GENERAL DYNAMICS
Mission Systems

Bluefin SandShark™
Operations Manual

BLUEFIN ROBOTICS

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Trademarks

Notices

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PREFACE

Welcome to the Operations Manual for the Bluefin SandShark™ AUV. This document is intended to familiarize you with the system and provide you with the information necessary to carry out autonomous underwater vehicle (AUV) operations.

To prevent loss or damage to the AUV, General Dynamics Mission Systems has included many safety recommendations in this manual that should be followed carefully and should not be changed. These recommendations are highlighted with leading text indicating *Warning*, *Caution*, and *Note*.

This guide contains references to checklists and other manuals in the documentation set. This includes manuals for open-source software and commercial off-the-shelf (COTS) manuals. Please ensure that you have a full documentation set available before you begin any AUV maintenance, as descriptions of all of the tasks performed in a given procedure may not be covered in this guide. Contact General Dynamics Mission Systems if you need extra copies of any manual in this documentation set.

List of Reference Documents

This section lists the manuals General Dynamics Mission Systems provides for the AUV system. General Dynamics Mission Systems recommends that operators, supervisors, and technicians responsible for operating and maintaining the AUV become familiar with the contents of these manuals before using the equipment.

Table 1: Reference Documents

Document Name	Document Number
Bluefin SandShark™ Battery Safety Card	000-021-891
Bluefin SandShark™ Quick Reference Card	000-021-892
Bluefin SandShark™ Operations Manual	000-021-893
Bluefin SandShark™ Pre-Dive Checklist	000-021-894
Bluefin SandShark™ Dive Log	000-021-895
Bluefin SandShark™ Post-Dive Checklist	000-021-896
Bluefin SandShark™ Mobilization Checklist	000-021-897
Bluefin SandShark™ Payload Interface Control Document	000-020-764
Commercial Off The Shelf (COTS) Manuals	On Technical Publications CD
Material Safety Data Sheets (MSDS) Package	On Technical Publications CD

Intended Audience

This guide is written for personnel who operate, maintain, troubleshoot, and repair the Bluefin SandShark™ AUV system. Users of the AUV system should possess the following experience:

- Knowledge of underwater navigation and underwater vehicle operation.
- Experience in the field of undersea systems.
- Experience with marine operations and handling sub-sea equipment.
- Basic understanding of Microsoft Windows.
- Experience with electrical systems.

Training

General Dynamics Mission Systems has provided this manual to assist you in operating and maintaining the Bluefin SandShark™ AUV system. Users are expected to have undergone General Dynamics Mission Systems's AUV training program. Users operating and maintaining the AUV must be trained in its use. Do not attempt to perform maintenance on or repairs to this system if you have not been trained in operation and maintenance of the AUV. Contact the Marine Operations Department at General Dynamics Mission Systems for training details (Bluefin_Support@gd-ms.com).

Glossary

Shall is used only when application of a procedure is mandatory.

Should is used only when application of a procedure is recommended.

May and *need not* are used only when application of a procedure is discretionary.

Will is used only to refer to the future, never to indicate any degree of requirement for application of procedure.

Abbreviations and Product Specific Terms

The abbreviations and product specific terminology used in this manual are described in Table 2.

Table 2: Glossary

Abbreviation or Term	Description
COTS	Commercial off-the-shelf
Deployment	The complete trip, from the time the ship (loaded with an AUV and all support equipment) leaves the dock, until it returns. A deployment may comprise multiple missions containing multiple dives. The deployment leaves from the mobilization/demobilization site.
Dive	A single operational segment during which the AUV executes a set of uploaded waypoints, returning to the surface once complete. The AUV may surface multiple times in a single dive to acquire GPS positions, but the dive is not complete until all waypoints have been executed, or the dive has been aborted by the AUV or the operator.
DVL	Doppler velocity log
GPS	Global positioning system

Table 2: Glossary (Continued)

Abbreviation or Term	Description
HAZMAT	Hazardous materials
MEH	Main electronics housing. Pressure vessel holding the MVC.
Mission	A series of one or more dives the AUV completes to accomplish a larger task. For example, during one dive, the AUV might run a lawnmower pattern over a certain area to collect sonar data, and during the second dive, it may perform the same task in an adjacent area.
MVC	Main vehicle computer.
PMA	Post-mission analysis
PV	Pressure vessel

Classification of Hazards

The warnings, cautions, and notes contained in this manual are defined as follows:

Warning

•Identifies an operating procedure, practice, condition or statement which, if not strictly observed, could result in injury or death.

Caution

•Identifies an operating or maintenance procedure, practice, condition, or statement which, if not strictly observed, could result in equipment damage or destruction, loss of mission effectiveness, long-term health hazards, or environmental damage.

Note

NOTE:	An essential operating or maintenance procedure, condition, or statement.

Warning

General Warnings

•Procedures in this guide may require handling hazardous materials. Personnel shall become familiar with hazards and comply with the guidance in the applicable material safety data sheets (MSDSs).

•Do not put fingers between the propeller blades. Always use a stick or probe to move propeller blades.

•When opening or closing AUV shipping container latches, always make sure that the latches are flush with the side of the shipping containers. Latches that protrude from the shipping container may cause injuries.

Battery Warnings

Warning

•Before operating the Bluefin SandShark™ Battery, read all warnings provided in the manual.

•Only personnel certified in shipping hazardous materials are authorized to pack and ship batteries.

•These conditions should be avoided:

•1. Do not expose the batteries inside the pressure vessel directly to water

•2. Do not attempt to overcharge or overdischarge the battery

•3. Do not expose the battery to an ambient temperature of more than 60°C (140°F)

•4. Do not discharge the battery when the ambient temperature is less than -20°C (-4°F) or greater than 55°C (131°F).

•5. Do not charge the battery when the ambient temperature is less than 0°C (32°F) or greater than 45°C (113°F).

•These thermal conditions may damage the AUV and apply only to the battery cell chemistry.

•In the event of fire where lithium ion batteries are present, call 911 or local emergency services and flood the area with water where it is safe to do so. Virtually all fires involving lithium ion batteries can be controlled with water. However, when water is used hydrogen gas may be released, which can form an explosive mixture with air. Where water is not available, LITH-X (powdered graphite) or copper powder fire extinguishers, sand, dry ground dolomite or soda ash may also be used as smothering agents.

•Fire fighting equipment shall be available and prepositioned before commencing battery charging operations and shall be equivalent to or better than the following:

•Sprinkler protected space with a minimum of seven (7) gallons per minute flow rate, OR

• A standard shipboard firehose

Warning

•Do not cut into, puncture, drop, or damage the battery.

•Do not attempt to measure the battery current by directly connecting a meter between the positive and negative terminals. This will cause high current to flow and the internal fuse to blow, potentially resulting in damage to the battery's electronics.

•Do not purposely short the battery terminals.

•NEVER force any probe, wire, or other instrument or hardware in to the battery connectors.

Warning

•Batteries are defined as hazardous materials for the purpose of shipping.

•When the battery is outside of the vehicle, only personnel certified in the shipping of hazardous materials are authorized to pack and ship the batteries to locations other than General Dynamics Mission Systems. Non-certified personnel may pack the batteries in their original shipping box and ship them back to General Dynamics Mission Systems.

Cautions

General Cautions


Caution

•The thruster is designed to operate in water. When operating in air, monitor the temperature with Dashboard.


Caution

•Do not power wash the AUV or its components as this may cause damage to the AUV or its components.


Caution

•Do not use an O-ring that shows any sign of damage or wear.

•Do not remove a connector by pulling on the cable as this may damage the integrity of the cable.

•Cables and connectors that are pinched, compressed, or otherwise under strain in the stowed position may lose their watertight integrity.

•Do not allow DC-4 Silicone Grease lubricant to come into contact with the connecting faces, pins, or pin sockets of the connectors as this may compromise the electrical connection.

•Do not bend wet-mateable connectors back and forth to work the connectors together. Bending or squeezing the connectors causes the pins to bend and can damage the pins and connectors.

Battery Cautions


Caution

•Before using an AUV battery, vehicle operators must read all warnings provided in this manual.

•Ensure that the vehicle is powered OFF before removing the battery from the vehicle.

•Batteries should be stored in a cool place (ambient temperature less than 40°C (75°F)) away from direct sunlight.

Caution

- Do not drop the battery. If the battery is dropped, it should be thoroughly inspected for any sign of damage. Contact Bluefin_Support@gd-ms.com before moving, using, or shipping a damaged battery.
- If severe mechanical damage occurs, avoid shorting out the lithium cells or exposing them to water. Either of these conditions may result in a fire.
- Do not allow water to enter the battery.
- Do not place equipment or materials on the battery lid or connectors.

Caution

- Do not charge the batteries in ambient temperatures over 45°C (113°F). Over temperature conditions will terminate the charging cycle. Over temperature conditions may occur when charging the battery in a elevated ambient temperature environment.

2

INTRODUCTION

Bluefin SandShark™ AUV

The Bluefin SandShark™ AUV is a self-propelled, untethered, unmanned underwater vehicle capable of conducting independent survey operations at depths up to 200 meters.

Figure 1: 200m Bluefin SandShark™ AUV

The AUV system consists of two sections:

- Tail Section — Fixed
- Payload Section — Modular and user-defined

AUV Components: Tail Section

The tail section is a pressure vessel. Some of its components are commercial off-the-shelf (COTS) components. Their documentation is collected on the Technical Publications CD.

Components

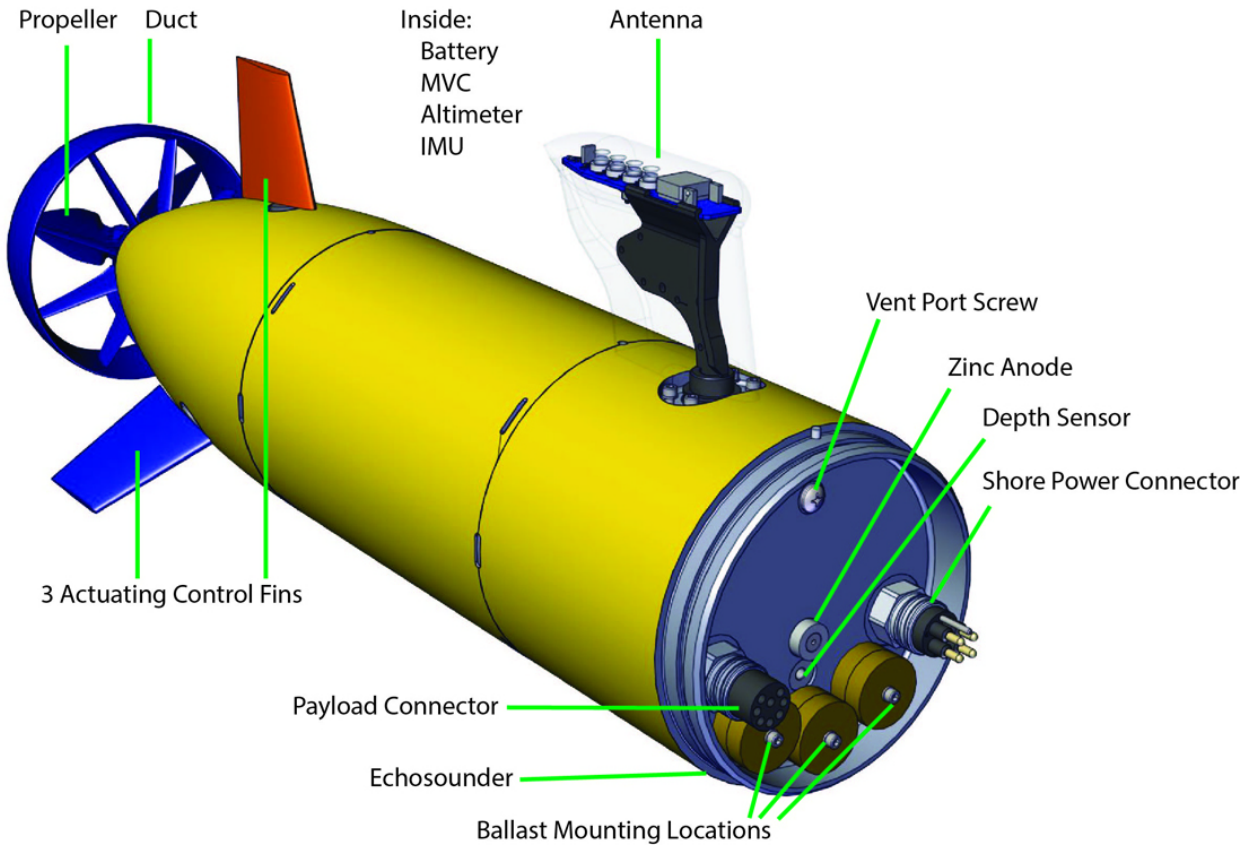


Figure 2: Tail Section Components

Components

Propulsion System

The propulsion system contains a motor inside the pressure vessel and a duct and propeller outside it. They are magnetically coupled.

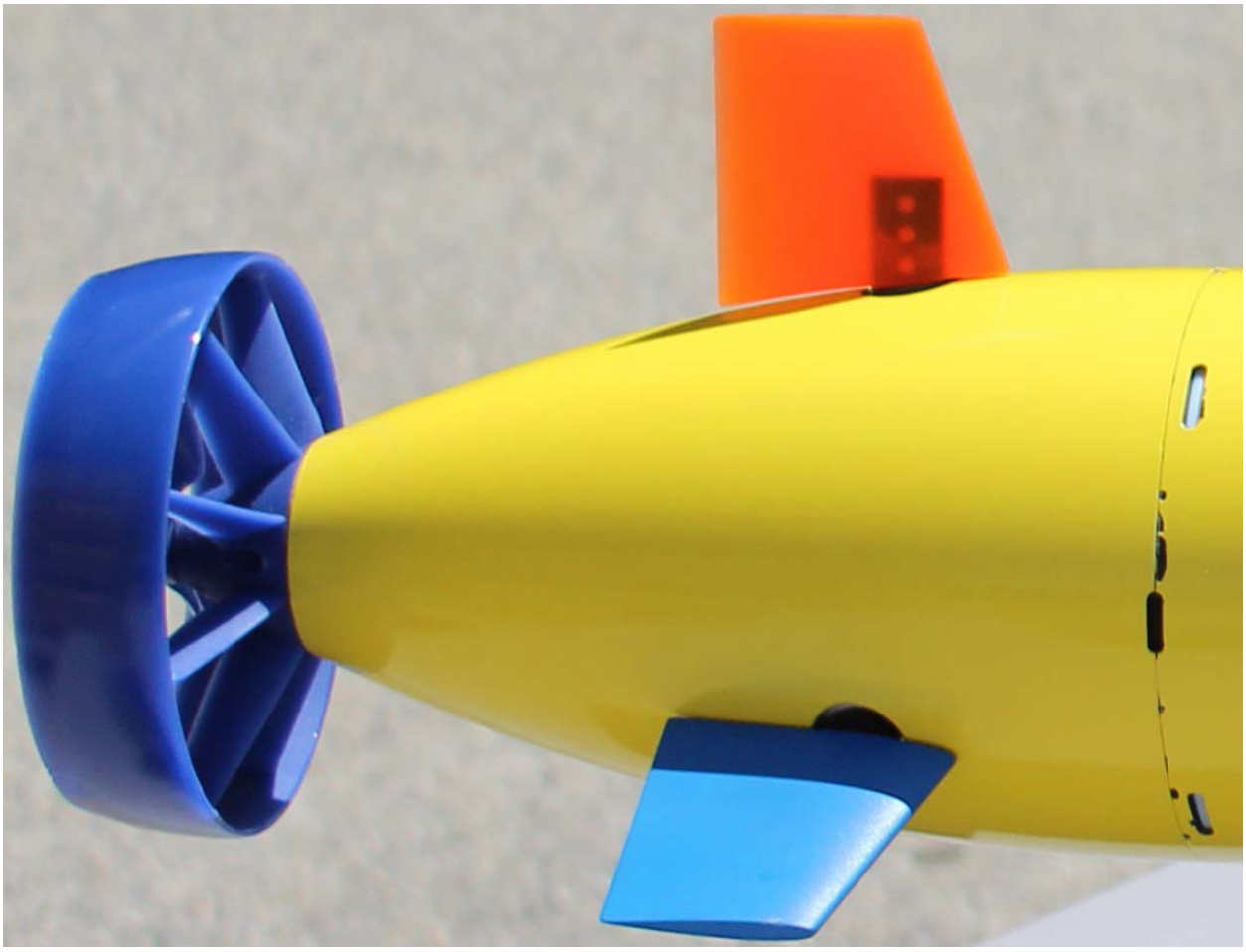


Figure 3: Tail Section with Fins

Fins

The 3 articulating fins (part number: 000-017-509) steer the vehicle.

Battery

The battery (part number 000-016-395) is a 251 Wh Li ion battery. See Chapter 5, "Power" for more information.

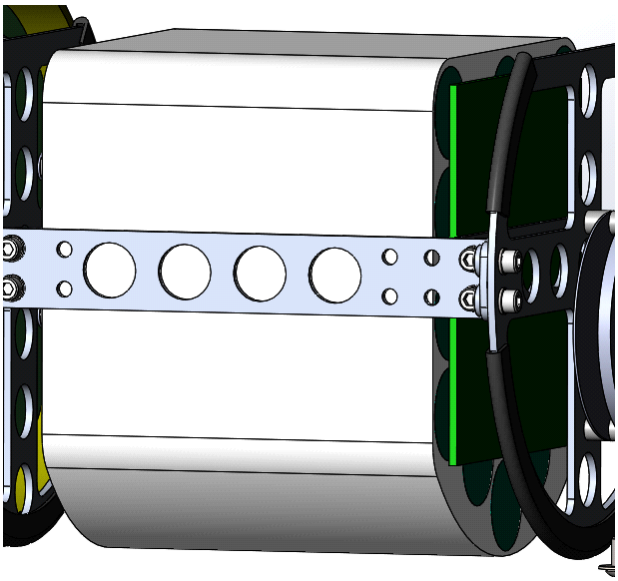


Figure 4: The Battery Mounted in the Battery Chassis

Antenna

The antenna (part number: 000-016-391) contains the magnetic ON/OFF switch, communication and GPS antennas, status LEDs, and strobe lights.

