger number that yields more range but causes a slower position update rate, or a smaller number that limits range but also provides faster position updates. For example, an

AquaMap™ Diver system with three baseline stations will provide about one position update per second if limited to 100m range, but only one position every three seconds if limited to a 500m range.

Based on this discussion, we can therefore establish the rules of thumb for the maximum available range for AquaMap™ Diver:

Rules of Thumb for the

AquaMap™ Diver Operating Range

1. The maximum reliable operating range for AquaMap™ Diver in an elevated noise environment is 500m for the high-power version (VLT-1H and RBS-1H), and 250m for the regular power version (VLT-1 and RBS-1).
2. Operating range is limited to about 50x water depth under typical conditions. Assume a maximum of 25x water depth for more reliable operation.
3. Operating range is also site specific, and will vary significantly from site to site and over time depending on acoustic conditions. Evaluate your work sites through testing, and establish your own upper limits.
4. Operating range is limited by the configuration file (.PAR file) installed in your system. If the .PAR file allows a greater maximum range, then position updates will be slower. They will be faster at a smaller maximum range.

Observation Recording with AquaMap™ Diver

One of the principal applications of the AquaMap™ Diver system is sea floor mapping or surveying. That means, associating observations with precise positions. For example, in an archeological survey, a diver or dive team might search the sea floor and record the locations of the various pieces of wreckage encountered. This information can then be used to draw a map of the site, or to return on a later dive to one specific piece of wreckage for further examination.

The DS-3 diver terminal supports such electronic observation recording. Figure 2 illustrates the method. On the left, we see the diver navigation screen. The diver here is currently at (A), with the position coordinates indicated by (F). He has selected waypoint wp4 at location (B) as his next target. The range and bearing to wp4 is stated in (C). But, also seen are three small green diamond symbols near (D). These are observation recordings taken by the diver while passing those locations (blue diver track).

The diver initiates an observation by hitting the 'Observe' key (button #5, it is the single button below the row of four buttons). At that moment, the observation screen as seen in figure 2 on the right pops up. The current position, depth and estimated position error of the location is automatically recorded. The diver can now add an observation classifier from a programmable list. In this demo it is shown as 'Hello', but would typically be the type of wreckage, sea floor composition or animal encountered,

as applicable. The diver can also record an associated number, such as perhaps the size of a piece of wreckage.

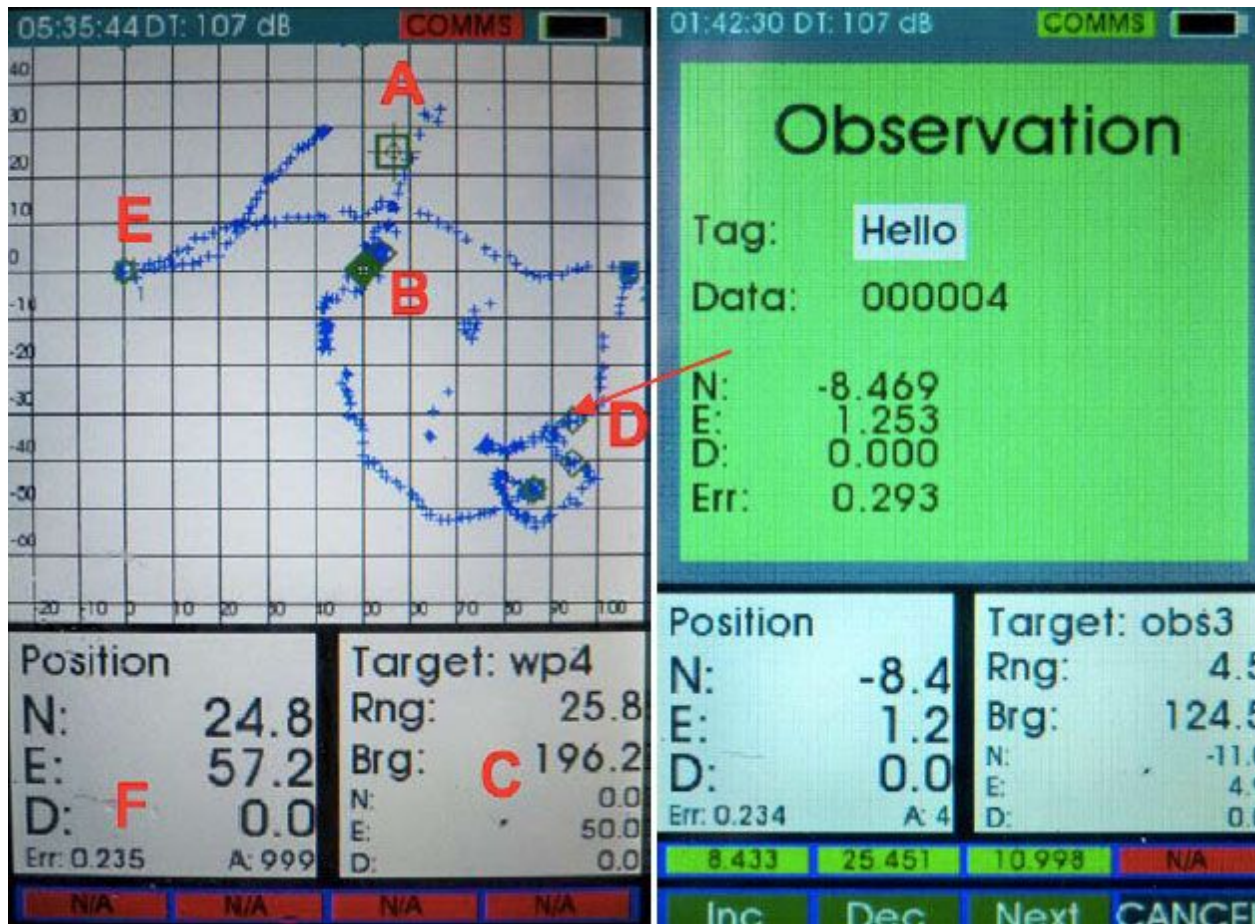


Figure 2: Electronic Position Recording with the DS-3 diver terminal

Following the dive, the observation records can be downloaded from the diver station to a PC.

2. AquaMap™ Diver System Components

Principal Components of the AquaMap™ Diver 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 diver hand held unit (DS-3), and the VLT-1 are paired together to display the positioning and navigation data to the diver. The transponder receives the position data from the baseline stations and feeds that information into the DS-3, which processes the data and outputs its relative location on the screen for the diver to use for navigational purposes.
- Additional components include a MCU-5 charger and various cables and connectors for charging and configuring the various stations.

AquaMap™ Diver System Components

- Mobile Station: VLT-1
- Diver Station: DS-3
- 3-4 RBS-1 Baseline Stations

Baseline Station Components

- Connector Adapter per station
- MCU-5 (Charges 5 stations at once, doubles as data cable)
- Dummy Plug per station for utility connector



Figure 2: AquaMap System Components

3. List of Operational Tasks

Sections of the installation and operation process contain the following steps.