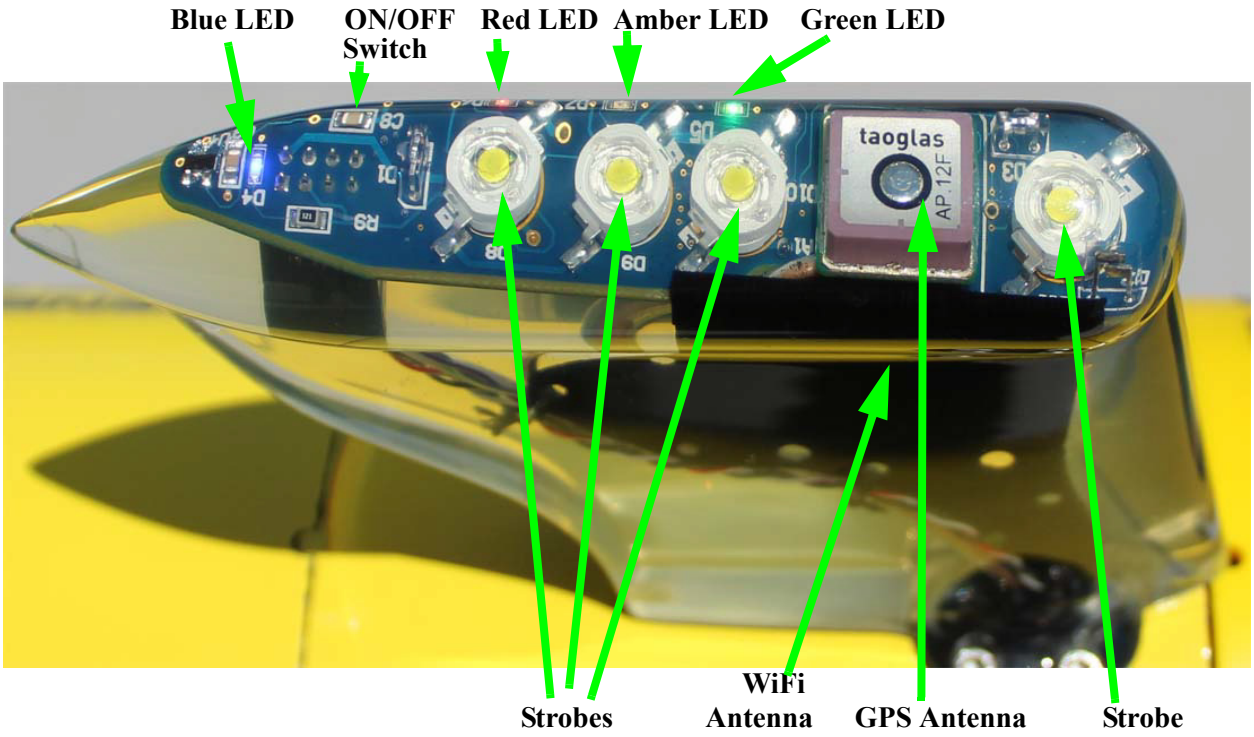


Figure 5: Antenna

Table 3: LED Status

LED	Meaning
Blue	Battery Power Enabled (steady)
Red	Test failed (steady) Misson aborted (steady) Mission aborting (flashing)
Amber	Reserved for user-defined payload
Green	Ready to run (steady) Note: Propeller is active when the LED is in this state Running a mission (flashing) Note: Propeller is active when the LED is in this state
Red and Green	Serious Error State (steady)
Red and Amber	Ethernet communications error state (steady)

The visible and infrared strobes are configurable to be:

- Always on
- Always off
- Flashing at high speed (1x every second)
- Flashing at low speed (1x ever 5 seconds)

Echosounder

The Imagenex 852 echosounder (part number: 000-016-370) is exposed at the bottom of the pressure vessel. It reads altitude (how far above the bottom of the body of water the vehicle is running).

Main Vehicle Computer (MVC)

The Main Vehicle Computer analyzes navigation sensor data and controls the vehicle.

Pressure Sensor

The pressure sensor (part number: 000-016-438) is exposed on the front endcap of the tail section. It reads absolute pressure, which converts to depth (how far below the surface of the body of water the vehicle is running).

Connectors

The 8-pin payload and 4-pin connectors on the pressure vessel endcap are wet-matable Subconn Micro connectors. See “External Interface” on page 247.

Figure 6: Connectors on Endcap

Both connectors must be mated to a cable or plug with the locking sleeve tightened down during in-water operations. The payload connector must be connected to the payload or have a dummy plug installed. The shore power connector must have the shorting plug installed.

Before storing the vehicle:

1. Remove the shorting plug.
2. Install dummy plugs on both connectors.

AUV Components: Payload Section

Empty Payload

The empty payload contains mounting points for components, ballast, and foam. Each mounting point is a 4-40 threaded insert, compatible with standard stainless steel hardware.

Equipment Requirements

The components required to operate and maintain the AUV are listed in Appendix “Topside Equipment” on page 249.

Personnel Requirements

The Bluefin SandShark™ AUV is designed to be run by a single operator when launched from shore. Boat-based operations require a second operator for safety.

Maintenance Requirements

The maintenance requirements for the Bluefin SandShark™ AUV system include:

- Visual inspection of vehicle components and subsystems for fit, assembly, and external damage. Regularly scheduled diagnostic tests to ensure the vehicle’s functionality.
- Replacing and repairing missing, consumed, or damaged items.

Preventive Maintenance

Preventive maintenance (PM) occurs at regular intervals, including during each of the operations phases (such as pre-dive and post-dive). PM is performed either afloat or ashore.

Corrective Maintenance

Corrective maintenance (CM) is performed on an as-needed basis. The need for corrective maintenance is established during PM. For instance, a failed diagnostic check on a fin during pre-dive PM would require replacing the fin. CM is performed either afloat or ashore.

Format of Maintenance Procedures

Table 4 describes the type of information found in the preventative and corrective maintenance procedures.

Table 4: Maintenance Procedure Structure

Heading	Description
Procedure Type	A short two- or three-word phrase that indicates a preventative, corrective, or assembly procedure. Maintenance procedures always start on a new page.
Procedure Name	The name of the maintenance procedure described (e.g., “Replacing the Dropweight”).
Tools and Equipment Required	A list of tools and equipment required to perform the maintenance procedure.
Background Information	Any important information that helps you perform the procedure. Sometimes this is an important note or basic information about the component on which you are about to perform maintenance.
Description of Work	Step-by-step procedure explaining how to perform the required task.

Only qualified AUV maintenance personnel should perform these procedures. A trainee under the direct supervision of a fully qualified, General Dynamics Mission Systems trained AUV operator or technician can perform these procedures for qualification and training. If you have questions about maintenance, contact General Dynamics Mission Systems Technical Support (Bluefin_Support@gd-ms.com).

3

AUV OPERATIONS

Bluefin SandShark™ AUV operations have 4 phases:

1. General Preparation
2. Mission Preparation
3. Operation
4. Post-Mission Activities

General Preparation includes initial system and operations environment setup and awareness of the vehicle's operational limits and range.

Mission Preparation includes mission planning and preparing the vehicle for the mission onsite.

Operation includes starting, monitoring, and ending a mission.

Post-Mission activities include downloading and analyzing the data, shutting down the vehicle, and rinsing the vehicle with fresh water.

The Operations Checklists guide users through the phases and required steps:

- Bluefin SandShark™ Pre-Dive Checklist (000-021-894)
- Bluefin SandShark™ Dive Log (000-021-895)
- Bluefin SandShark™ Post-Dive Checklist (000-021-896)
- Bluefin SandShark™ Mobilization Checklist (000-021-897)

Setting Up the Operations Environment

The following sections describe the initial system and operations environment setup and configuration.

Setting Up IP Addresses

All IP addresses and SSIDs are pre-configured for the vehicle, operator laptop, and router as delivered. Contact Bluefin_Support@gd-ms.com if they need to be changed.

Topside Software

The Bluefin SandShark™ AUV requires an operator laptop running Planner and Dashboard. The latest software topside distribution must be obtained from General Dynamics Mission Systems.

Shore Cable Usage

•Always turn off the vehicle before connecting the shore cable.

The shore cable connects the vehicle and the operator laptop and is used for faster transfer of data and large files. The vehicle end connects to the payload connector on the tail section endcap. The laptop end connects to the laptop's ethernet port.

Only one Bluefin SandShark™ should be connected to a wired network at a time.

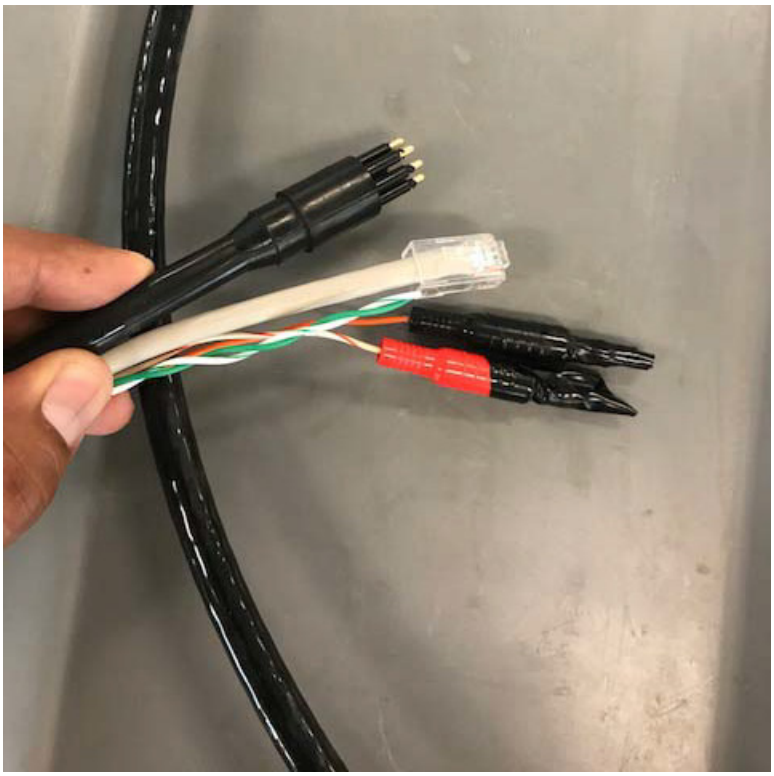


Figure 7: Shore Cable

Heat Awareness

Operating on Deck

Be mindful of heat, especially on a hot day. When running on deck, power off unnecessary payloads. Use Dashboard to monitor the temperature of components.

Caution

- If the vehicle overheats, pour water over the tail section aft of the antenna until it cools.
- If extended operation in air is required, a hose can be used to help limit tail section temperatures.

Operating in Water

When running in water, monitor the temperature sensors when able to communicate with the vehicle.

Range Awareness

The vehicle has a maximum range of 24 nautical miles and maximum speed of 5 knots. Omnidirectional WiFi has an expected range of 50 to 90 meters based on the surroundings. The vehicle can drive outside the WiFi communications range in a few seconds.

General Dynamics Mission Systems strongly recommends installing an emergency locator device in the payload section of the Bluefin SandShark™ AUV. Some options include:

- RDF beacon: can be tracked using a handheld RDF unit on the search vessel to provide the relative bearing of the AUV. The RDF beacon only works when the AUV is at the surface.
- UAT-376 transponder: can be tracked using a handheld dive range interrogator held in the water or a topside USBL unit such as a Trackpoint 3. Provides relative bearing and distance. The UAT-376 works when the transponder is submerged. It should be mounted as low as possible in the payload to possibly continue working at the surface, but is unlikely to work at the surface.

If no emergency locator device is installed, using binoculars and a panel unidirectional WiFi antenna can increase the search and communications range.

During testing and the pre-dive checkout, the vehicle should be tethered by tying a line to the vehicle handle and tying the other end down on deck. Tethers are optional but recommended.

Preparing for a Mission

Ballasting and trimming the vehicle

The vehicle must be ballasted and trimmed correctly to provide a stable base for data gathering. See “Trim Instructions” on page 261. for detailed trim instructions.

User-defined payload modules must conform to the requirements in the “Payload Interface Control document (ICD) for the Bluefin SandShark™ AUV” (000-020-764). See Appendix A: "External Interface".

Turning vehicle on

- Verify that all hands are clear of the propeller before turning on the vehicle.

To turn on the vehicle, pass one end of the neodymium magnet over the magnetic switch in the aft upper corner of the antenna. If the blue LED does not turn on, pass the neodymium magnet over the switch again. The green LED flashes during power up and turns solid when the vehicle is ready to operate.

Planning a mission

Missions are planned in Planner. See Chapter 8: "Planner: Introduction" to Chapter 14: "Planner: Using the Setpoint Tool" for more information on planning missions.

Vehicle Safety Parameters and Limits

The vehicle is pre-programmed with safety parameters and has physical limits. If the General Dynamics Mission Systems defaults are not suitable for an application or payload, contact General Dynamics Mission Systems for vehicle tuning instructions.

The key limits are:

- Depth: vehicle cannot dive below 660 feet (200 meters)
- Minimum stable speed: 1 knot
- Maximum speed: 5 knots
- Maximum range at 3 knots: 24 nautical miles

The key safeties are:

- Heat abort: the vehicle will automatically abort and surface if it overheats
- Battery abort: the vehicle will abort and surface at 10% of battery life remaining

Pre-Dive Checklist


Caution

•Always pick up the vehicle by the handle or by gripping the hull. The propeller, duct, antenna, and fins cannot support the weight of the vehicle.

•Do not touch the antenna when the vehicle is in the water. This can break the antenna.

The pre-dive checklist is used to check the vehicle status and readiness for a mission. A blank pre-dive checklist is located in “AUV Checklists” on page 289.

The pre-dive checklist contains verification tasks on land and in water. Tether the vehicle by tying a line to the vehicle handle and tying the other end of the line down on deck before putting the vehicle in the water for the pre-dive checklist. Remove the line only when the vehicle has passed the checklist. (Tethers are optional but recommended.)

Operating the Vehicle

Dive Log

The dive log (also called the ops mission template) is used to record vehicle mission properties, statuses, and events. A blank dive log is located in “AUV Checklists” on page 289.

Starting a Mission

On the Operator Laptop, start Dashboard and verify that it is communicating with the vehicle. for more information on Dashboard, see Chapter 15: "Dashboard: Getting Started" to Chapter 19: "Dashboard and Planner: Tracking, Recovery, Location".

First, pass the pre-dive checklist and verify that the mission has been uploaded to the vehicle. Untie the line from the vehicle handle that is tethering the vehicle to the deck.

Monitoring a Mission

WiFi does not work under water. The vehicle can only be monitored while it is at the surface. If it is within WiFi range when it surfaces, then the vehicle status will update in Dashboard and commands can be transmitted to it.


Caution

•WiFi does not work underwater.

How to end a mission

To abort a mission, click “Stop Dive” or “Wrapup Dive” in Dashboard’s Dive Monitor. “Stop Dive” stops the propeller and the vehicle floats to the surface. “Wrapup Dive” starts the mission wrapup behavior programmed in the mission file.

Vehicle Location and Recovery

At the end of a mission the AUV is typically located either at the recovery location, by seeing the strobe light, or by using omnidirectional WiFi communications from the operator laptop. If the AUV cannot be located through these methods it can be located using the procedures described in “Emergency Procedures” on page 37.

General Dynamics Mission Systems strongly recommends installing an emergency locator device in the payload section of the Bluefin SandShark™ AUV. Some options include:

- RDF beacon: can be tracked using a handheld RDF unit on the search vessel to provide the relative bearing of the AUV. The RDF beacon only works when the AUV is at the surface.
- UAT-376 transponder: can be tracked using a handheld dive range interrogator held in the water or a topside USBL unit such as a Trackpoint 3. Provides relative bearing and distance. The UAT-376 works when the transponder is submerged. It should be mounted as low as possible in the payload to possibly continue working at the surface, but is unlikely to work at the surface.

If no emergency locator device is installed, using binoculars and a panel unidirectional WiFi antenna can increase the search and communications range.


Caution

•Always pick up the vehicle by the handle or by gripping the hull. The propeller, duct, antenna, and fins cannot support the weight of the vehicle.

Post-mission Activities

Downloading Data

Payload data is stored in:

/mnt/dsm/data/**VEHICLE_NAME/Year-Month-Day-hour-minute-second**

on the vehicle. Use filezilla to copy it from the vehicle to the operator laptop. Data download is faster over the shore cable than over WiFi.

Shutting Down the Vehicle Safely

Shut down the vehicle using Dashboard. Wait for the Dive Monitor Status and Comms indicator lights to turn grey.

Pass one end of the neodymium magnet over the magnetic switch in the aft upper corner of the antenna. If the LEDs do not turn off, pass the neodymium magnet over the switch again.

If the vehicle is going into storage, remove the red shorting plug from the shore power connector and install a dummy plug.

Freshwater Rinse

At the end of the operations day the vehicle fairing must be rinsed with fresh water. See “Preventive Maintenance Procedure” on page 36.

Preventive Maintenance Procedure

Fresh Water Rinse

Tools and Equipment Required

- Fresh Water Source
- Water Hose
- Sponge or Cloth Rags
- Towels

Background Information

The fresh water rinse cleans the exterior of the vehicle after each dive.

Description of Work


Caution

•Do not power wash the AUV or its components as this may cause damage to the AUV or its components.

NOTE: *Do not let the fresh water hose run when not in use. Use the minimum necessary for the task. Always secure the hose when it is not being used.*

1. Rinse the outside of all fairings with fresh water.
2. Wipe down surfaces with a sponge or cloth rag.
3. Starting with the tail section, rinse all component subsystems with fresh water.
4. Separate the tail section from the payload section by removing the ortman key.
5. Rinse the front endcap of the tail section. The depth sensor hole in the center of the lower half must be flushed with fresh water.

This completes the fresh water rinse of the AUV.

4

EMERGENCY PROCEDURES

Introduction

At the end of a mission the AUV is typically located either at the recovery location or by using omnidirectional WiFi communications from the operator laptop. If the AUV cannot be located through these methods it can be located using the procedures described in this section.

Locating an AUV that is on the surface or submerged can be a very difficult task under the best of circumstances. Factors contributing to this problem are weather, currents, thermoclines, visibility, and the fact that the low freeboard of an AUV make it difficult to see over large distances.

To aid in the location of an AUV, a strobe light is installed in the AUV. The strobe light is normally only visible when the AUV is at the surface. Under favorable conditions (such as: night-time; low ambient light; less than 50 ft water depth; clear water), the strobe light can provide a visual indicator of the AUV's general location even when the AUV is submerged.

General Dynamics Mission Systems strongly recommends installing an emergency locator device in the payload section of the Bluefin SandShark™ AUV. Some options include:

- RDF beacon: can be tracked using a handheld RDF unit on the search vessel to provide the relative bearing of the AUV. The RDF beacon only works when the AUV is at the surface.
- UAT-376 transponder: can be tracked using a handheld dive range interrogator held in the water or a topside USBL unit such as a Trackpoint 3. Provides relative bearing and distance. The UAT-376 works when the transponder is submerged. It should be mounted as low as possible in the payload to possibly continue working at the surface, but is unlikely to work at the surface.

If no emergency locator device is installed, using binoculars and a panel unidirectional WiFi antenna can increase the search and communications range.

When is an AUV "Missing"

For the purposes of this section, the AUV is considered missing if the following conditions apply:

- The AUV cannot be located visually at its expected location (after an aborted or completed mission)

- The AUV is out of range of the omnidirectional WiFi communications.

Loss of Visual Contact on the Surface

One of the most difficult tasks during operations is locating the AUV on the surface after it has completed its mission. Sea-state and weather can make this even more difficult. Recording the expected end of dive location in the Dive Log is imperative in simplifying this task.

Where practical, the search vessel should transit to a point near the expected end of dive location prior to the end of the dive, and a keen lookout should be kept to try to spot the vehicle as soon as it surfaces.

In the event that the AUV is not visible due to sea-state or sun glare and outside the omnidirectional WiFi range, the emergency locator (if installed) should be used to determine the relative direction of the vehicle. The ship should then proceed cautiously in that direction with lookouts posted. If there is no emergency locator, use a panel unidirectional WiFi antenna and slowly rotate the antenna in a circle until communications are established.

If the AUV cannot be visually located during night operations, the strobe light (assuming it has not been disabled during mission planning) may be sufficiently bright to determine the general vicinity of the AUV.

Loss of Communications

One of the most common problems anticipated during AUV operations is loss of WiFi communications between the search boat and the AUV. This failure can be due to distance, environmental effect or equipment malfunction.

The range of an omnidirectional WiFi antenna is about 50 to 90 meters maximum and the range of a panel unidirectional WiFi antenna is about 500 meters maximum, depending on environmental conditions and height of the antenna. The effects of increased sea-state can dramatically decrease the usable range of the system. Sea-state can also submerge the AUV's antenna more than normal causing the WiFi to drop out. To re-establish communications, it may be necessary to close the distance to the last known position of the AUV on the surface or to the projected position that the AUV would be at that point in time during the mission.

The ways in which the AUV can be located are discussed in the sections that follow.

Using Search Boat Position and Range to Locate the AUV

If the AUV's WiFi or emergency locators are still powered, even if status updates are not functioning, appropriate topside equipment can be used to obtain direction and position information from these devices. This procedure will describe how to use the search boat's position and range information to locate the AUV.

Caution

•If contact is made with a missing vehicle, immediately issue a Stop Dive command from Dashboard to bring it to the surface, otherwise it might drive out of WiFi range. Note that it could take several minutes for the vehicle to reach the surface depending on the vehicle depth at time of Stop Dive command. The vehicle rises approximately one foot/sec. Immediately note the GPS position where contact is made in case the search boat moves or loses contact and needs to backtrack.

To locate the AUV using the Search Boat Position and Range:

1. Set up the operator laptop and launch Dashboard.
2. Set up the topside equipment used to communicate with the emergency locator.
3. Obtain the first range reading from the topside communications equipment.

NOTE: *Be aware that the vehicle may be on the bottom and therefore may show ranges no closer than the local water depth.*

4. Make an annotation on the chart of the search boat's location and draw a circle with a radius equaling the range value around the search boat's location.
5. Move the search boat to another position and take a new range reading. Make a new annotation as described in the previous step. Assuming the AUV has not moved significantly, there should now be two intersecting circles on the chart.
6. Turn the search boat 90 degrees and drive to a third location and take a new range reading. Make a new annotation on the chart. There should now be three intersecting circles on the chart. The intersection of the three circles indicates the approximate position of the AUV. (See Figure 8.)

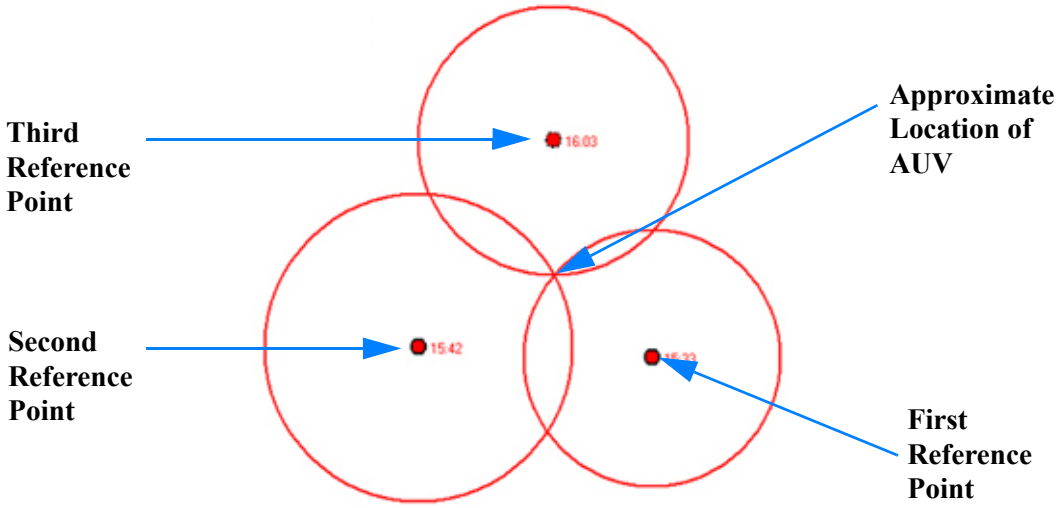


Figure 8: Approximate Location of AUV at Intersection of Three Circles

7. Place a new annotation at the approximate location of the AUV, and annotate it with something meaningful like “Location 1”. This marker will serve as a record of the first approximated location.
8. Drive the search boat to this location, keeping a keen lookout to avoid hitting the AUV with the search boat.

This procedure can be performed again with gradually smaller radius circles in order to accurately locate the AUV. If this procedure is performed correctly, the precise location of the AUV can be obtained in two hours or less.

Using the RDF Receiver to Locate the AUV

To locate the AUV using the RDF Receiver, the AUV must be on the surface, and sea state conditions must be favorable. The RDF Receiver tracks the RDF beacon in the AUV's payload.

To locate the AUV using the RDF Receiver:

1. Slowly rotate the handheld RDF unit at 1-2 rpm until the strongest signal is received.
2. Follow the direction the unit is indicating while monitoring the strength of the reception. Increasing signal strength indicates that the distance to the AUV is closing.
3. Drive the vessel in a straight line. If the signal strength is increasing, continue in this direction. If the signal strength is decreasing, turn the vessel 90 degrees (port or starboard), and drive in a straight line.
4. Continue in this direction as long as the signal strength is increasing. If the AUV is sighted, drive toward it and recover. If the signal strength begins to decrease, the Closest Point of Approach (CPA) has been reached. Go to the next step.
5. Turn the vessel 90 degrees (pick either port or starboard). Observe the signal strength. If the signal strength is increasing, this is the correct direction. Continue closing in on the AUV. If the signal strength is decreasing, this is the wrong direction. Turn the vessel 180 degrees from the current heading, and repeat the previous step.

NOTE: *When a signal is strong, it can sound the same over a wide angle. If the signal is strong in all directions, turn the RF gain down until the signal is strong only within a particular arc. Within the arc, the signal still may not appear to have a distinct hot spot. Note where the edges of the arc are. The source is probably halfway between them.*

This procedure should quickly close on the vehicle position.

Using the Directional WiFi Antenna to Locate the AUV

To locate the AUV using the directional WiFi antenna, the AUV must be on the surface, and sea state conditions must be favorable.

NOTE: *This procedure is unlikely to work unless conditions are very good. GD-MS strongly recommends installing a beacon with greater range than WiFi in the vehicle.*

To locate the AUV using the directional WiFi antenna:

1. Slowly rotate the handheld WiFi antenna at 1-2 rpm until the AUV connects to Dashboard.
2. Follow the direction the unit is indicating while monitoring the strength of the reception. Increasing signal strength indicates that the distance to the AUV is closing.
3. Drive the vessel in a straight line. If the signal strength is increasing, continue in this direction. If the signal strength is decreasing, turn the vessel 90 degrees (port or starboard), and drive in a straight line.
4. Continue in this direction as long as the signal strength is increasing. If the AUV is sighted, drive toward it and recover. If the signal strength begins to decrease, the Closest Point of Approach (CPA) has been reached. Go to the next step.
5. Turn the vessel 90 degrees (pick either port or starboard). Observe the signal strength. If the signal strength is increasing, this is the correct direction. Continue closing in on the AUV. If the signal strength is decreasing, this is the wrong direction. Turn the vessel 180 degrees from the current heading, and repeat the previous step.

This procedure may close on the vehicle position.

Using the Strobe or Other Visual Aids to Locate the AUV

Locating the AUV on the surface at night is probably one of the easiest methods of finding the vehicle. As long as the strobe is functional, the search vessel should be able to spot it from reasonably far distances. Strobe settings can be configured during mission planning.

The strobe light is normally only visible when the AUV is at the surface. Under favorable conditions (e.g. night-time; low ambient light; less than 50 ft water depth; clear water), the strobe light can provide a visual indicator of the AUV's general location even when the AUV is submerged.

Other mechanisms for locating the AUV visually at night are the application of highly reflective tape on the topside of the AUV fairings prior to deployment. Using a searchlight, the AUV can be easily spotted if the light shines on the reflective tape.

General Dynamics Mission Systems recommends the use of both the strobe and reflective tape to ensure the ability to locate the AUV visually at night.

5

POWER

The battery used by the Bluefin SandShark™ AUV is a rechargeable 251 Wh Lithium Ion battery with cells encased in a Passive Thermal Management System (PTMS), which absorbs excess heat to limit risk of a thermal event. For more detailed information, see the “Payload Interface Control Document (ICD) for the Bluefin SandShark™ AUV” (000-020-764) on the Technical Publications CD.

Charging the Vehicle

To charge the vehicle, connect the charging brick to the vehicle's shore power connector, as shown in Figure 9. Then connect the charging brick to a power outlet on the wall. The battery charges at a 2 amp rate and will automatically stop charging when it is full. Charging a completely depleted battery takes 4 to 6 hours. The battery can be safely left connected to the charger after charging is completed, but should be taken off the charger after 12 hours.

NOTE: *Always connect the charger first to the vehicle, then to the wall power outlet.*

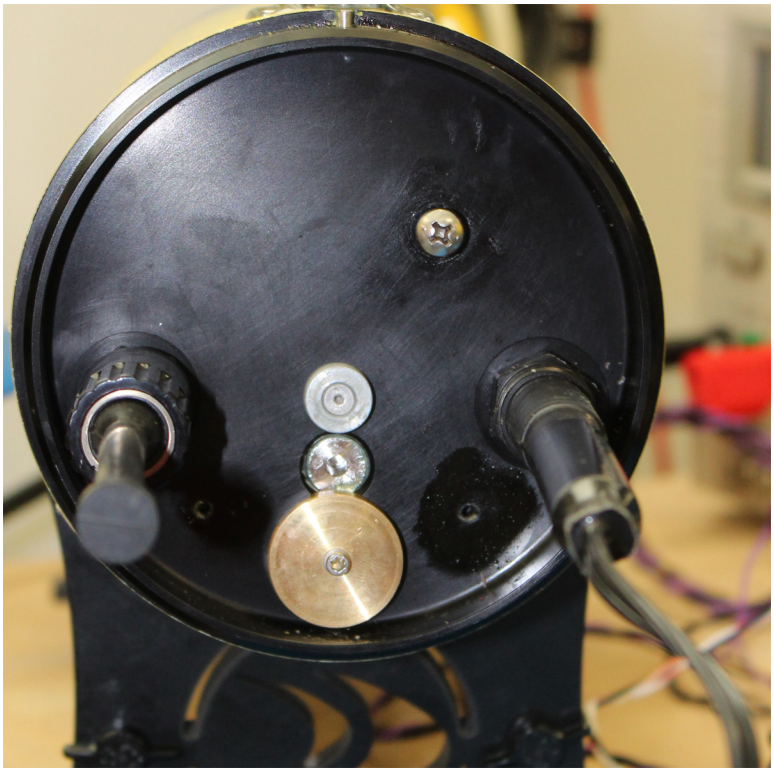


Figure 9: Charging the Vehicle

Battery Details

The battery is a 251 Wh Li Ion battery made of Li Ion cells embedded in the PTMS, a heat absorbing technology. The PTMS and the control circuitry protect it against over-voltage, over-current, under-voltage, over temperature, and under-temperature events. It automatically balances cell voltages during charging. It is rated for storage from -25°C to 85°C.

UN 38.3 Certificate

The battery is UN 38.3 certified. The testing report is included in the technical information package.

Lithium ion batteries must have a UN 38.3 certification to be shipped commercially. They are dangerous goods and must be packed by hazmat-certified personnel for air freight shipment. Non-hazmat certified personnel may pack the batteries for ground shipping, but they must be labeled according to UN specifications.

The battery must be shipped class 9 Hazmat.

Long Term Storage

Optimizing Battery Life-Span

Charge and discharge rate, cell voltage, temperature, cell age and number of cycles all contribute to the battery lifetime. The capacity of all batteries reduces over time.

Capacity is dependent on the number of charge and discharge cycles, rate, and temperature. Each cycle reduces the amount of available capacity. Capacity fades faster when cells are maintained at a high state of charge (SOC) and at a higher temperature, or when cells are held at low temperature and low SOC. In general, batteries that are charged and discharged at a lower rate preserve their capacity longer.

Batteries left uncycled for more than 3 months should be connected to shore power to allow for the cells to rebalance and prevent cell damage.

Worst case conditions that reduce capacity (in order of worst first)

- Storing cells at elevated temperature at 100% SOC.
- Storing cells at a cold temperature at 0% SOC
- Storing cells at cold temperature at 100% SOC.

Preventing Damage Through Overdischarge

The battery electronics prevent overcharging but cannot prevent over discharging in storage as all lithium polymer cells exhibit self-discharge. Over time, the cells in the battery pack could discharge below a threshold that could cause damage. Additionally, the electronics pack draws a minute amount of current in the inactive state. Ensure that the batteries are monitored monthly. If battery voltage drops below 21 V and is greater than 14 V, recharge batteries to 27.3 V. If battery voltage drops below 14 V, contact General Dynamics Mission Systems immediately at Bluefin_Support@gd-ms.com.

Packing and Ground Shipping the Vehicle

Tools/Equipment Required

- Vented Pelican Vehicle Shipping Case
- Vented Pelican Support Equipment Case
- 2 TSA Locks
- 3 Mil Plastic Bag large enough to fit the vehicle inside and roll closed

Background Information

Warning

•The following procedure involves the use of hazardous materials. Ensure all personnel are familiar with the hazards listed in the specific manufacturer's Material Safety Data Sheet (MSDS) and that Personal Protective Equipment (PPE) guidance is followed.

Warning

•Batteries are classified as hazardous materials for the purpose of shipping. Only personnel certified in the shipping of hazardous materials are authorized to pack and ship the batteries. General Dynamics Mission Systems suggests contacting a HAZMAT training facility or program to have personnel trained and certified.

The tail section contains the vehicle battery.

For air shipment, the tail section must be shipped by trained personnel with a Hazmat endorsement.

For ground shipment, the tail section can be shipped by non-Hazmat personnel with the labeling listed below.

The tail section can be shipped in Group II packaging for transport by air cargo or surface transport.

General Dynamics Mission Systems batteries are packaged and shipped in accordance with IATA Dangerous Goods Regulations (58th Edition, 2017) IATA/UN Specification for Lithium Batteries UN3481, Packing Groups I, Packing Instruction 967.

NOTE: *IATA regulations are not guaranteed to be up to date. IATA regulations must be checked every time a battery is shipped to check for recent changes to local, state, or federal regulations.*

Related Documents

- IATA Dangerous Goods Regulations (58th Edition, 2017) IATA/UN specification for Lithium batteries UN3481, Packing Groups II, Packing Instruction 967.

Procedure

1. Verify that the battery has been discharged to shipping/storage capacity (25.27 V, 3.61 V/cell, 30% SOC).
2. Turn the vehicle off.
3. Remove the fins.

4. Pack all support equipment listed in the “Bluefin SandShark™ AUV Mobilization Checklist” 000-021-897 in the support equipment case.
5. Open the vehicle shipping case.

Figure 10: Ground Shipping Case: Pelican

6. Insert the vehicle in a 3 mil thick plastic bag and roll the top closed.
7. Place the wrapped vehicle in the shipping case, with the antenna and handle lying in the cutout.
8. Place the shipping paperwork in the shipping case.
9. Close the shipping case and the latches.
10. Secure each latch with a TSA lock.
11. If the person packing the tail section is HAZMAT certified, ensure that the shipping case is labeled as directed in the IATA Dangerous Goods Regulations.

12. Ensure that the shipping box is labeled with the following labels on 2 opposite sides:

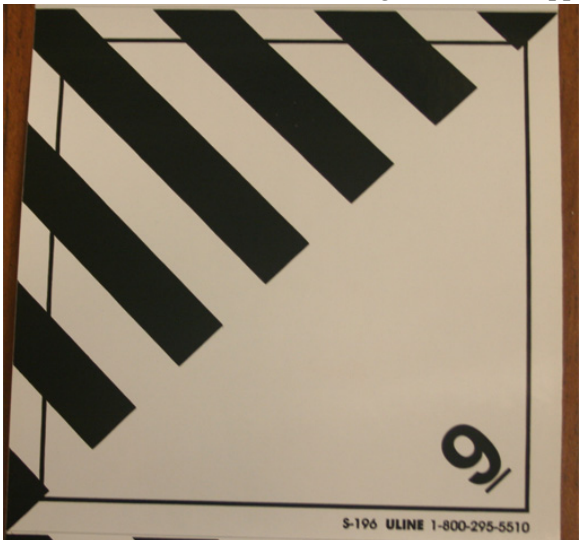


Figure 11: Class 9 Label (black and white)

Figure 12: This Side Up

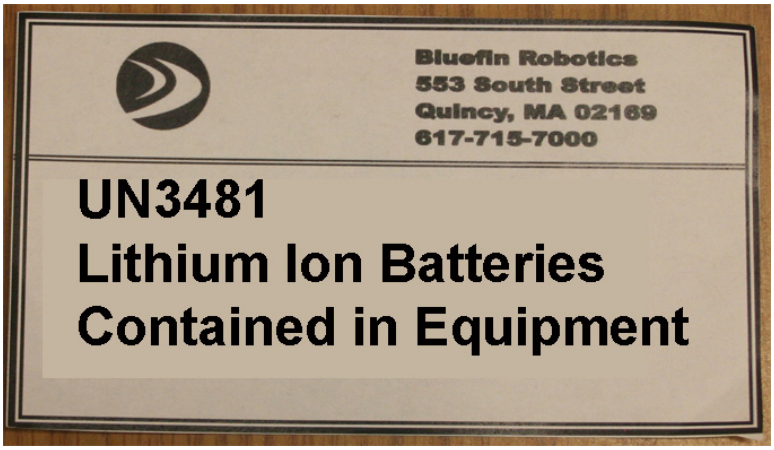


Figure 13: UN 3481 Lithium Battery

Figure 14: 24 Hour Emergency Contact Information Label

Figure 15: Do Not Load or Transport Package If Damaged Label

13. If the person packing the battery does not have a Hazmat certificate, apply the following label on 2 opposite sides:

Figure 16: LITHIUM BATTERIES - FORBIDDEN FOR TRANSPORT ABOARD AIRCRAFT AND VESSEL

14. Write “251 Wh” on the sides with the labels.
15. Affix MSDS to the case using the adhesive plastic envelope.
16. Affix dangerous goods documentation to the case.
17. Affix packing list to the case.
18. Affix destination label to the case.
19. Ship according to your internal shipping procedures and applicable laws and regulations.

This completes the vehicle packing and ground shipping procedure.

Unpacking the Vehicle

Tools/Equipment Required

- N/A

Procedure

1. Place the vehicle shipping case on a stable, level surface, with the lid facing up.
2. Unlock and remove the latch padlocks.
3. Loosen the latches on the case and open the lid.
4. Unroll the plastic bag.
5. Remove the vehicle from the case.