1. Installing
 - Charge the batteries
 - Install software
 - Mount the mobile station
 - Conduct noise test
2. Deploying
 - Mount baseline stations
 - Enter baseline positions in software
 - Activate and deploy mobile station

- Baseline station input in DS_TERM
- 3. Operation
 - Start operation
 - Adjust the display
 - Record annotations
 - Retrieve the system
- 4. Reporting
 - Replay the survey record
 - Save images of the survey record
 - Create the report document

3.1 Getting Started

These tasks should be done when you first receive the AquaMap™ Diver system. The first operation should be in a quiet location like a dock, lake or pond – allow a day to become familiar with operational procedures.

Installation Tasks

- Charge the batteries
- Install Software
- Mount the Mobile station
- Conduct Noise Test

Charge the Batteries

The RBS-1, VLT-1, and DS-3 are all equipped with rechargeable batteries.

For the RBS-1 and VLT-1, plug each station into the MCU-5 and turn them on (**they will not charge unless they are on**). After the software on these stations has finished loading, the red LED light on the end of each station will begin a blink pattern of one second on and one second off. When it is done charging, the blink pattern will change to one second on and **three** seconds off. **Note:** If the batteries were completely dead they should require about 3.5 hours for a full charge. If any other LED blink patterns occur please see the RBS-1 Hardware Technical Manual for a table of blink patterns that will illustrate a cause for variation. If a hardware problem is detected via LED blink pattern, **DO NOT** attempt to troubleshoot. Please contact Desert Star Systems for return authorization or replacement. The DS-3 charge procedure is slightly different from the RBS-1 and VLT-1, but just as simple.

Connect the DS-3 to the MCU-5 and turn on the station with the magnet swipe.

For the first five minutes of power being applied to the DS-3, it will begin stabilizing the temperature of the batteries for charging. The charge display will read Stabilize. The process typically takes 5 minutes but could take up to 1 hour if the DS-3 is transitioning between hot and cold environments or

the station is hot from previous use. To speed up temperature stabilization, charge the DS-3 in a temperature controlled environment. Once charging begins, a dialog window will appear with relevant temperature and power deposits in mA. Fast charging will terminate as soon as a temperature limit has been reached. A message will indicate fast charging is Done in the dialog box. From that point on, trickle charging will take place. Fast charging will in general yield about five hours of operation, and is in particular useful to give the station 'a quick jolt' during a surface interval. For a guaranteed battery top-off, just leave it connected for twelve hours. The battery will then last for a dive of up to ten hours.

Always try to charge the batteries a day or two before a mission. The nickel cadmium batteries in the stations slowly discharge themselves over a period of 6 months, even if they're not being used. Note: As with all new rechargeable batteries, full battery capacity may be a bit lower for the first few charge cycles. Expect longer battery life after it has cycled several times.

Prepare the RBS-1 Stations

The RBS-1 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 |

Table 1: Blink Pattern Meanings

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. For the DS_Term software, you must first install .net framework. Open the CD under My Computer and double click on **donetfx35**.

Mount the Mobile Station Diver station mounting can be accomplished in many different ways, and should consider ease of use and practicality in your dive environment and under your dive conditions, along with optimization for acoustic considerations. From the acoustic positioning perspective, the main consideration is the placement of the cabled sonar transducer, this being the antenna of the system that both receives and transmits the acoustic signals. When deciding on your mounting technique, consider the following:

- The sonar transducer placement should minimize obstructions of the line of sight between it and the four baseline stations. Such obstructions will shield the acoustic signals. The main obstruction is the diver's body, and thus keeping the transducer some distance away from the diver is a good idea. This could be in front of the diver, below the diver or above the diver.
- The sonar transducer should stay out of the bubble stream of a SCUBA regulator because the air bubbles will shield acoustic signals.
- The sonar transducer should stay some distance away from the SCUBA regulators to minimize interference of the high-frequency (hissing) noise sometimes associated with breathing through the regulator.
- For precise measurements, the sonar transducer should be mounted such that it can remain motionless at points to be measured.



Figure 1: A diver using the DS-3 to navigate underwater. Shown in the picture is the DS-3 (on top).

The VLT-1 is hard mounted to the bottom with it's transducer on top (in front of the DS-3).

One technique, variations of which have proven successful, is shown in Figure 1. Here, the DS-3 station is mounted on a plastic kick board, with the sonar transducer installed on the front edge of the kick board. The VLT-1 acoustic transponder is mounted on the underside of the kick board (not visible here), where it works as a keel, keeping the board upright. A compass is attached to the kick board as well.

As the diver swims with the board in front, the sonar transducer is at least some distance away from the diver's body and its shielding effect. It is also apart in particular from the SCUBA regulator first stage, which is sometimes a source of noise, and well away from the bubble stream. The kick board tends to keep the diver's body aligned, making it easier to swim straight lines. The sonar transducer is visible to the diver and can be placed precisely at any desired spot. The sonar transducer is also not floating on a long cable, thus making its position more certain.

Ultimately, diver mounting will be specific to your job. Use this as a starting point, but experiment for best results.

Note: At this point, discussions will include usage of the DS-3 Diver Navigation Terminal. All functions of the DS-3 can be accessed by using the buttons on the keypad, short of turning the terminal on, which requires a separate magnet as illustrated in the DS-3 Hardware Technical Reference manual. Most of the DS-3 interfaces are user intuitive and require little explanation. In the event that a button number is called out for menu navigation, its corresponding number will be addressed as it relates to **Figure 3** below.



Figure 3: Keypad

For example, **Button 1** would be the top left button (see **Figure 3**) and **Button 4** would be the top right button. Please familiarize yourself with the button layout.