NOTE: *There may be shipping or other documentation included in the shipping case. File this documentation as applicable.*

6. Inspect the vehicle.
7. Charge the battery to 27.3 V.
8. After charging, connect to the vehicle using Dashboard.
9. Open the battery status window.
10. Take a screenshot of the battery status window and email it to Bluefin_Support@gd-ms.com.
11. Warranty Terms:
    In accordance with the standard terms and conditions that can be found at the link shown below, the 251 Wh Bluefin SandShark™ Battery is covered by a 1-year warranty. Due to IATA Dangerous Goods Regulations all Lithium Batteries must be shipped at or below a 30% state of charge (3.61 V/cell). General Dynamics Mission Systems Batteries are packaged and shipped in accordance to this new regulation. In order to activate the 1-year warranty for your new General Dynamics Mission Systems Battery you must perform a full charge on the Battery within 30 days of the shipment's departure from General Dynamics Mission Systems. Once the Battery has been charged the log files on the Battery Charger must be downloaded and e-mailed to General Dynamics Mission Systems for verification that the Battery received the required post-shipment re-charging. Once General Dynamics Mission Systems is able to review the logs you will be notified that the 1-year warranty has started.

http://www.bluefinrobotics.com/assets/Downloads/Terms-and-Conditions-of-Sale.pdf

12. Move the vehicle to a battery storage area or work bench.
13. Place the padlocks and any packing materials inside the shipping case, close and latch the shipping case, and place the case in storage.

This completes the procedure for unpacking the tail section.

6

MAINTENANCE PROCEDURES

Introduction

This chapter explains maintenance procedures required in normal operation.

Corrective maintenance procedures are performed on the vehicle system when operational tests, failure diagnosis, or other observations have detected a failure in the system that can be repaired by the vehicle operator or technician.

The Repair Manual contains only those intermediate level maintenance procedures which can be performed by the technician in a workshop or ISO van in the field. General Dynamics Mission Systems-approved parts and procedures must be used to repair the vehicle. Using unapproved parts and procedures will void the vehicle warranty.

More complex, or depot level corrective maintenance requires specialized equipment and extensive disassembly of vehicle components. Depot level maintenance is carried out by General Dynamics Mission Systems, either on site or at General Dynamics Mission Systems's facilities.

Fairings and Ortman Keys

Vehicle fairings are cast aluminum or ABS plastic. Each section has ortman key grooves at the ends. When the cylindrical sections are pressed together to connect, the ortman key grooves form a channel for the ortman key. Inserting the teflon ortman key attaches the sections together. The ortman key is inserted through oblong slots in the fairing.

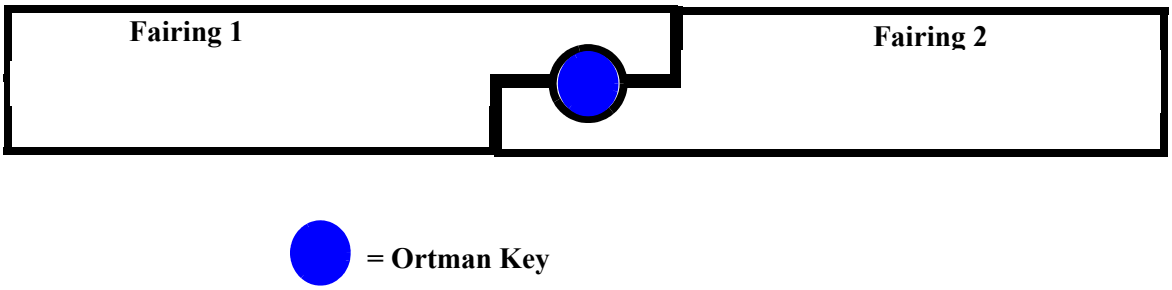


Figure 17: Ortman Key Diagram

Figure 18: Ortman Key

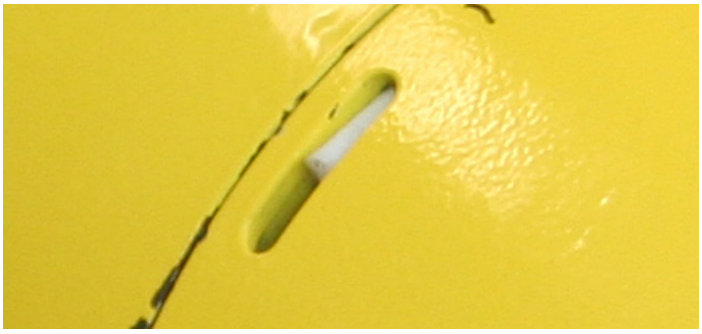


Figure 19: Ortman Key Access slot (Ortman Key End Visible)

The vehicle can be operated with some damage to fairings, but must not be operated if there is any damage to sealing surfaces on the pressure vessel fairing.

Ortman Key Installation Procedure

Tools and Equipment Required

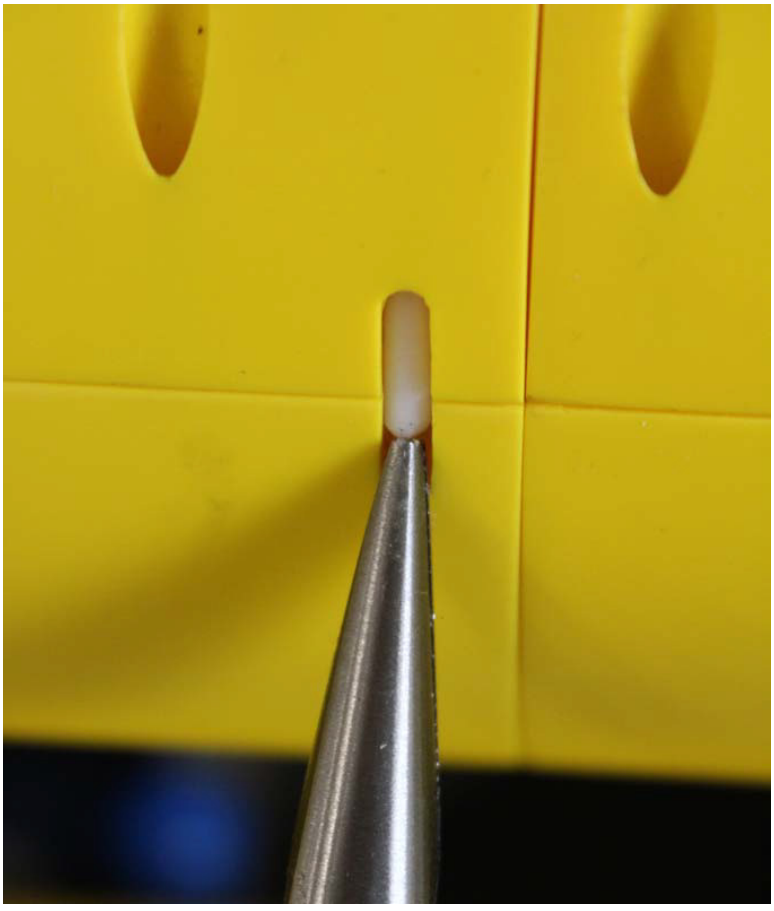
- Needlenose Pliers
- Ortman Key

Background Information

Teflon ortman keys are used to attach cylindrical vehicle sections together.

Description of Work

1. If a section uses o-rings to seal out water, verify that they are there and in good condition.
2. Press the sections together so the ortman grooves line up and form a channel.
3. Insert the ortman key through one of the access slots in the fairing. Push it in. As the front end reaches each of the 4 access slots, use needlenose pliers to guide it back in the channel and continue pushing the key in until it is fully inserted.



This completes the ortman key installation procedure.

Ortman Key Removal Procedure

Tools and Equipment Required

- Needlenose Pliers

Background Information

Teflon ortman keys are used to attach cylindrical vehicle sections together.

Description of Work

1. Grasp an end of the ortman key with needlenose pliers inserted in the access slot.

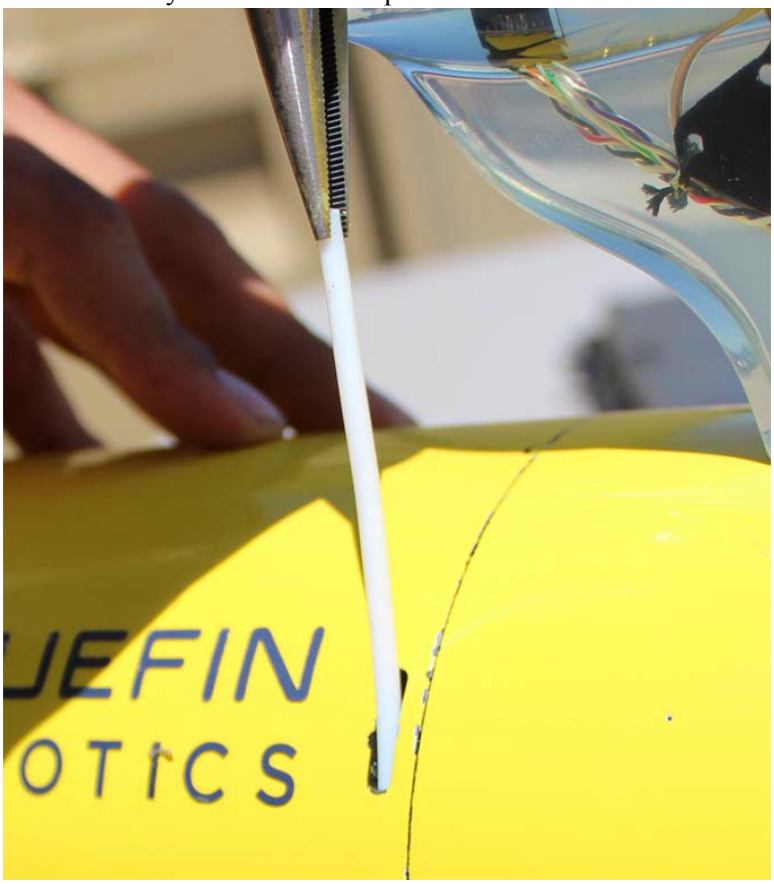


Figure 20: Pull Ortman Key Free

2. Pull the ortman key free of the vehicle.

This completes the ortman key removal procedure.

O-Ring and Seal Maintenance

O-rings must be whole and in good condition. Inspect and lightly lubricate with DC-4 before use.

If a seal is leaking, contact General Dynamics Mission Systems.

Section Attachment Procedure

Tools and Equipment Required

- O-rings (BUNA-N, 2-044, 2-047)
- Ortman Keys
- DC-4
- Needlenose Pliers

Background Information

This procedure applies to all sections and sub-sections attached with ortman keys. The tail section has 4 subsections: the propeller and duct, the fin housing, the battery and control housing, and the endcap.

Description of Work

1. If a section has o-rings, verify that they are intact, in place, and lightly lubricated with DC-4. The following o-rings are in the tail section:

- Fin housing aft: 2-044
- Fin housing fore: 2-047
- Endcap aft: 2-047

2. Slide the sections together so the ortman grooves align. Verify that the o-rings are not pinched or torn.
3. Install the ortman key.

>> See "Ortman Key Installation Procedure" on page 59.

This completes the section attachment procedure.

Section Separating Procedure

Tools and Equipment Required

- Needlenose Pliers

Background Information

Sections are attached with an ortman key.

Description of Work

1. Place the vehicle in a cradle.
2. Remove the ortman key.

>> See "Ortman Key Removal Procedure" on page 60.

3. Slide the sections apart.

This completes the section separating procedure.

Connector Mating Procedure

Tools and Equipment Required

- Canned Air
- 3M Silicone Spray

Background Information

The tail section endcap has 2 Subconn connectors: a MCBH4M and a MCBH8F. They must be mated properly to a cable or dummy cap for vehicle operations in water.

Description of Work

1. Spray the endcap connector and the cable connector with canned air.
2. Spray a light film of 3M silicone spray on the connector on the endcap.
3. Align the pins and sockets on the 2 connectors and press the cable's connector straight into the endcap connector until the faces are flush.
4. Tighten the plastic locking collar down.

This completes the connector mating procedure.

Connector Unmating Procedure

Tools and Equipment Required

- N/A

Background Information

The tail section endcap has 2 Subconn connectors: a MCBH4M and a MCBH8F.

Description of Work

1. Loosen the plastic locking collar.
2. Grasp the cable by the connector and pull straight out.

This completes the connector unmating procedure.

Tail Section Sealing Procedure

Tools and Equipment Required

- Laptop
- Vacuum Pump
- Rare Earth Magnet
- Phillips Head Screwdriver
- O-Rings (BUNA-N; 2-044, 2-047)
- Ortman Keys
- Needlenose Pliers
- DC-4

Background Information

The cast aluminum tail section is a pressure vessel and must be properly sealed before operations in water. It has 3 subsections: the propeller and fin actuation housing, the tube, and the antenna section endcap. Ideally, it operates with a 10 psi absolute vacuum. If the vacuum does not hold, contact General Dynamics Mission Systems.

Description of Work

1. Attach the sections.

>> *See "Section Attachment Procedure" on page 62.*

2. Turn on the vehicle
3. Log in on the vehicle.
4. Monitor the pressure inside the MEH while performing the rest of this procedure.

>> *See "Internal Pressure Area" on page 236.*

5. Using the Phillips head screwdriver, remove the vent screw on the endcap.
6. Hold the vacuum pump hose to the vent screw hole and pull a 1-5 psi vacuum.
7. Quickly replace and tighten the vent screw.
8. If the vacuum does not hold, contact General Dynamics Mission Systems. The vehicle should not be operated in water.

This completes the tail section sealing procedure.

Propeller Replacement Procedure

Tools and Equipment Required

- Woodruff Key
- Retaining Ring (000-016-373)
- Retaining Ring Pliers
- Aquashield
- Cotton Swab

Background Information

The propeller slides onto the propeller shaft and is held in place by a woodruff key and a retaining ring. The propeller's central hole must be coated in aquashield where it touches the shaft.

This task must be performed on a workbench because the woodruff key falls out when the propeller is removed.

Description of Work

1. Using retaining ring pliers, open and remove the retaining ring from the propeller shaft.

Figure 21: Retaining Ring

Figure 22: Retaining Ring on Propeller Shaft

2. Slide the propeller off the shaft. The woodruff key will fall out.
3. Prepare the new propeller by coating the inside of the center hole with aquashield.

4. Insert the woodruff key in the slot on the shaft, curved side in. Hold in place with a finger.

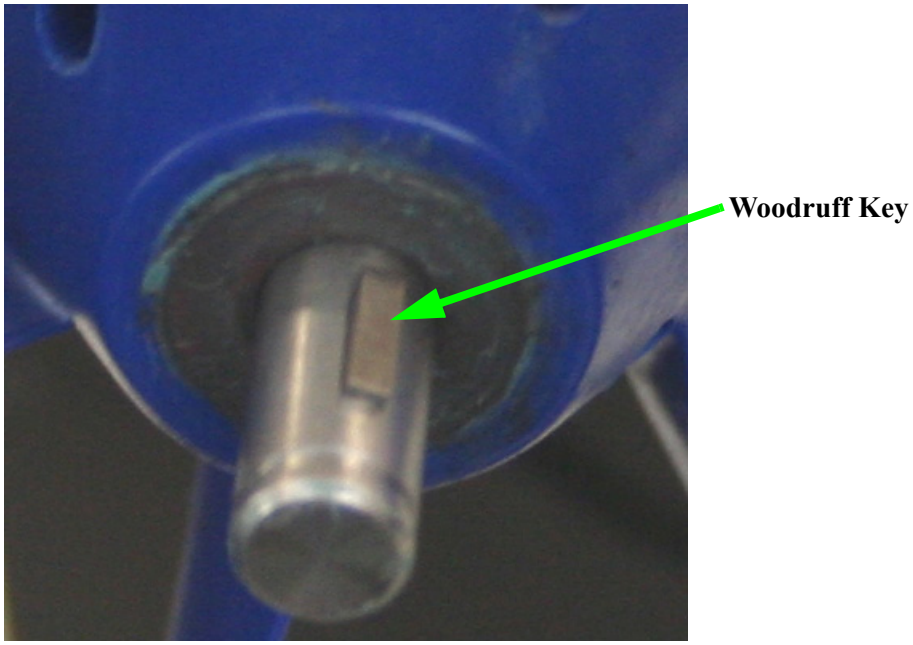


Figure 23: Woodruff Key

5. Align the notch in the propeller's center hole with the woodruff key and slide it onto the propeller shaft and over the woodruff key. It will h old the woodruff key in place.
6. Using the retaining ring pliers, open a retaining ring and insert it on the shaft to hold the propeller in place. Verify that it is fully seated in the groove on the shaft and closes flat when the pliers are removed. Do not use a bent retaining ring.

This completes the propeller replacement procedure.

Duct Replacement Procedure

Tools and Equipment Required

- 4 screws: SCS3PL04012
- 3/32” T-Handle Hex Wrench
- Aquashield
- Cotton Swab

Background Information

The duct slides onto the propeller shaft and is secured to the fairing with 4x 4-40 screws.

Description of Work

1. Remove the propeller.

>> *See “Propeller Replacement Procedure” on page 67.*

2. Unscrew the 4 screws on the duct with a t-handle hex wrench.

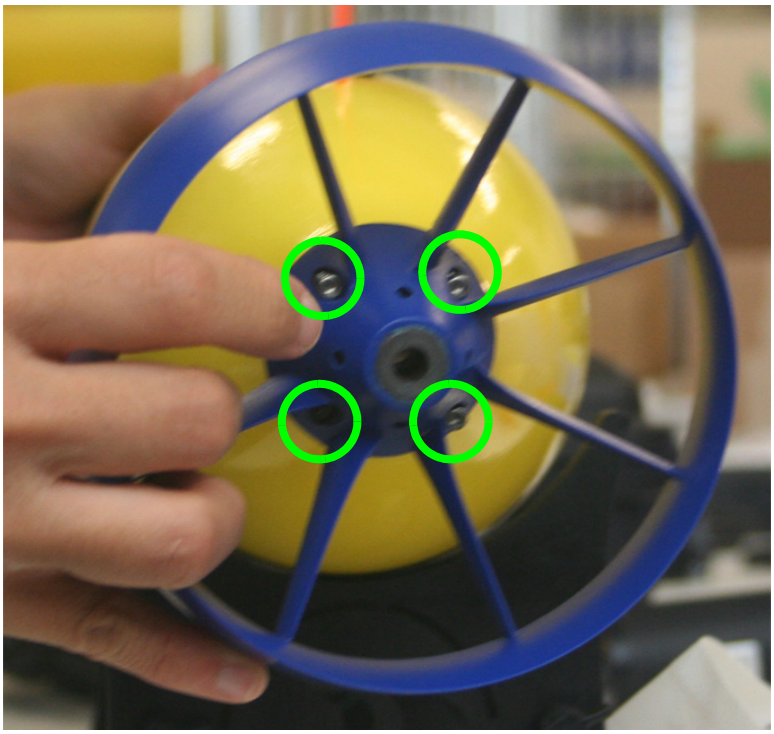


Figure 24: Location of Screws on Duct

3. Slide the duct off the propeller shaft.
4. Apply Aquashield to the threads of the 4 screws.
5. Put 4 screws through the screw holes of the new duct.
6. Slide the duct onto the propeller shaft and align the screws with the mounting holes on the fairing.

7. Using a t-handle hex wrench, engage the 4 screws in the mounting holes, then tighten down in a star pattern.
8. Install the propeller.

>> *See "Propeller Replacement Procedure" on page 67.*

This completes the duct replacement procedure.

Fin Replacement Procedure

Tools and Equipment Required

- N/A

Background Information

The 4 articulating fins are removed and inserted without tools. The two dowels on the fin's pin connector are used to align the fin with the connector on the vehicle. When fully seated, a small gap remains between the blade of the fin and the vehicle fairing.