Conduct a Noise Test

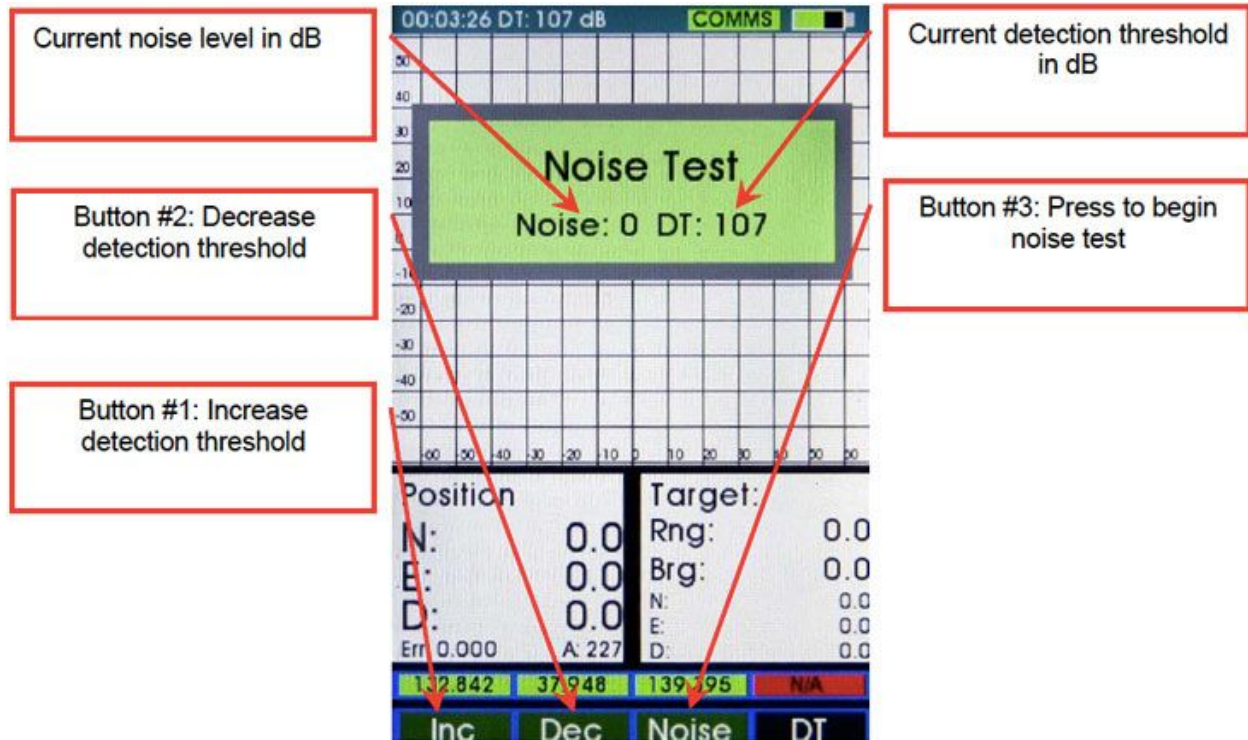


Figure 4: DS-3 Noise Test Menu

With the DS-3 powered on, the Noise Test Menu is accessed by pressing button 4 twice from the first (NAV) menu. It serves two purposes: to measure the ambient acoustic noise in the surrounding environment, and to adjust the detection threshold of the mobile station.

Pressing button 3 will engage the noise test. A dialog window will appear as shown in **Figure 4**, and display the ambient acoustic noise as well as the detection threshold (**DT**).

If noise levels approach the decibel level represented in the detection threshold, then the detection threshold will need to be increased using button 1. **Note:** If the detection threshold is increased, the mobile station will become less sensitive to reports from the baseline stations. If it is necessary to work in an environment with a lot of ambient noise and the detection threshold is increased to reduce positioning errors caused by ambient noise interference, move the baseline stations closer together to avoid signal loss. Desert Star Systems also offers high power versions of the baseline station (RBS-1H) and diver transponder (VLT-1H) for this purpose. Please contact Desert Star Systems for more details.

If noise levels are well below the detection threshold, then the detection threshold can be decreased using button 2. This will make the mobile station more sensitive to baseline station reports and is useful if you experience loss of baseline station signal, as indicated by the baseline station distance fields at the bottom of the display sometimes going red (N/A).

Press button 3 again to end the noise test

3.2 Deploying

Overview: This section explains how to mount the baseline stations (RBS-1) in their correct places, and program the DS-3 diver terminal with their positions with either a baseline station survey or manual position input with DS_TERM software.

1. Deploying

- Mount baseline stations
- Activate and deploy the mobile station
- Conduct baseline survey
- Baseline station input in DS_TERM

Mount Baseline Stations The baseline stations (RBS-1) need to be turned on, and the **ON/OFF** knob turned an additional 90° after the LED blink pattern enters Standby mode as outlined in Table 1. This 90° additional turn will ensure that the baseline station powers down prior to depletion of the internal batteries.

The baseline stations should be set up at four corners of a rectangle area that is to be surveyed. If an auto baseline survey is to be conducted the placement of the baseline stations must be exactly to the specifications outlined in **section: Conduct baseline survey**. If the operator wishes to manually enter the baseline positions, this process is discussed in **section: baseline station input in DS_Term**, to which a specific arrangement of baseline stations is not required.

Things to Keep in Mind

AquaMap™ Diver 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 diver's transponder. 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 75-150 meters spacing, though sub-meter accuracy is available throughout the systems capabilities.

- 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 and weight to increase the tension on the station's anchor line.

Activate and Deploy Mobile Stations

Following deployment of the baseline stations, first, power on the DS-3 with magnet lanyard as illustrated in the DS-3 Hardware Technical Manual. Second, turn on the VLT-1 mobile station, and allow the cabled transducer to enter the water. **Note:** It is important that the DS-3 be turned on first, as it will send a break command to the VLT-1 if it is on first, causing it to malfunction and require a power cycle. Once the VLT-1 status LED has entered **Standby** mode as outlined in **Table 1**, turn the **ON/OFF** knob an additional 90° to ensure the station powers off before the internal battery is depleted.

Conduct a Baseline Survey

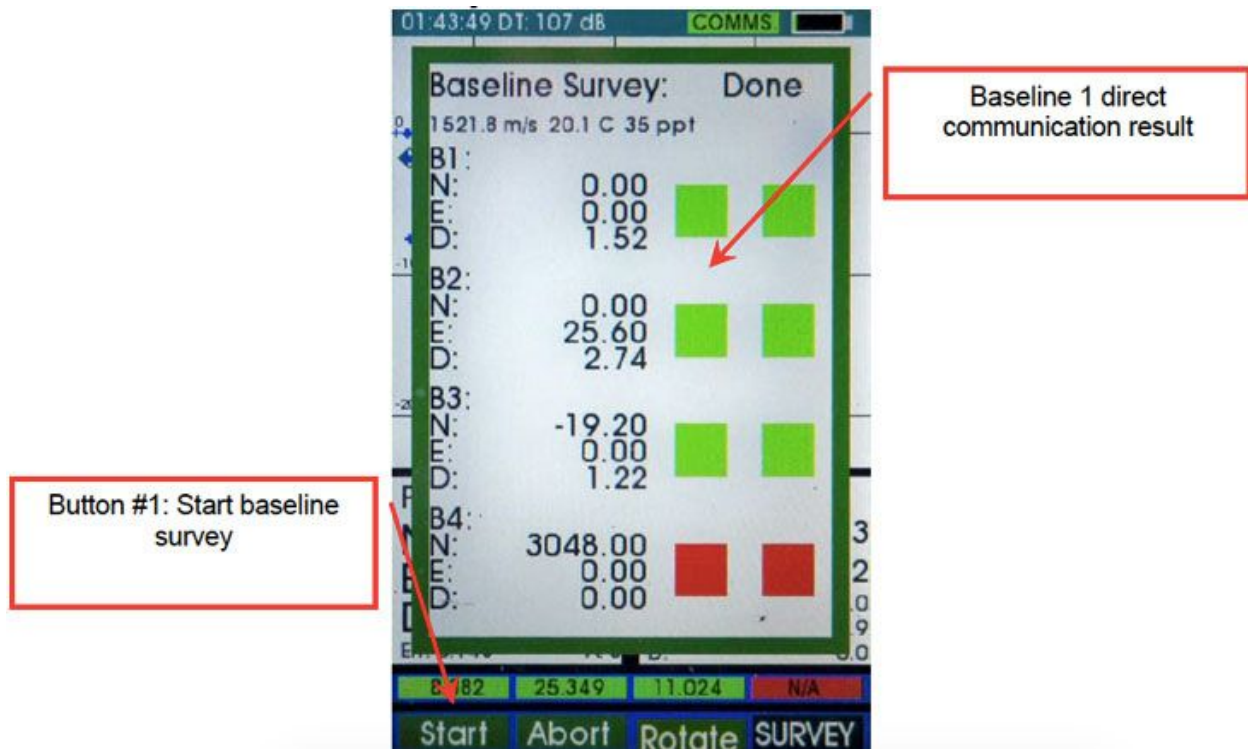


Figure 5: Baseline Survey Menu

With the DS-3 powered on, the Baseline Survey Menu is accessed by pressing button 4 three times from the NAV menu. It provides two options, start the baseline station survey with button 1, and

abort with button 2. When the start button is activated, a baseline survey screen will pop up with relevant information for the survey. The location data of the individual baseline stations are displayed as well as two boxes which represent direct and round trip links from the DS-3 to the baseline stations. The direct link is identified by the left box and round trip link is identified by the right box.

Before beginning an automatic baseline survey, it is critical that the baseline stations be placed in a proper configuration for the resulting geometry, following the baseline survey, to be accurate. When a viewer is at baseline station 1, baseline station 2 will be north, baseline station 3 will be to the right(northeast), and baseline station 4 to the left(northwest).

If the stations were not placed so that the direction from station 1 to station 2 is not North, pressing button 3 will provide an additional menu for rotating the angle of the entire array, so that Northing and Easting data will be accurate from then on.

The survey can last from 1 to 6 minutes depending on the quality of communication between stations. It is very important that neither the diver station nor of course the baseline stations move during the survey, or else measurement errors are incurred. After the survey has completed, a green box reports a good link and red reports bad. If a bad result is reported on a direct link between the DS-3 and a baseline station, then there may be an obstacle between the diver and that station. If a round trip link fails between a baseline station and the DS-3, then there is an obstacle between that station and one of the other stations.

Baseline Station Input in DS Term

The baseline stations menu is used to manually enter baseline station positions into DS-3 memory, as compared to acquiring the baseline station positions with a baseline survey as illustrated in Section 4.5.

This may be done for several reasons:

- Baseline station positions may have been independently determined, such as with a differential GPS system.
- For repeat surveys in an area, where the baseline stations are always mounted in the same, previously surveyed locations (often marked by physical monuments).
- When operating in UTM or other coordinates and baseline positions have been converted to that coordinate system by external means.
- When operating an AquaMap™ system with multiple diver stations and a surface station. In this case, the baseline survey is done by the surface station and the results are transferred to the diver station.

Enter the appropriate position data into the correspondingly labeled box for each baseline station. To commit the baseline station positions to DS-3 memory, press the “configure” button. Caution: configuring baseline positions to DS-3 memory through this method will also send target list data to the DS-3. If the list is blank, the target data on the DS-3 will be erased permanently.

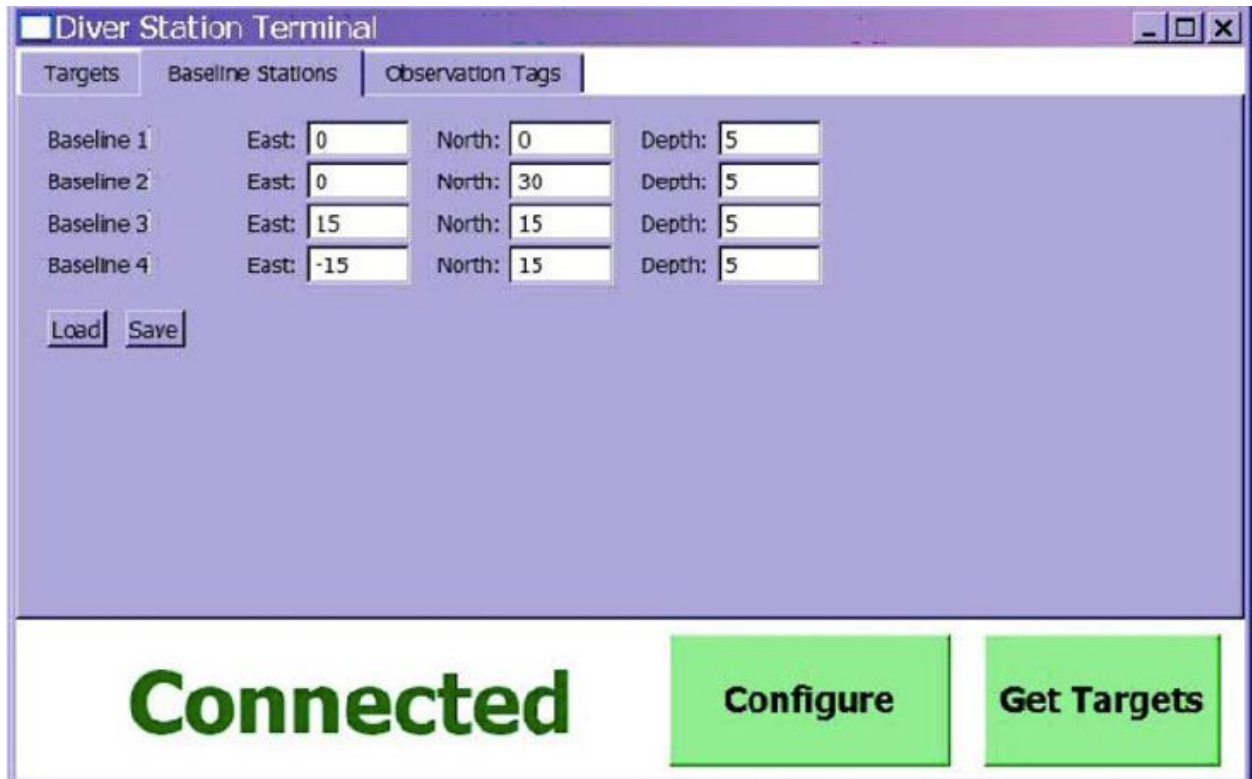


Figure 6: Baseline Station Menu

If a baseline station was configured to DS-3 memory in error, simply edit its location information in the baseline stations menu and press the “Configure” button again to correct it.

If the operator would like to save baseline station location data into PC memory for future reference or to configure to the DS-3 later, press the “Save” button and select a name and location to save the data. To recall the saved file, press “Load” and select that file.

3.3 Operation

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

1. Deploying
 - Start tracking
 - Adjust the display
 - Record observations and annotations
 - Retrieve Observations

Start Tracking

Once you have completed the baseline station survey, you are ready to begin tracking. There is no additional step to follow and as soon as the VLT-1 and sonar transducer are submerged you should begin to see positions updating on the DS-3 display.

Adjust the Display

Once tracking has begun, the display can be adjusted as needed. The available tasks from the NAV screen are: zooming in, zooming out, and centering on the diver's position. Button 5 add an observation marker.

“Zooming In” brings the screen closer to what is being displayed on the center of the display. Therefore if you want to zoom in on yourself, the diver, then you would press Button #3 Center, then press Button #1 In until it is zoomed in on your position. “Zooming Out” does the exact opposite.