Description of Work

1. Put the vehicle on a workbench on foam with u-shaped cutouts or a support rack.
2. Put one hand on the fairing to stabilize the vehicle.
3. Pull each fin straight out, one at a time.
4. Align the replacement fin so the dowels on the pin match the notch on the connector.

Figure 25: Dowels on Fin Pin and Connector Indent

5. Press in gently until the fin is fully seated.

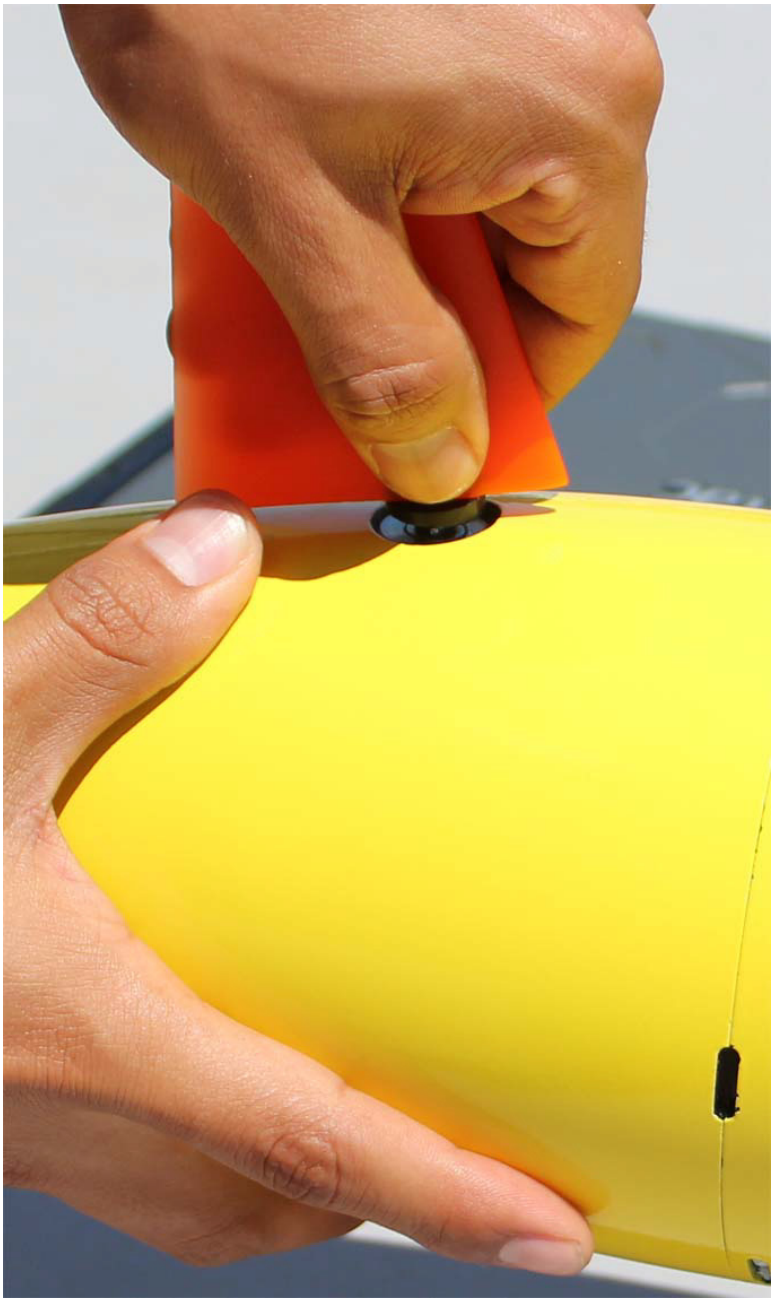


Figure 26: Insert Fin

6. Repeat for each fin.

This completes the fin replacement procedure.

7

TROUBLESHOOTING

Introduction

This chapter explains some common causes of vehicle problems and how to correct them.

Corrective maintenance procedures are performed on the vehicle system when operational tests, failure diagnosis, or other observations have detected a failure in the system that can be repaired by the vehicle operator or technician.

This chapter contains only those intermediate level maintenance procedures which can be performed by the technician in a workshop or ISO van in the field. General Dynamics Mission Systems-approved parts and procedures must be used to repair the pressure vessel. Using unapproved parts and procedures will void the vehicle warranty.

More complex, or depot level corrective maintenance requires specialized equipment and extensive disassembly of vehicle components. Depot level maintenance is carried out by General Dynamics Mission Systems Robotics, either on site or at General Dynamics Mission Systems's facilities.

Cautions

- Never unseal the pressure vessels outdoors.
- All procedures in the Repair chapter are intermediate level maintenance. They can be performed in a properly equiped workshop or ISO van.
- Use only General Dynamics Mission Systems-approved parts and procedures. Using unapproved parts and procedures will void the vehicle warranty.

Roll and CB-CG Separation

Increase CB-CG separation to reduce roll and pitch instability.

See "Trim Instructions" on page 261.

Waypoint Catch Radius

General Dynamics Mission Systems suggests a catch radius of 7 meters.

If the vehicle circles and can't find the waypoint, increase the catch radius.

If the vehicle turns away from the waypoint too soon, decrease the catch radius.

Dashboard: Testing and Troubleshooting

This chapter describes how to control, test, and troubleshoot devices and systems on the AUV using Dashboard.

Most of the vehicle's devices and systems can be both monitored and controlled from Dashboard. Although controlling devices is possible, the operator would typically not switch off devices or device software drivers during a mission. This would normally only be done during testing and maintenance.

Switching Circuits On and Off

Dashboard allows you to switch the Power Control Board circuits on and off. This is done from the **Power and Ground Faults** window.

Switching circuits on and off allows you to perform the following tasks:

- Identify ground faults.
- Restart circuits that fail to initialize properly.
- Turn off devices that are not needed to conserve power or prevent overheating.
- Power off individual circuits for maintenance.

To switch an MEH circuit on or off:

1. Select **Devices > Power and Ground faults** from the menu bar, or click the power and ground faults button (lightning bolt) on the tool bar. The Power and Ground Faults window (Figure 27) opens.

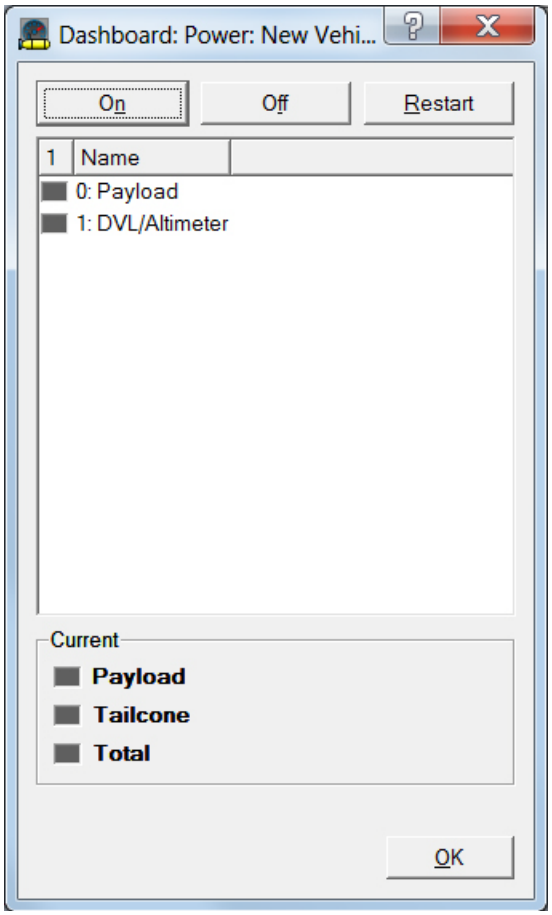


Figure 27: Power and Ground Faults Window

2. Click the circuit name, then click On or Off once to turn the circuit on or off.

NOTE: *If a circuit has an error, the error must be cleared before the circuit can be turned on or off. Click the circuit name and then click* ***Clear Error****.*

NOTE: *When you switch off a circuit, the associated device software driver will stop running. After switching the circuit back on, you will need to restart the driver. A driver may fail if the power is set to off and the driver is* ***not*** *set to off. For information on starting device software drivers, see "Starting and Stopping Device Software Drivers" on page 80.*

NOTE: *Communications circuits pop up a confirmation dialog before turning off the circuit. Do not turn off a communication circuit while using it to communicate with the vehicle. You will not be able to turn it back on.*

3. The status indicator turns grey for Off or blue for On. If the status indicator does not change color when you click the button, click the button again.

NOTE: *The power indicator is only updated every two seconds. Feedback for the command (on/off) is not always immediately available and two seconds is the default minimum time for an update. In a comms-poor environment, such as acomms, when restarting a circuit you may not see the indicator go off at all.*

Starting and Stopping Device Software Drivers

Dashboard allows you to stop and restart device software drivers. This is done from the Device Status window.

To start or stop a device driver:

1. Select **Devices >Device Status** from the menu bar, or type **Ctrl + D**. The Device Status window (Figure 28) opens.

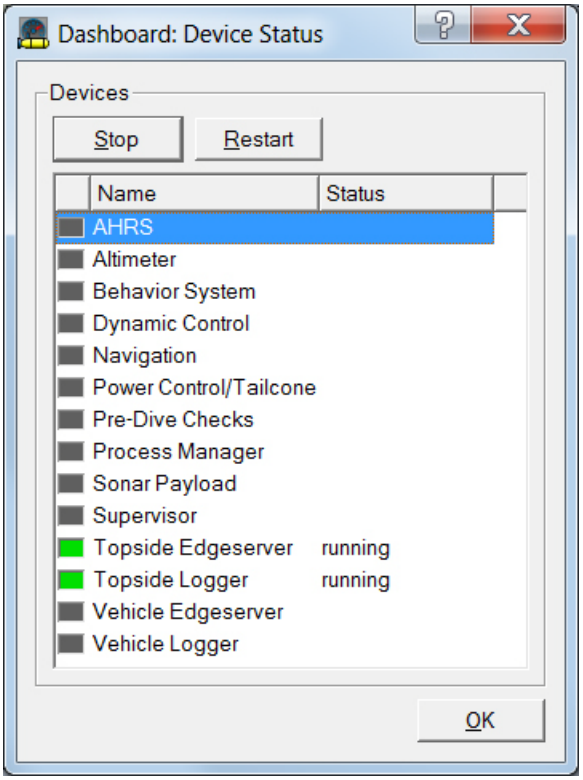


Figure 28: Device Status Window

2. Highlight the applicable device driver by clicking on the name of the device in the current devices list.
3. Click the **Stop** or **Restart** buttons as applicable. The status indicators and information fields will update. If you have stopped the device, the status indicator will be grey. If you started the device successfully, the status indicator will turn green. While starting up, the status indicator will be yellow and the status message will say initializing. If the device fails, the status indicator will turn red.

Troubleshooting the AUV from Dashboard

During mission preparation and pre-dive, while running a mission, or during routine maintenance, Dashboard will display error messages to inform the operator if devices or systems are not functioning properly.

The primary source for information is the Dive Monitor. A red status indicator in any of the areas in the Dive Monitor signals a failure in a related system or device. Further information about the failure can usually be found in the related Dashboard component windows. In the event of a failure during a mission, the status indicator in the Dive Status group will turn red, and a message will appear in the *Details* field, notifying the operator of the problem source, as shown in the example below.

Figure 29: Example of an Error Displayed in the Dive Monitor Status Area

Additional information on the failed device or system can typically be located in either the Device Status window, or the Power and Ground Faults window.

Environmental Errors

The Environmental Status Group area in the Dive Monitor alerts the operator to problems in environmentally sealed components of the AUV.

To identify an environmental error:

1. A red status indicator will alert you to an error state.
2. Click the expansion button located on the right hand side of the appropriate field. (In the example below, this is the *Pressure* field.)

Figure 30: Example of a Pressure Error Displayed in the Dive Monitor

3. The expanded view appears (Figure 31) allowing you to identify the affected component, in this case, the MEH.

NOTE: *Similar expansion windows are available for Pressure faults, Temperature faults, and Humidity faults.*

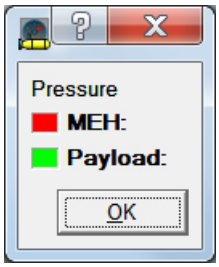


Figure 31: Example of an MEH Error displayed in an Expansion Window

NOTE: *A leak or other environmental error can only be addressed by the repair or replacement of the affected component.*

Communications Errors

Status indicators in the dive monitor communications area will alert the operator to any communication problems.

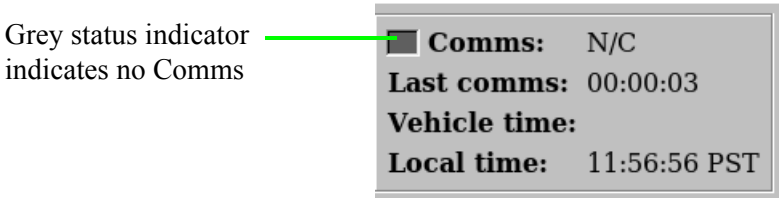


Figure 32: Communications Error Displayed in the Dive Monitor

If there is a problem with the communications connections, do either of the following.

- Verify all external connections between the Operator Computer and the AUV. This includes connections between the Operator Computer and the communications hubs and between the communications hubs and the AUV (e.g. Shore Cable).
- Power cycle all topside communications equipment.
- Restart Dashboard.

Then check the Comms status in the Dive Monitor and/or Pre-Dive Checkout window.

>> For more information on communications connections, see "Connecting to the AUV" on page 194.

Battery Power Errors

The status of the AUV's battery can be checked in the Dashboard Dive Monitor and in the Battery component window.

Summary battery information is available in the Dive Monitor. More detailed battery status information can be found in the Battery Status window. The battery status window is accessed by clicking the battery icon in the tool bar, or by selecting **Devices > Battery** from the menu bar. You can also double-click on the battery bar in the Dive Monitor.

See "Battery Status Window" on page 222 for more information.

If the battery is offline (grey indicator):

- Check that all battery cables are properly connected.
- Switch the battery on using the **ON** control button in the battery component window.

If that does not work, then:

- Power cycle the vehicle

If that does not work, then:

- Check installation of battery and the cable to the MEH

If the battery voltage or current is too low (yellow indicator):

- Remove and replace or remove and charge the battery.

8

PLANNER: INTRODUCTION

The Planner application allows you to create and edit missions to be executed by an AUV. Planner incorporates charts and maps to simplify the creation of missions by providing an intuitive and user-friendly interface.

The Planner application:

- Lets you create missions using Planner's simple click and place pre-defined mission elements.
- Lets you configure survey and mission parameters to plan around obstacles.
- Lets you edit the properties of pre-existing missions created in or imported into Planner.
- Outputs the mission file and all associated files to a directory on the Operator Laptop or to an external storage device in the appropriate format for uploading to the AUV.

A complete description of the Planner interface and how to use it is found in this manual. The remainder of this chapter describes how to install, launch, and exit Planner.

Installing Planner

If General Dynamics Mission Systems has provided the Operator Laptop (OL) for your AUV system, Planner will already be installed on it. If you are installing Planner on a different computer, you will install it using the Planner installer on the OTS CD you have received.

To install Planner:

1. Insert the Topside Software CD into the CD-ROM drive.
2. Double-click on the Planner installer desktop icon to run the installation program:

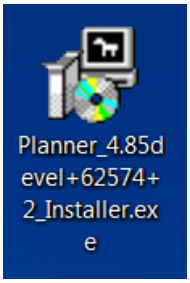


Figure 33: Planner Installer Icon on Desktop

3. Read and accept the General Dynamics Mission Systems Software License Agreement.

Figure 34: General Dynamics Mission Systems Software License Agreement

4. The installation program starts and guides you through the process.

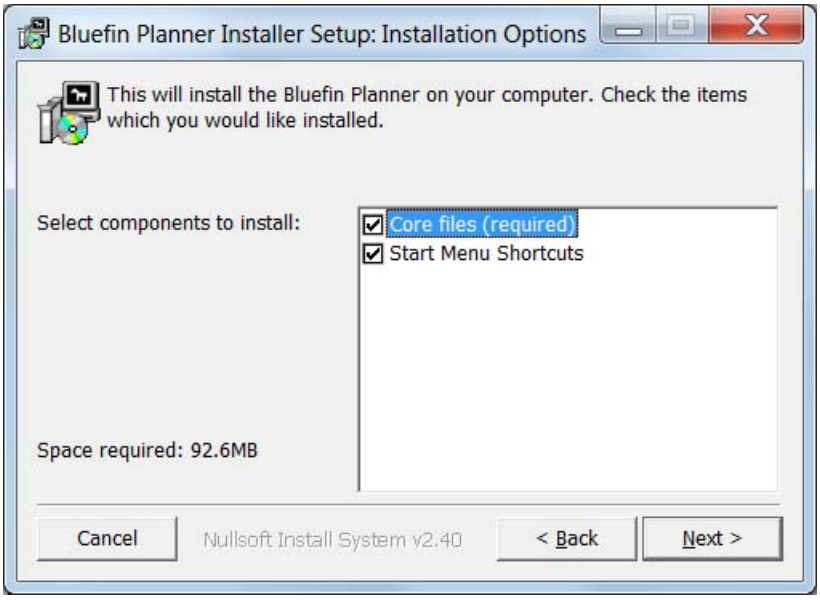


Figure 35: Starting the Planner Installer and Selecting Files to Install

5. Select Core Files.
6. (Recommended) Select Start Menu Shortcuts.
7. Click Next. The installer prompts you to select the destination folder.

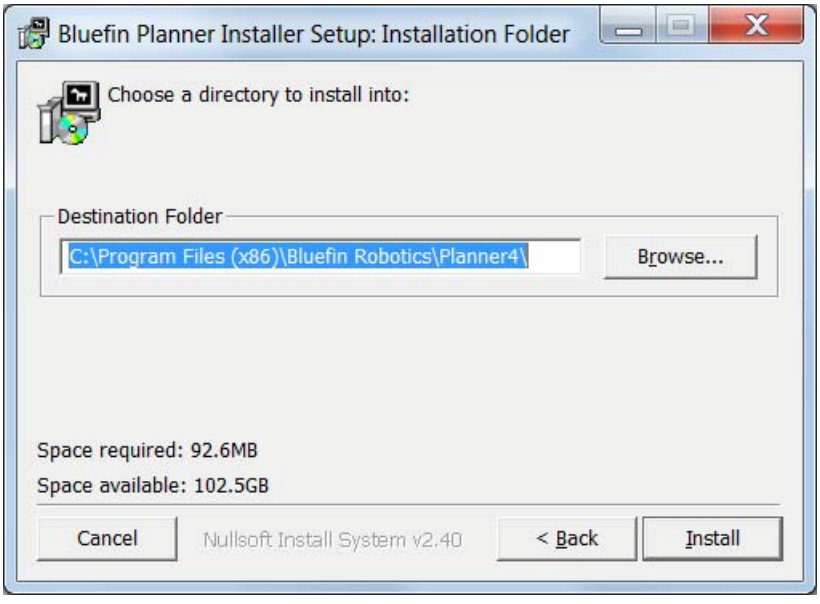


Figure 36: Selecting the Destination Folder

8. Select the destination folder. General Dynamics Mission Systems recommends using the default location. The default directory is:
   `C:\Program Files (x86)\Bluefin Robotics\Planner4\`
9. Click the **Install** button to proceed (or click **Cancel** to stop the installation).
10. A progress bar is displayed indicating the progress of the installation process.

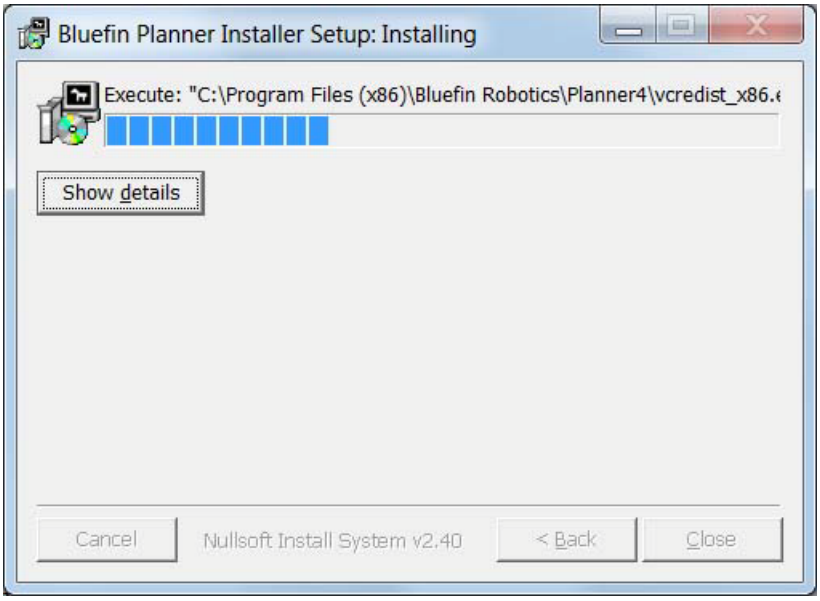


Figure 37: Installation Progress Bar

11. When the installation is complete, click **Close** to finish the installation process.

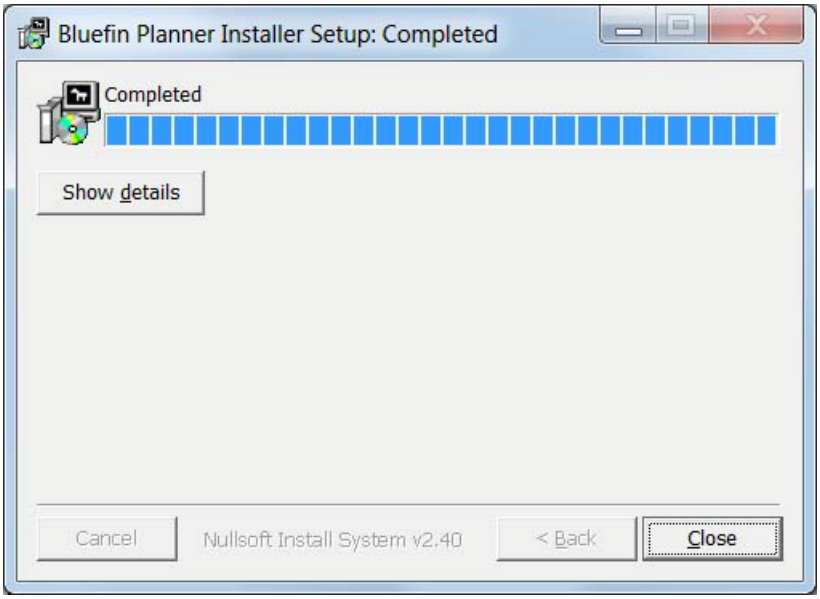


Figure 38: Installation Completed

12. If the Windows Program Compatibility Assistant pop-up window opens, click **Reinstall using recommended settings** and repeat the installation process.

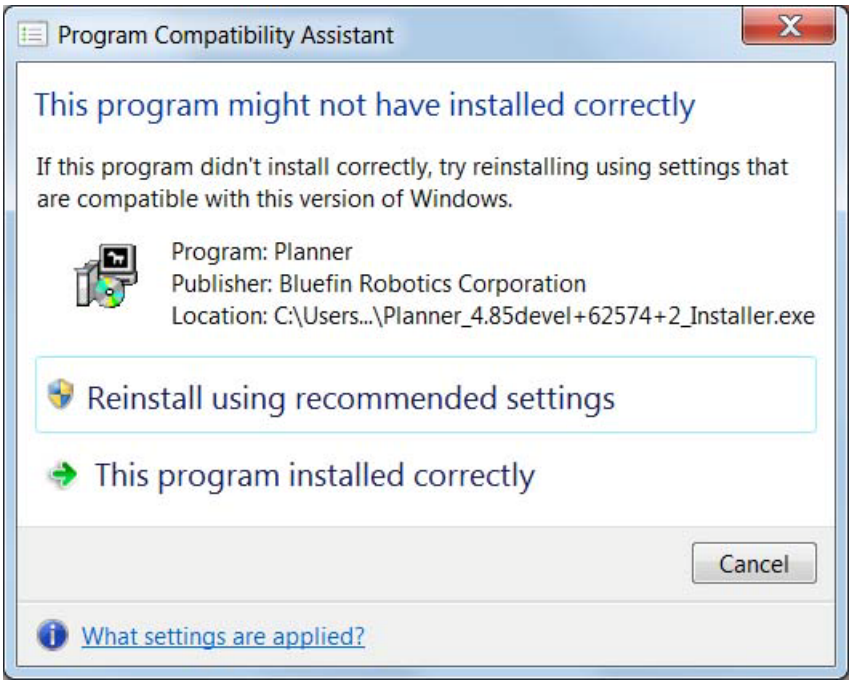


Figure 39: Program Compatibility Assistant

Planner is now installed.

Getting Started

Starting Planner

You start Planner as you would any software application, by double-clicking the Planner icon located on the desktop, or from within the Bluefin Robotics entry in the Start menu.

When you start Planner you will be prompted to fill in operator information that is used to identify the mission, and you will also select your vehicle system from a list of AUVs so that Planner will be configured to work with your AUV system.

To start Planner:

1. Double-click the Planner icon on the desktop, or select Start > All Programs > Bluefin Robotics > Planner. The program launches, displaying the vehicle selection window.

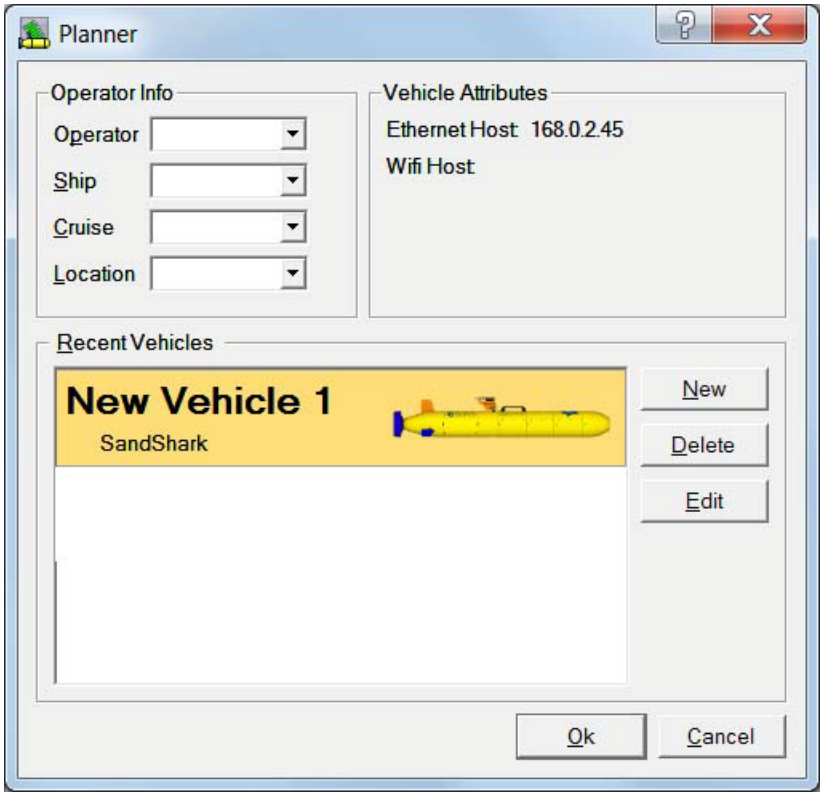


Figure 40: Launching Planner–Vehicle Selection Window

2. Enter the operator information (optional):
   - Operator Name
   - Ship's Name
   - Cruise (Deployment) Name
   - Location
3. Select your vehicle from the recent vehicles list.

NOTE: *If your vehicle does not appear in the list, see "Adding a New Vehicle or Editing an Existing Vehicle" on page 91.*

4. Click **OK**.
5. The Planner interface opens to the main window. Planner opens with the most recently viewed chart displayed.

NOTE: *If you are unable to start Planner, please do not hesitate to contact Customer Service at Bluefin_Support@gd-ms.com.*

Adding a New Vehicle or Editing an Existing Vehicle

If you have more than one AUV that you use Planner for, you can add more vehicles to the recent vehicles list in the vehicle selection window.

To add a vehicle:

1. In the vehicle selection window, click the **New** button next to the recent vehicles list. The **Vehicle Edit** window opens.

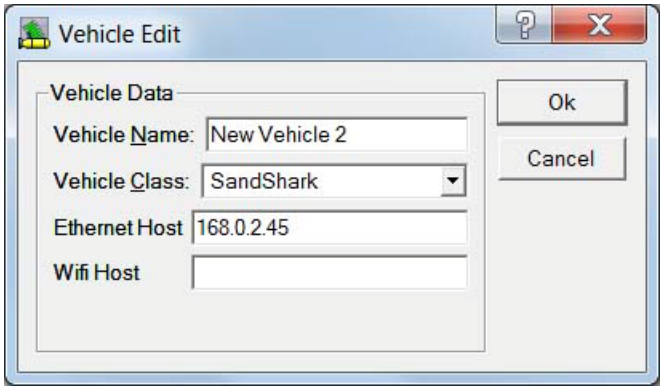


Figure 41: Vehicle Edit Window

2. In the Vehicle Name field, enter a name for the new vehicle.
3. Use the pull-down menu in the vehicle class field to select the vehicle type.
4. Enter the Ethernet Host and other addresses for the various communications links in the communications device fields.
5. Click **OK** to save the settings and return to the vehicle selection window.

To edit a vehicle:

1. In the vehicle selection window, select the vehicle you want to edit from the recent vehicles list.
2. Click the **Edit** button next to the recent vehicles list. The **Vehicle Edit** window (see Figure 41) opens.
3. Edit the fields you want to change, and click **OK** to save the changes and return to the vehicle selection window.

Deleting a Vehicle from the Vehicle Selection Window

If you want the Planner vehicle selection window to display only the vehicles that you have, you can delete vehicles from the recent vehicles list.

To delete a vehicle:

1. Select the vehicle from the recent vehicles list.
2. Click the **Delete** button next to the recent vehicles list. A confirmation dialog opens.
3. Click **OK** to delete the vehicle from the list, or click **Cancel** to return to the vehicle selection window without deleting the vehicle.

NOTE: *Deleting a vehicle from the list does not remove that vehicle type from the list of available vehicle classes in the Vehicle Edit window. You can always create a new vehicle if you accidentally deleted one.*

Setting Preferences

In the Preferences window you can set default measurement units for the application, specify which mission features are displayed in the chart section, and configure the list section.

The Preferences window is accessed by selecting **Edit > Preferences** from the menu bar.

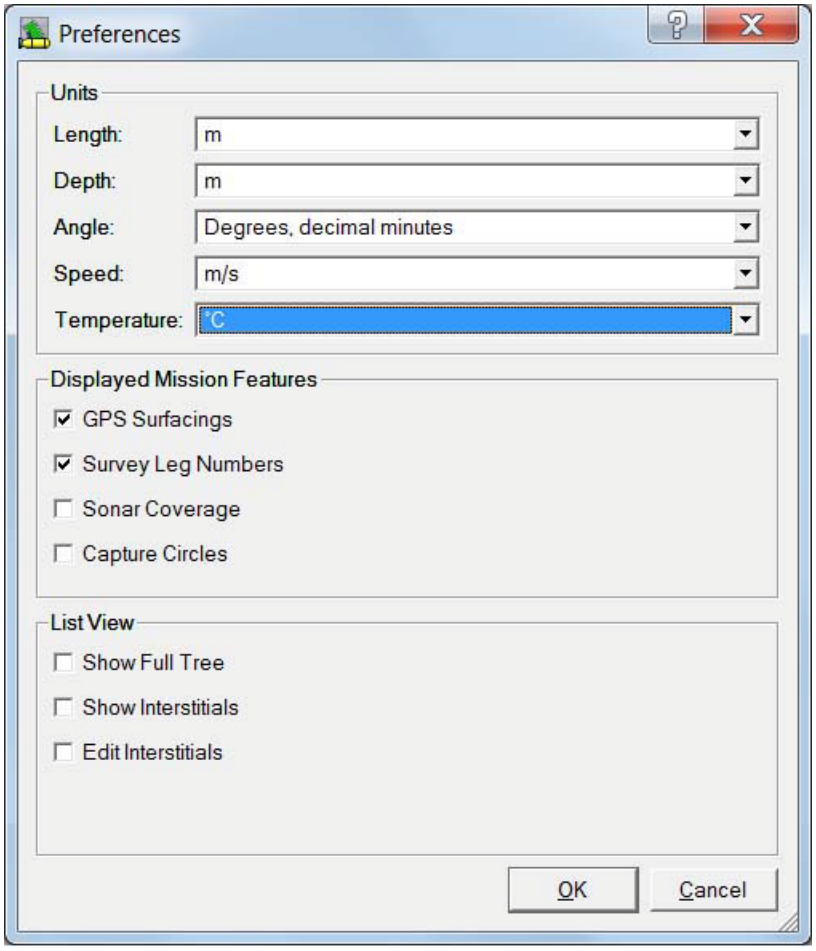


Figure 42: Preferences Window

In the Preferences window you can choose:

- The measurement units used when working in Planner.
- The mission features that are displayed in the graphical representation of the mission in the chart section:
  - **GPS Surfacing** displays the points at which the AUV surfaces for GPS
  - **Survey Leg Numbers** displays numbers for each leg of the survey
  - **Sonar Coverage** displays a yellow overlay on each survey leg to indicate sonar coverage
  - **Capture Circles** displays a capture circle around each point with a capture circle

NOTE: *The sonar coverage overlay may not display for all payload types.*

The display options for the list view area:

- By selecting the **Show Full Tree** checkbox, the full tree structure of the mission elements is available in the list section.

- By selecting the **Show Interstitials** checkbox, the mission element interstitials (transits between elements) are shown on the map.
- By selecting the **Edit Interstitials** checkbox, the interstitials can be edited.

You can change application preferences at any point during mission planning.

Exiting Planner

To exit Planner, either:

- Click the **X** in the top right corner of the Planner application window, or
- Select **File > Exit**.

Getting Help

This document is available in pdf format under the Help menu in the Planner menu bar. To access this document, from the menu bar, select **Help>User Guide**.

NOTE: *If you need assistance, please do not hesitate to contact Customer Service at Bluefin_Support@gd-ms.com.*

9

PLANNER: INTERFACE

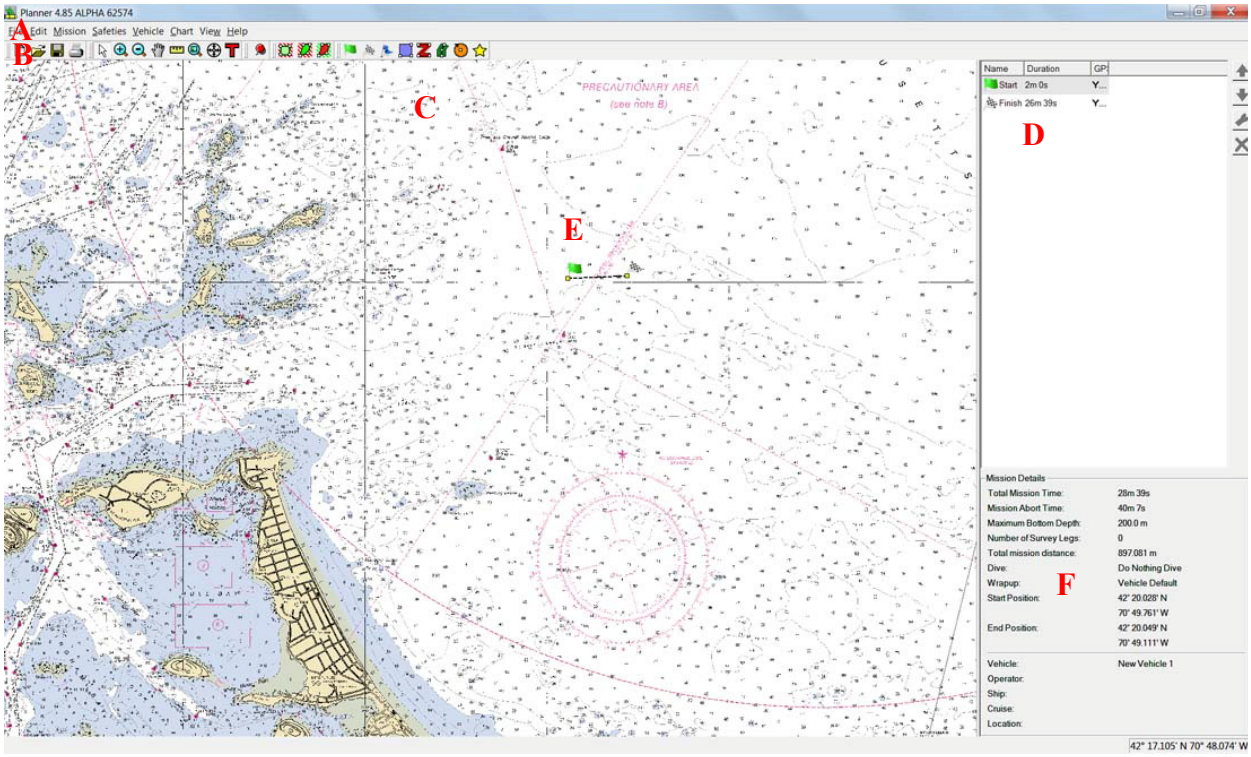
The Planner user interface contains the following three main areas (in addition to menu and tool bars):

- Chart Section
- List Section
- Mission Details Area

Either the chart section or the list section can be used for planning missions. The chart section allows you to view the planned mission in a graphical format on a chart of the intended mission area, and resize, rotate, and reorganize the mission elements. The list section allows you to view the mission's elements in chronological order and to reorder them. Of course, you can use both sections simultaneously, for example, plotting the mission on the chart and then fine-tuning the mission using the drop-down items in the list section. From either section, you can select a particular mission element for detailed editing of its behavior or its survey payload parameters.

If you are planning multiple missions during a Planner session, the list section contains tabs representing each planned mission. You can also select or deselect either the chart section or the list section so that only one of them is displayed. This is useful for viewing the maximum amount of detail in the chart section, for example.

The Planner interface is described in this chapter.



A Menu Bar–contains a number of drop-down menu items for configuring Planner, creating and editing missions, and saving, exporting and importing missions.

B Tool Bar–contains tools for quickly creating mission elements, working in the chart section, and saving and importing mission files.