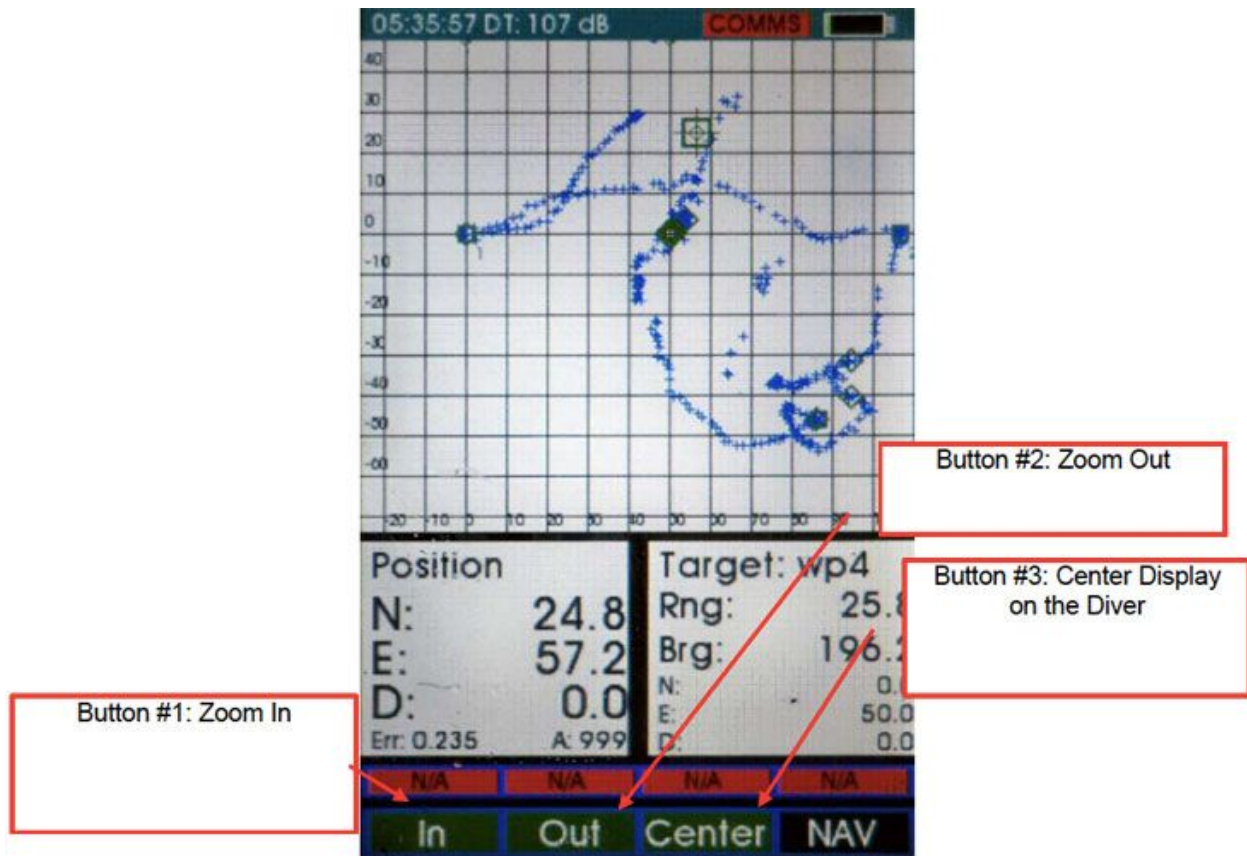


Figure 7: DS-3's NAV Display

Record Observations and Annotations

The Observation Menu is accessed at any time by pressing button 5. If pressed by mistake, the only way to avoid entering an observation point into memory is to cancel the action with button 4. If button

5 is pressed a second time, then the Observation Menu will close and the current location will appear as a target on the grid.

The function of the Observation Menu is to set markers on the survey grid so that they can be revisited at a later time or to annotate. A number can be assigned to the observation, as well as a tag name selected from a pre-defined list of for example species in a benthic survey (tag assignment covered in **Section 5.3 of the DS-3 Technical Reference Manual**). To adjust the Data number, press buttons 1 and 2 to increment and decrement the selected number in either direction. Press button 3 to move the adjustment field left one position. When a tag name is saved into memory, pressing button 3 will also move the selection field to the tag line for adjustment. Press buttons 1 and 2 to navigate through saved tag names.

Once the operator is satisfied with the description of the observation, button 5 is pressed again to exit out of the observation menu. Press button 4 to cancel the observation point if it was entered in error.

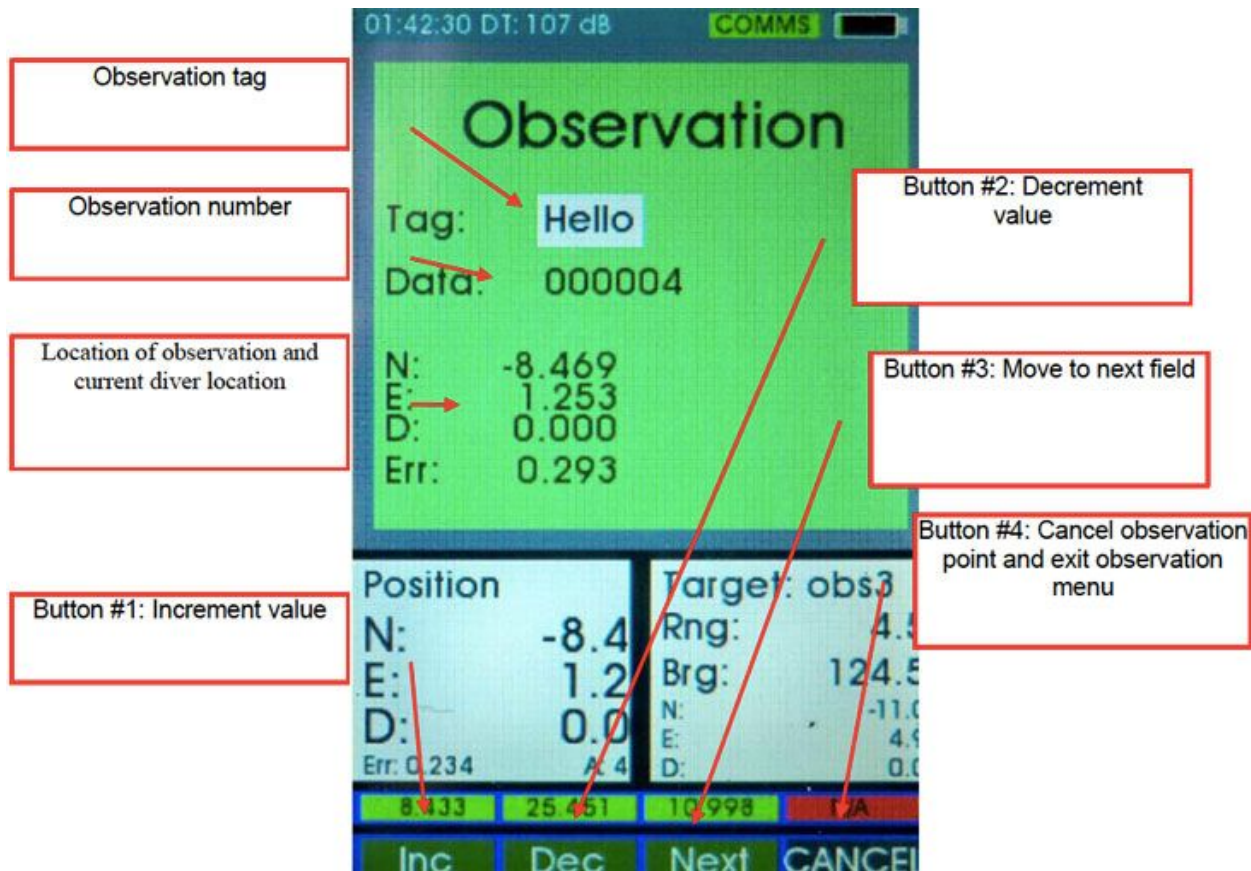


Figure 8: DS-3's Observation Display

Retrieve Observations

After you have completed the dive and have made observations/annotations you can download the observation data to the computer through DS_Term. First connect the DS-3 to the MCU-5 on the COM port connection making sure the DS-3 is on. Then open up DS_Term. Once connected through DS_Term, make sure the **Targets** tab is selected. Click on the **Get Targets** button in the bottom right corner (highlighted green). Note: Do not select the **Configure** button as it will erase all of the data on the DS-3. After you have retrieved all of the observations, you should save the data to the computer; click on the **Save** button. To erase the observations from the DS-3, first click on the **Clear** button. Once the screen has been cleared, click on **Configure** button then reset the DS-3.

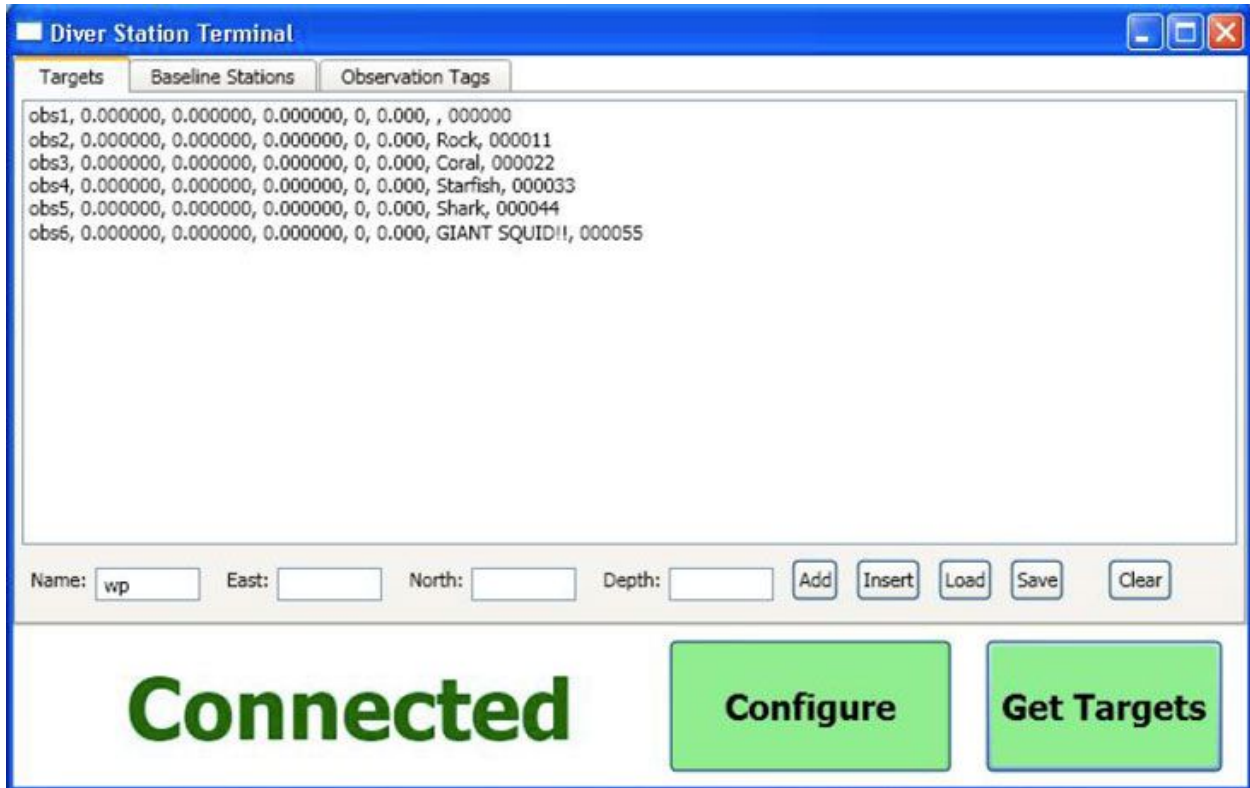


Figure 9: DS_Term Targets Screen

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, diver's regulators, diver's air bubbles, etc... The best way to locate controllable noise is to

use the noise test feature on the DS-3 to monitor noise levels as you swim away from possible sources of noise.

The Noise Test Menu is accessed by pressing button 4 twice from the NAV menu. It serves two purposes: to measure the ambient acoustic noise in the surrounding environment, and to adjust the detection threshold of the mobile station.

Pressing button 3 will engage the noise test. A dialog window will appear as shown in **Figure 9**, and display the ambient acoustic noise as well as the detection threshold (**DT**).

If noise levels approach the decibel level represented in the detection threshold, then the detection threshold will need to be increased using button 1. **Note:** If the detection threshold is increased, the mobile station will become less sensitive to reports from the baseline stations. If it is necessary to work in an environment with a lot of ambient noise and the detection threshold is increased to reduce positioning errors caused by ambient noise interference, move the baseline stations closer together to avoid signal loss. Desert Star Systems also offers high power versions of the baseline station (RBS-1H) and diver transponder (VLT-1H) for this purpose. Please contact Desert Star Systems for more details.

If noise levels are well below the detection threshold, then the detection threshold can be decreased using button 2. This will make the mobile station more sensitive to baseline station reports and is useful if you experience loss of baseline station signal, as indicated by the baseline station distance fields at the bottom of the display sometimes going red (N/A).

Press button 3 again to end the noise test, or press button 4 to move to the next menu.