C Chart Section–The chart section displays a nautical chart of the intended operating area on which the AUV's mission is plotted. Using the chart tools, you can measure distances, magnify areas, add annotations, etc. You can also use the chart area together with the tracking feature to track the AUV in real-time on the chart (some systems/requires additional topside equipment)

D List Section–In the list section you can view details of the mission in a list format, with columns displaying how the mission is configured.

E Mission -The mission appears here as a series of connected elements.

F Mission Details-displays summary information about the mission as it is planned.

Figure 43: Planner Interface

The Chart Section

In the Chart section, you can load a chart to aid in plotting your mission, or to use when tracking a mission. You use the tool bar buttons to plot and edit mission elements, and to manipulate the chart. As you create a mission, a graphical representation of the mission displays on the chart. The mission can be edited directly in the chart section or it can be fine-tuned in the list section.

Planner recognizes the following chart formats:

- Geo-Referenced Chart (.JPG, .TIF)
- Geo-Referenced Raster Chart Images (.BMP, .PNG)
- Raster Nautical Charts (RNC): BSB format, file extensions .KAP or .CAP
- Vectorized Chart (VPF): file extension .DHT

Information about TIFF charts output from the NOAA Chart Reprojector can be found at the following web site:
https://coast.noaa.gov/digitalcoast/tools/chartreprojector

NOAA TIFF charts may be downloaded here:
https://www.nauticalcharts.noaa.gov/mcd/Raster/download_agreement.htm

Information about Digital Nautical charts can be found at the following web site:
https://dnc.nga.mil/DNCdb.php

Most of the information you will need is found on these web sites, including chart conversion, applying patches, etc. Please contact General Dynamics Mission Systems Customer Support at *bluefin_support@gd-ms.com* if you need further assistance with charts.

Loading a Chart

To view a chart of the mission area, you must first load the chart into Planner. Your version of Planner may come with a number of charts pre-installed. If there are pre-installed charts, these will be listed at the bottom of the Chart menu. To choose one of these charts, simply select the Chart menu and scroll down to the chart list and click on the applicable chart.

To load a chart:

1. Select **Chart > Select Chart** from the menu bar. The Choose Chart To Open window opens.
2. Find the chart of the survey area, select it and click Open. The selected chart opens in the chart section.

NOTE: *If the chart you have selected requires specifying a particular projection type (e.g. non-geo-referenced tiff charts), or requires selecting particular features to display (e.g. DNC charts) an alert will be displayed informing you that the chart properties need to be adjusted in order for the chart to display correctly. For more information, see "Editing Chart Properties" on page 98.*

Editing Chart Properties

When you select a chart for use in Planner for the first time, you may have to specify the projection type or select which features of the chart to display. You can also assign a name to the chart which will display in the recently used charts list in the Charts menu.

Setting the Projection Type for an Imported Chart

Depending on the format of the chart you are importing, you may have to set the correct projection type for the chart. There are three available options: Unprojected, Mercator, and UTM. The projection type for the chart will be included in the documentation accompanying the chart.

To set the projection type:

1. Select **Chart > Edit Chart Properties** from the menu bar.
2. The Pick Projection window opens (Figure 44).

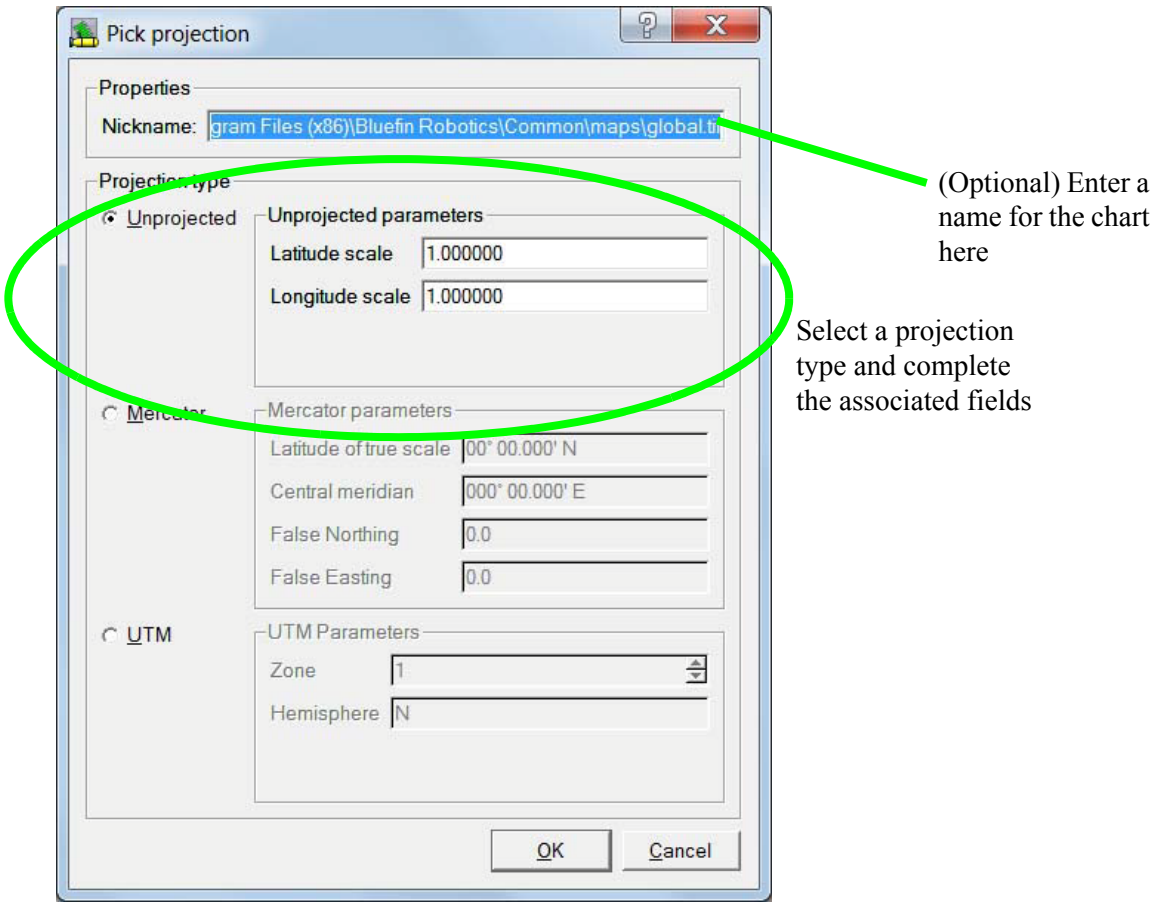


Figure 44: Projection Type Selection Window

3. Select the applicable projection type for the chart and complete the fields associated with that type.
4. Enter a descriptive name for the chart in the Nickname field in the Properties area. This will make it easier to find charts in the future.

5. Click OK to apply the configuration to the imported chart.

Selecting Features When Importing a Digital Nautical Chart (DNC)

When you import a Digital Nautical chart into Planner, you will need to select which features of the chart you want displayed in the chart area. This is done in the Import Options window (Figure 45). You can select features to import by checking or unchecking the check boxes next to individual features.

NOTE: *Displaying all of the features in a DNC may make the mission difficult to view on the chart. You can experiment with which features to view until you find a feature set that is appropriate.*

NOTE: *The available import options vary between DNCs. The Import Options window shown here is an example.*

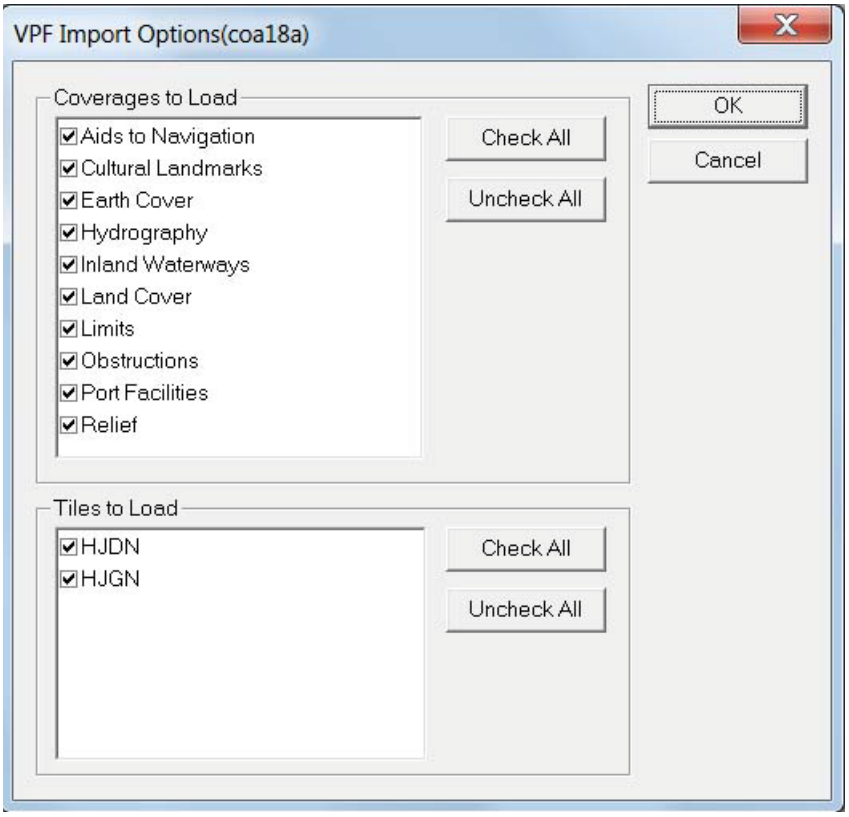


Figure 45: Import Options Window for Digital Nautical Charts

Naming a Chart

The default name of a chart you are using in Planner can be changed, so that it can be easily identified and selected from the list of recently used charts in the **Chart** menu.

To name a chart:

1. Select **Chart > Edit Chart Properties** from the menu bar. In the chart information window, you can specify a name for the chart.

NOTE: *Depending on the format of the chart, if this is the first time you are opening the chart in Planner, you may have to select the projection type or select features (for a DNC). For more information, see "Setting the Projection Type for an Imported Chart" on page 98, and "Selecting Features When Importing a Digital Nautical Chart (DNC)" on page 99.*

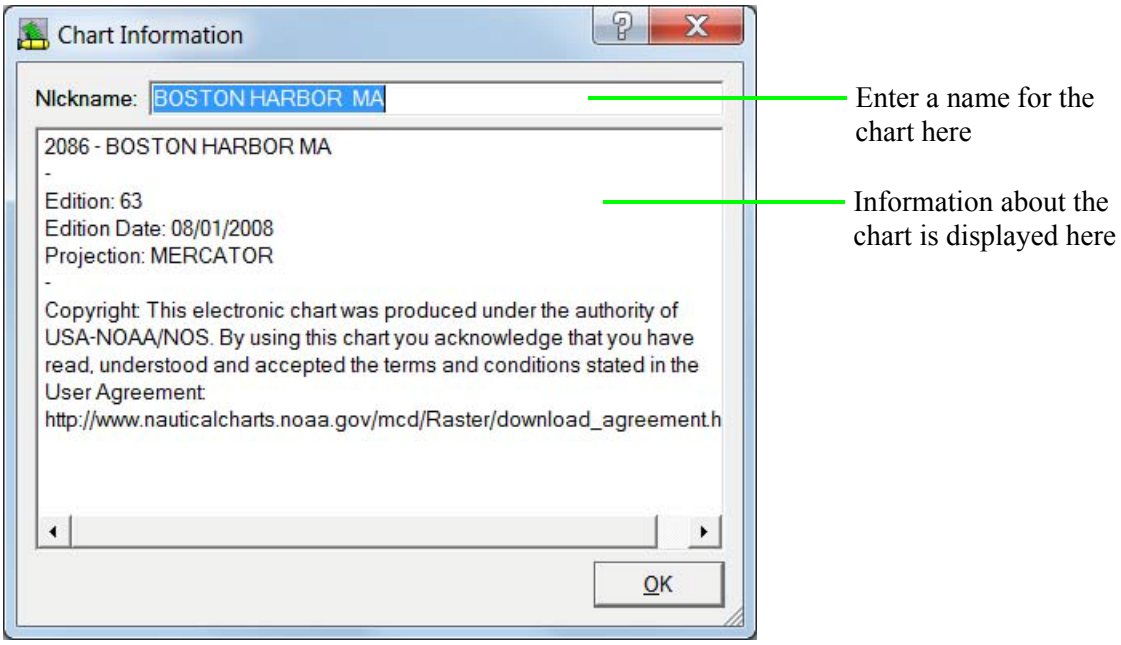


Figure 46: Chart Information Window

2. Enter the name of the chart in the Nickname field, and click **OK**. The chart is named, and the new name will display in the list of charts at the end of the chart menu.

Working in the Chart Section

Planner contains a number of tools for working within the chart view while planning missions or tracking vehicles.

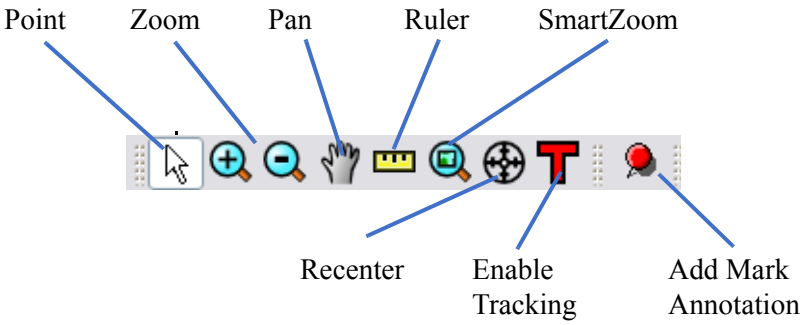


Figure 47: Chart Section Tools

Zooming In or Out on the Chart

If you want to focus on a particular area of the chart, you can use the zoom in or zoom out tools in the tool bar. The zoom in button magnifies a selected area of the chart. To zoom in, select the zoom in tool, then either click on a point in the chart (2x magnification), or click and drag over an area of the chart. To zoom out, select the zoom out tool, and click on a point in the chart.

Moving the Chart

Use the pan tool to move the chart in the chart section. Select the pan tool, then click and hold a point on the chart, and move the chart by moving the cursor.

The pan tool can also be selected by holding the space bar when the point tool is being used.

1. Select point tool.
2. Move cursor over the chart area
3. Press and hold the space bar, the cursor changes to the pan tool icon
4. While holding the space bar, left click and drag the mouse to move the chart
5. Release the space bar and the cursor changes back to the point tool.

Taking Measurements in the Chart

The ruler tool allows you to measure distances on the chart. To take a measurement, select the ruler tool, click a point on the chart, then move the cursor to a second point and click again. The distance between the two points will display in the bottom left corner of the Planner interface, as well as the Azimuth (compass heading) between the two points.

Using the SmartZoom Tool

The SmartZoom tool allows you to zoom in and center the chart on the mission elements and annotations on the chart.

Automatically Recentering the Chart

The Auto Recenter tool allows you to center the chart on a selected tracking asset as it moves. It retains the same zoom level. Click on the icon and select the asset from the menu. For example, if you track the ship, the chart will recenter on the ship with each new GPS update.

Enabling Tracking

Tracking shows the last reported location of the AUV or other assets based on data from a selected communication sensor. Use the enable tracking tool to enable tracking of the AUV or other assets. For more detailed information about tracking, see Chapter 14: "Planner: Tracking".

Adding Annotation Marks

You can add annotations to any chart to aid in location of the AUV, visually represent obstacles, demarcate areas that have already been surveyed, mark sonar contacts, etc. An annotation mark is a mark on the chart accompanied by a short label, and, if desired, surrounded by a number of rings at a configurable distance from the center of the annotation.

NOTE: *Planner saves annotations in the mission file, not the chart. The annotations will reappear if the mission is loaded into a later Planner session, or in Dashboard.*

To place an annotation, click the add annotation tool on the tool bar and click a point on the chart, or select **Chart > Add annotation** from the menu bar and click a point on the chart. A mark appears on the chart, labeled with the time it was created.

You can customize the mark by selecting the pointer tool, right-clicking on the mark, and selecting Edit in the pop-up menu. The **Edit Annotation Mark** window (Figure 48) opens in which you can specify the exact appearance of the annotation mark. The available options are as follows:

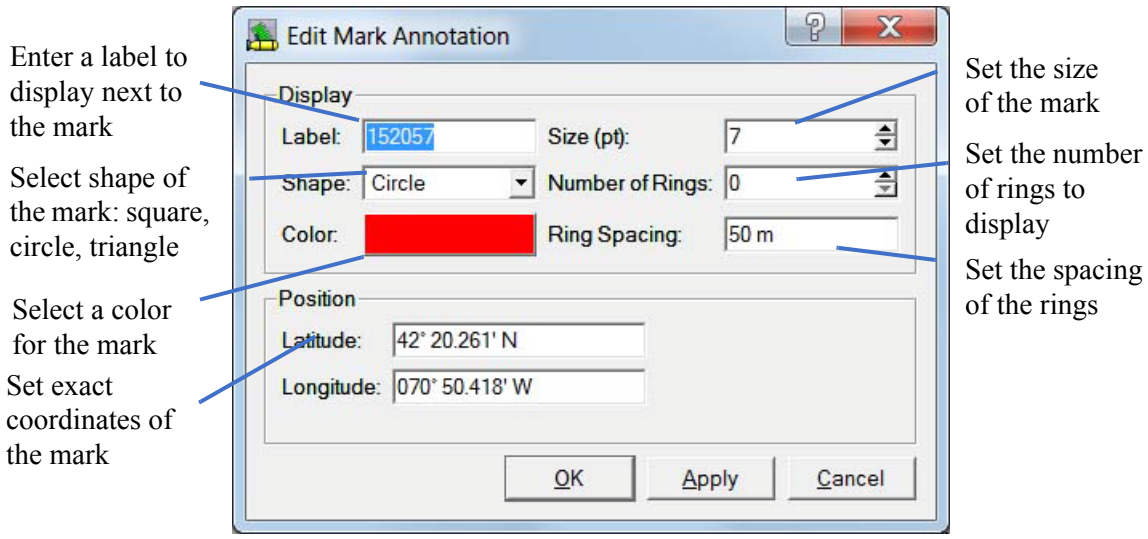


Figure 48: Editing an Annotation Mark

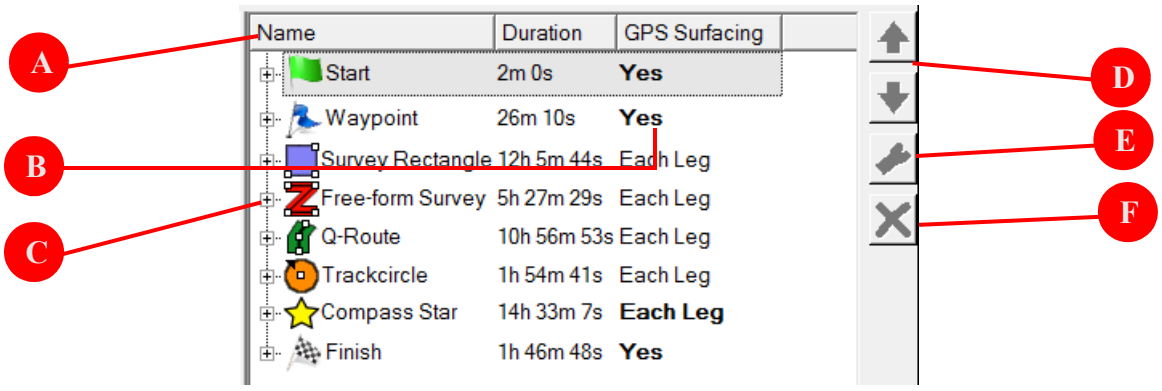
You can delete the mark by selecting the pointer tool, right-clicking on the mark, and selecting Delete in the pop-up menu.