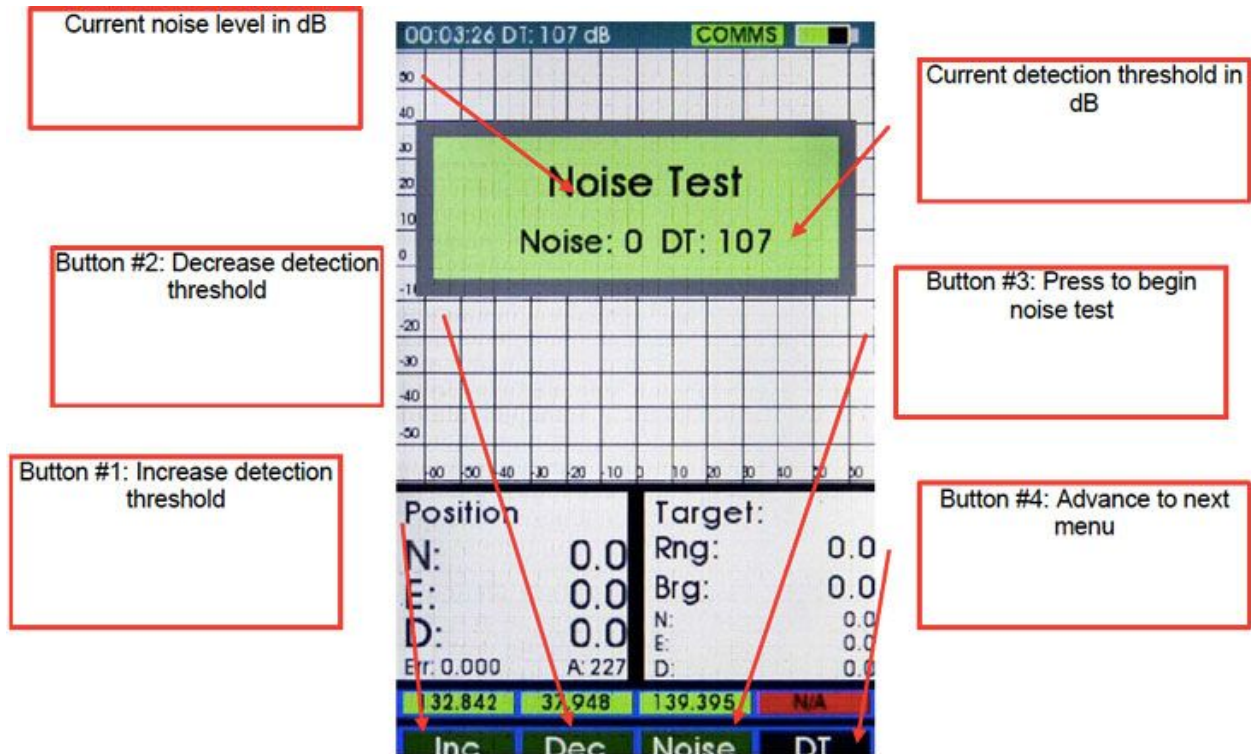


Figure 10: DS-3's Noise Test Display

Appendix E: Messaging Using Surface Station

The DS-3 station can send and receive messages from the surface. This feature requires additional hardware: STM surface station with a single sonar transducer. This feature also requires additional software, DiveBase Level 2. The deployment and operation of the software can be found in the DiveBase Level 2 Operator's Manual. This section will be used to explain and demonstrate messaging on the DS-3 only.

It is very important that the message list that is downloaded to the STM-3 (in the .par file) is also downloaded to the DS-3. If the exact same list is not downloaded to each station (DS-3/STM) then the messaging capability will not work.

The message list is defined in DiveBase Level 2 by going to File → Edit a Configuration File → Simple Edit. After you're in the simple edit configuration menu click next until you're on the third configuration screen. At the bottom of this screen you will see a button that says "Edit Pre-defined Messages". Clicking this button will bring up the message list and allow you to define your own messages. Be sure to only edit the .par file that you have downloaded to the RBS-1 and VLT-1

stations (they do not need the correct message list). The .par file you edit should match the file that is on all of the active hardware.

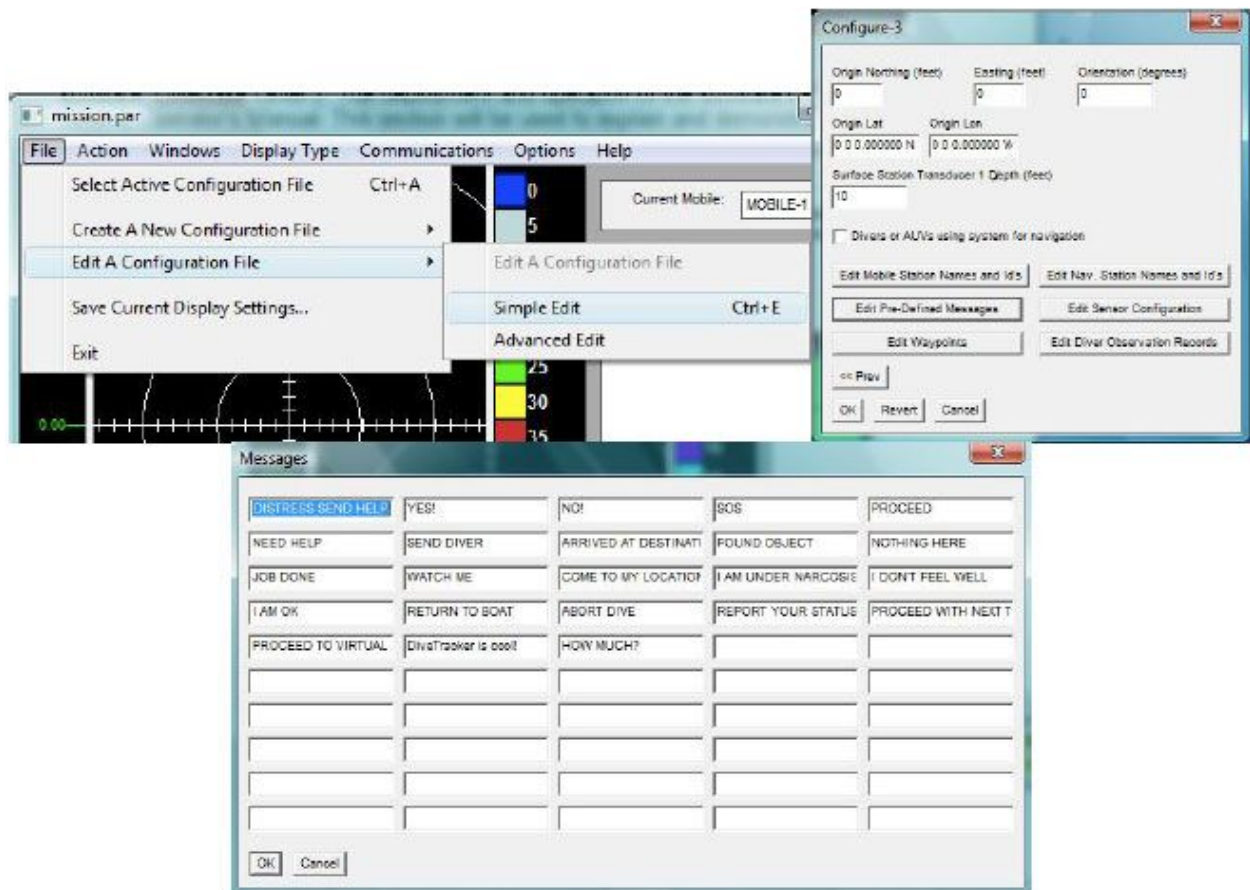


Figure 10: Setting up a message list in DiveBase Level 2

After the message list is defined in DiveBase Level 2 you're ready to load it onto the diver station using DS_Term as shown in figure 11. You will need to know where you saved the ".par" configuration file you made using DiveBase Level 2 to do this. Click the load button in DS_Term under the messages tab and select the ".par" file you made using DiveBase Level 2. If your DS-3 is connected to the computer then you should see the Configure button become active. Click this button and your message list will be downloaded onto the DS-3.

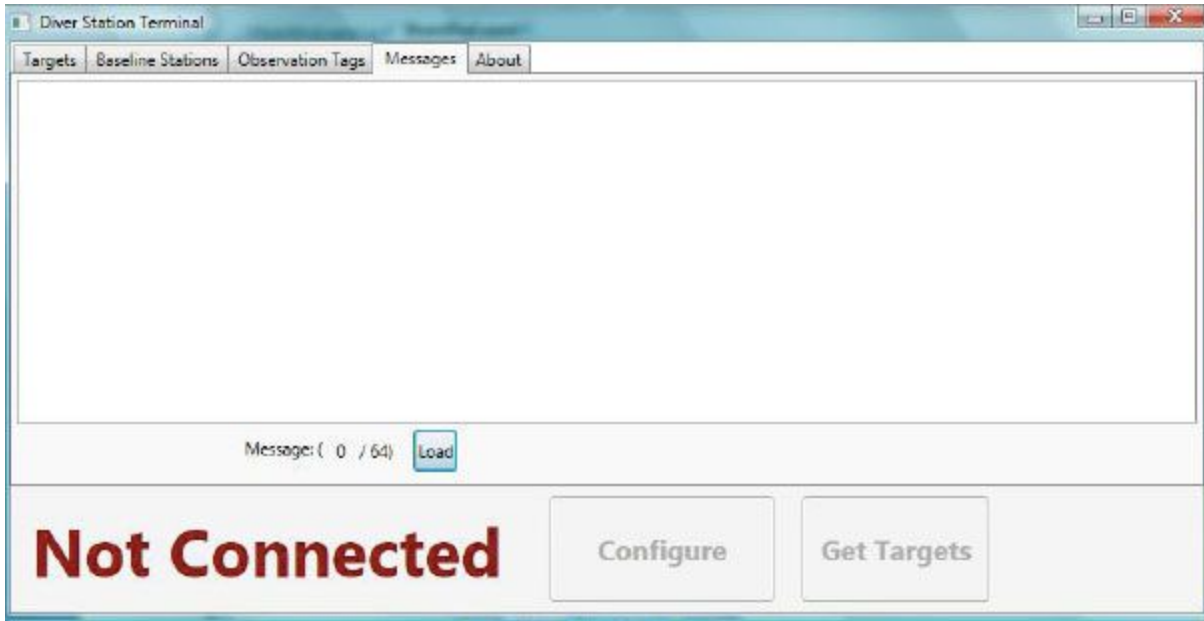


Figure 11: Downloading a message list to the diver station using DS_Term.

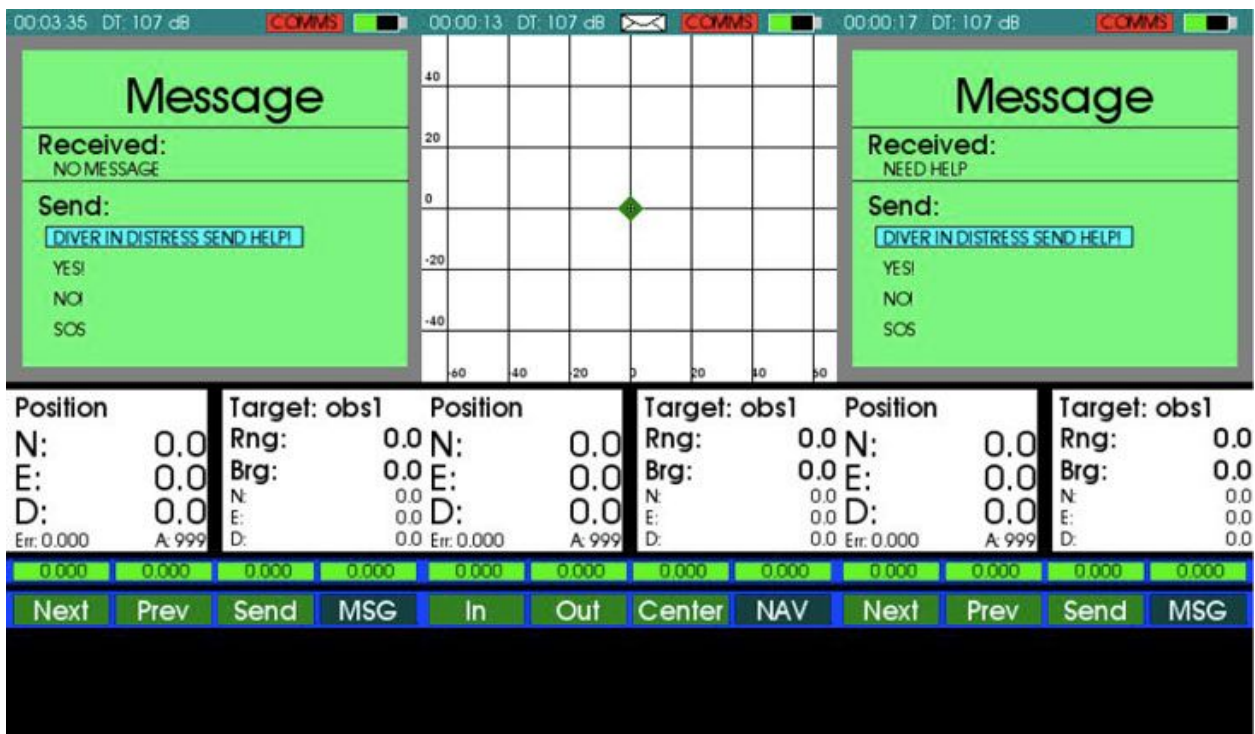


Figure 12: DS-3's Message Display

The first image on the left of the screen is the Message screen, which is brought up by using Button 4. In the first image, the diver can send a message to the surface by scrolling through the list of

preprogrammed (user defined) message. Once a message is chosen, the Send Button sends the message to the surface and DiveBase Level 2 receives the message.

The second image (in the middle) is the Navigation screen. This is the main screen that a diver uses when navigating underwater. When the operator at the surface sends a message, all of the divers in the water will see an envelope at the top of their display. To read the message, the diver must navigate to the MSG window (using Button 4). Once in the MSG menu, the message automatically populates. **NOTE:** Any previous message that was not read will be automatically erased once a new message is received from the surface. The DS-3 does not store messages.

The third image (on the right) is the screen that is displayed once a received message is read. The diver can read the message and dismiss it without replying (select Button 4 until NAV display) or the diver can reply by selecting a message from the list and pressing Button 3.

Note: For DiveBase Level 2 operation and messaging please refer to the DiveBase Level 2 manual.