Caution

•If two annotations are very close to each other, a drop-down menu appears and allows the user to select one to delete. Double-check the annotation name before deleting it.

The List Section

In the List section, you can view a planned mission in a list format. The mission elements are listed in the order in which they occur, and the details of each mission element (and survey trackline) can be displayed in the adjacent columns. In the list section, you can fine-tune the mission configuration by individually adjusting the defaults for settings. Adjustable settings include: GPS surfacing and thruster speed among others.



A Each column represents mission information (e.g. duration) or a configurable feature (e.g. speed).

B In some instances, you can edit mission elements directly in the list section. For example, if you select the waypoint, and click in the GPS field, you can turn GPS Surfacing on or off for that waypoint.

C You can expand the display of a particular element by clicking on the + sign next to it. The sub-elements are displayed and can be available for editing. for that element.

D The arrow buttons allow you to move elements up or down in the mission sequence.

E This button accesses a mission element's properties window.

F This button deletes a mission element.

Figure 49: The List Section

Viewing a Mission Plan in the List Section

A mission plan created in the chart section is automatically displayed in the list section, and any changes you make in the chart section are displayed in the list section and vice versa. By default the Planner window is split into the chart section and the list section. You can resize either section by locating the pointer on the border between the two and dragging the border left or right. You can also choose to view only the list section or the chart section by selecting or deselecting them in the **View** menu.

Expanding the List

By default the list section displays only the top level mission elements (e.g. waypoint) but the full layout is available by clicking on the expansion button (+) next to the mission element. If the expansion button is not visible, it can be turned on in Preferences. See “Setting Preferences” on page 92.

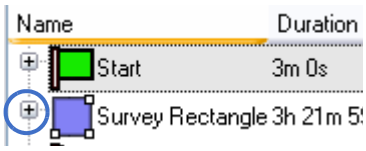


Figure 50: Expanding a Top Level Mission Element

To view more detail about the various configurable features of the mission element, you can add columns to the list section. This is done by selecting features from the **View** menu. The available features vary by system, but typically include the following: mission duration and speed, depth/altitude, track spacing, survey dimensions or number of tracks, and sonar configuration.

NOTE: *If all the possible features are displayed in the list, it is recommended that you deselect* ***Chart Section*** *in the* ***View*** *menu, in order to be able to properly view the full list.*

Changing the Order of the Columns in the List Section

You can change the order of the columns in the list section by grabbing a column heading and dragging it to a new location in the column heading bar. An outline of the heading appears as you drag it to its new position.

Editing Mission Elements in the List Section

To the right of the list section are four buttons, an up arrow, a down arrow, a wrench, and an X. These buttons are used to change the order of mission elements, access the Edit Properties Window for a selected element, or to delete an element. If a particular function isn’t available for a selected element, then that button will be inactive.

Some element attributes can be edited directly in the list section. Where this is possible, the selected attribute will become active when it is clicked. For example, if you select a survey rectangle element and then click in the RPM column, up and down arrow controls appear next to the RPM value for that element, allowing you to increase or decrease the speed for that element (see figure below).

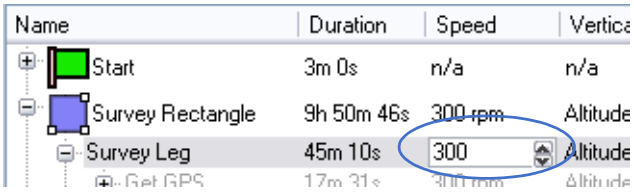


Figure 51: Editing an Element Attribute in the List Section

NOTE: *Individual smaller elements in a larger mission element are locked to prevent editing by default. To unlock the smaller elements in a larger mission element, select the larger mission element and click the wrench button. The larger mission element's properties window opens. Click OK to close the window and unlock the individual smaller elements.*

Moving a Mission Element

To move an element within the mission, select that element in the chart section and then click the up arrow button to move the element above the preceding element in the list, or the down arrow button to move the element below the next element in the list.

Accessing an Element's Properties Window

To access an element's properties window, select the element in the chart section and then click the wrench button. In the properties window, you can configure layout, control options, and sonar options.

>> *For more information about the Properties window, and editing mission elements, see Chapter 12: "Planner: Editing Mission Elements".*

Deleting an Element

To delete an element, select the element in the chart section and then click the X button.

The Mission Details Area

The Mission Details area displays summary information about the mission as it is planned. This includes the location and layout of the mission, survey(s), energy estimates, and operator/creator information. This information is saved with the mission. This area automatically updates itself as changes are made in other sections.

Figure 52: The Mission Details Area

Total Mission Time

The total mission time estimate does not use current in its time calculations. If a mission area has significant currents, increase the mission abort time factor in the mission safeties to compensate for reduced travel speed.

Creating Multiple Missions in a Planner Session (Using Tabs)

You can plan multiple missions during a single Planner session by creating a new tab with a new mission. To open a new tab, select **File > New Tab** from the menu bar, or press **CTRL + T**. (Note: Opening a new tab is different from creating a new mission using **File > New**, as creating a new mission closes the current mission.) Using tabs allows you to switch between mission plans easily, and leaves the other mission plans visible on the chart section to aid you in planning new missions.

When creating multiple mission plans in a single session of Planner, the missions appear as separate tabs in the list section. The selected mission tab is always the active mission. When you switch between mission tabs, the inactive mission plans in the chart section are still displayed, but are faded out.

If a mission has been read from or saved to a file, its name is displayed in the mission tab. General Dynamics Mission Systems recommends saving new missions before you start working in them. This will help you quickly identify a mission when multiple tabs are present.

Menu Bar Items

Figure 53: Planner Menu Bar

The Menu bar, located near the top of the Main window beneath the Title bar, consists of a series of drop-down menus.

A check mark displayed to the left of some menu items indicates that the corresponding feature is enabled. Select the command to toggle the feature on/off.

Planner menus display shortcut key combinations adjacent to certain commands in the drop-down menus. These combinations activate a menu item using the keyboard.

Table 5: Menu Bar Items

Menu	Item Description
File	**New**–Creates a new mission **Open**–Opens an existing mission **Save**–Saves the active mission **Save As**–Names and saves the active mission **Save to RDSM**–Saves the mission to a removable data storage module. Not applicable to this vehicle. **Print**–Print mission **New Tab**–Opens a new mission tab in the list view **Close Tab**–Closes the active tab **Import**–Imports a mission file created in a different application. **Export**–Exports a mission to a different format (not for use in Dashboard or on the vehicle). The export wizard allows users to select from multiple supported formats and filter the types of data exported. (Formats include Geo-referenced TIFF, jpeg, and others.) **Exit**–Exits Planner

Table 5: Menu Bar Items

Menu	Item Description
Edit	**Undo**–Reverses the most recent change. **Redo**–Reapplies the change. **Cut**–Removes a selected element. **Copy**–Places a copy of the selection on the clipboard. **Paste**–Pastes from the clipboard. **Switch Vehicle or Operator**–Closes the current Planner session and opens a new one. **Move Element Earlier** and **Move Element Later**–Rearranges the order of elements in the element list and in the mission. **Element Properties**–Edits the properties of a selected mission element. Opens the Edit Survey Properties dialog. **Delete Element**–Deletes a selected element from the mission. **Preferences**–Sets application and interface preferences. (Including display units, display of elements, etc.) **Night Mode Toggle-**Changes the display to or from red-on-black night mode.
Mission	*>> For more information about mission elements and creating mission elements, see Chapter 10: "Planner: Mission Elements".*
Safeties	**Set Mission Timer**–Sets the abort timer for the mission. **Set Depth/Altitude Limits**–Sets the maximum bottom depth and minimum safe operating altitude in the survey area. **Configure Dive**–The dive configuration settings determine which type of dive the AUV uses to get beneath the surface of the water. **Configure Wrapup**–The wrapup configuration settings determine how the AUV behaves at the end of the mission, both during normal operations and when an abort occurs. **Edit Bounding Region**–Edit the mission bounding box. **Clear Bounding Region**–Removes the mission bounding box.
Vehicle	**Default Mission Properties**–Accesses the default mission properties window for the selected vehicle.

Table 5: Menu Bar Items

Menu	Item Description
Chart	**Select Chart**–Select a chart to use in the Planner Chart area **Edit Chart Properties**–Name charts and configure how they are displayed. **Configure Tracking**–Access the tracking configuration window to set up tracking. **Add Annotation**–Add annotations to the mission file. (e.g. mark known hazards, shallows, etc.) **Clear Annotations**–Clear all annotations from the mission. ***NOTE:*** *This clears ALL annotations, not just selected ones.* **Show Tracking**–Toggle tracking display on/off **Show Chart Background**–Toggle Chart display on/off **Show Annotations**–Toggle annotation display on/off
View	**Show Chart Section**–Displays the chart section (deselecting hides the chart section) **Show List Section**–Displays the list section (deselecting hides the list section) The bottom section of the menu allows you to select which mission properties you would like to see displayed in the list section.
Help	**About**–Displays information about the application, including version number.

NOTE: *Some menu items are grayed-out when not available.*

Tool Bar

The Planner tool bar, located below the Menu bar, contains a series of user interface controls. These controls, which sometimes duplicate the commands found in the Menu bar, include file management tools, tools for navigating and manipulating the chart section, and tools for plotting mission elements, including surveys.

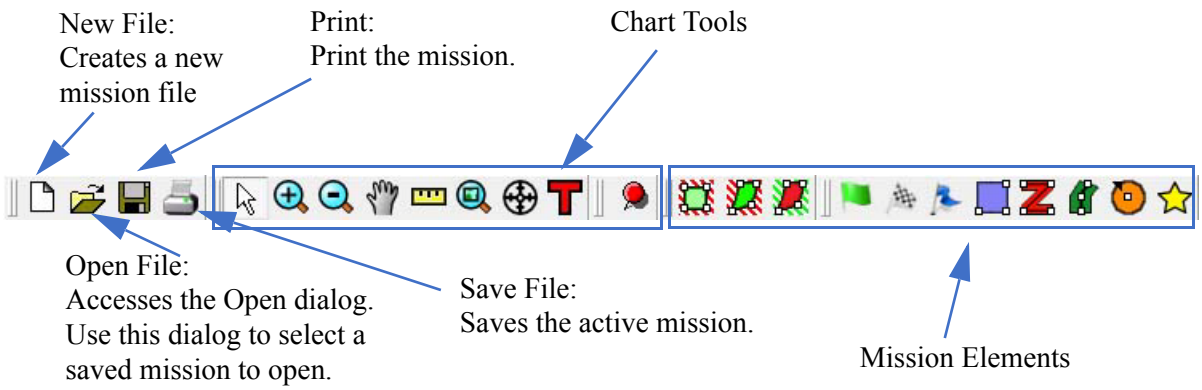


Figure 54: Planner Tool Bar

The sections of the tool bar are tear-off menus. To move a section of the tool bar around the screen, click on the two vertical bars at the left edge of the section and drag it to the new location. To return the section to the tool bar, click on the section window title and drag it back to the tool bar. The tear-off menus can be hidden or displayed individually by right-clicking in the menu bar or tool bar and selecting the section name in the pop-up menu. Selecting Line up in the pop-up menu moves all of the tear-off menu sections displayed in the tool bar to the left.

>> For more information about the chart tools, see "Working in the Chart Section" on page 100

>> For more information about mission elements, see Chapter 10: "Planner: Mission Elements"

10

PLANNER: MISSION ELEMENTS

Mission elements are the building blocks of a survey mission. They are pre-defined elements that allow you to easily and intuitively create complex missions which include start points, multiple survey types, and transit paths, in a variety of environments and using a variety of payloads.

Each element is pre-configured with default settings, but these can be changed during mission planning to fully customize the mission for your particular operating requirements. Note that the payload sonar is only starboard-facing.

This chapter describes the mission elements available in Planner. The available mission elements are listed below:

- Start Point
- End Point
- Waypoint
- Survey Rectangle
- Freeform Survey
- Q-Route Survey
- Trackcircle Survey
- Compass Star (for Navigation calibration of some vehicles. This vehicle does not use compass star calibration.)
- Setpoint (for Functional Testing)
- Mission Bounding Box
- Keep-In Zone
- Keep-Out Zone

Start Point

The mission start point element is the point from which Planner starts calculating mission parameters, including mission duration and safety settings. The start point does not need to correspond exactly with the actual launch location of the AUV, but it is recommended that you try to launch the AUV as close to the planned start point as possible, and not closer to the first point of the survey element than the planned start point.

NOTE: *It is important to keep in mind that the vehicle will not travel directly to the start point flag on the chart and then directly along the line from the start point flag to the next element of the survey. When placed in the water, and at the surface, the AUV will travel on the same heading as the start point, relative to the next element of the mission. However, once the vehicle submerges it will turn directly toward the next element in the mission plan. For example, if the survey is located due south of the start point, the AUV will travel due south until it submerges.*

To place a start point:

1. Select the start point tool in the tool bar or select **Mission > Set Start Point** from the menu bar.

NOTE: *To assist you in plotting the start point, the coordinates of the cursor are displayed in the bottom right corner of the Main Window.*

2. Click a point on the chart to place the Start Point.
3. (Optional) The start point can be edited by right-clicking on the element and selecting edit from the drop down menu. The Edit Start Point opens and allows you to set the exact coordinates of the element, and whether or not to surface for GPS updates.

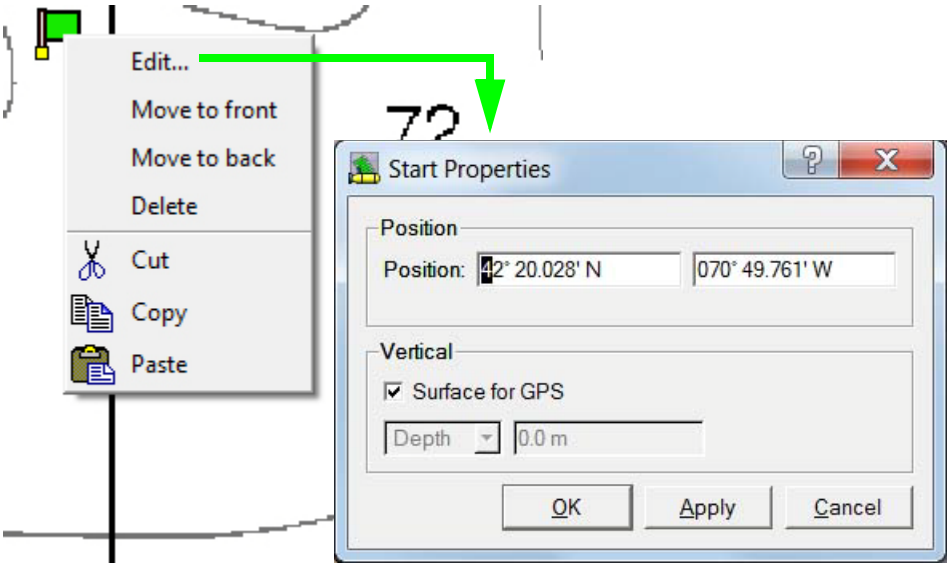


Figure 55: Editing the Start Point

NOTE: *You can also move the start point by dragging the element to a new location on the chart.*

End Point

The End Point element is the destination of the AUV. End Point settings can be configured for transit speed, GPS surfacing, and recovery options.

To place the end point:

1. Click the end point element tool on the tool bar or select **Mission > Set Mission End Point...** from the menu bar.
2. Click a point on the chart to place the End Point.

NOTE: *When an end point is placed on the chart, a dashed line is drawn between the end point and the preceding element. The line does not necessarily exactly correspond with the path the AUV will follow. The AUV will take whichever path from its current location to the point specified that is most efficient.*

The end point can be edited as shown below:

3. (Optional) The end point can be edited by right-clicking on the element and selecting edit from the drop down menu. The Recovery Point Properties window opens and allows you to set the exact coordinates of the element, and whether or not to surface for GPS updates.

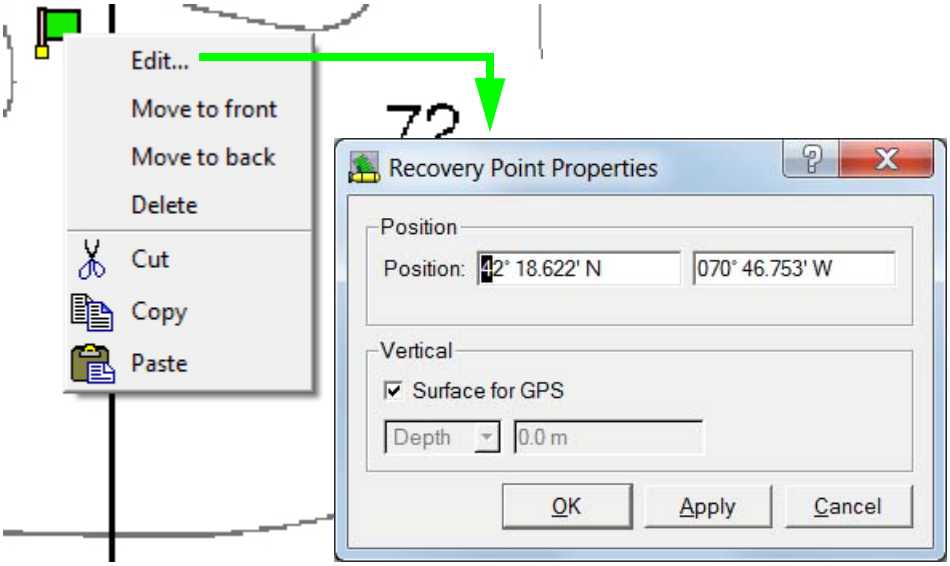


Figure 56: Editing the End Point

NOTE: *You can also move the end point by dragging the element to a new location on the chart.*

Waypoint

The waypoint element is used to plot a transit path to, from, or between start points, survey elements, and/or recovery locations. Waypoint settings can be configured for transit speed, GPS surfacing, and sonar coverage.

To place a waypoint:

1. Click the waypoint element tool on the tool bar or select **Mission > Add WayPoint** from the menu bar.
2. Click a point on the chart to place the Start Point.

NOTE: *When a waypoint is placed on the chart, a dashed line is drawn between the waypoint and the preceding element. The line does not necessarily exactly correspond with the path the AUV will follow. The AUV will take whichever line-of-sight path from its current location to the GPS point specified that is most efficient.*

The waypoint can be edited as shown below:

3. (Optional) The waypoint can be edited by right-clicking on the element and selecting edit from the drop down menu. The Waypoint Properties window opens and allows you to set the exact coordinates of the element, and whether or not to surface for GPS updates.

NOTE: *You can also move the waypoint by dragging the element to a new location on the chart.*

The transit path can be edited as shown below:

4. (Optional) Edit the transit path by right clicking on the transit path and select **Edit** from the drop-down menu. The **Transit Properties** window opens in which you can edit the following properties:

- Propeller speed for the transit path
- Frequency of GPS surfacing
- Payload Properties for the transit path

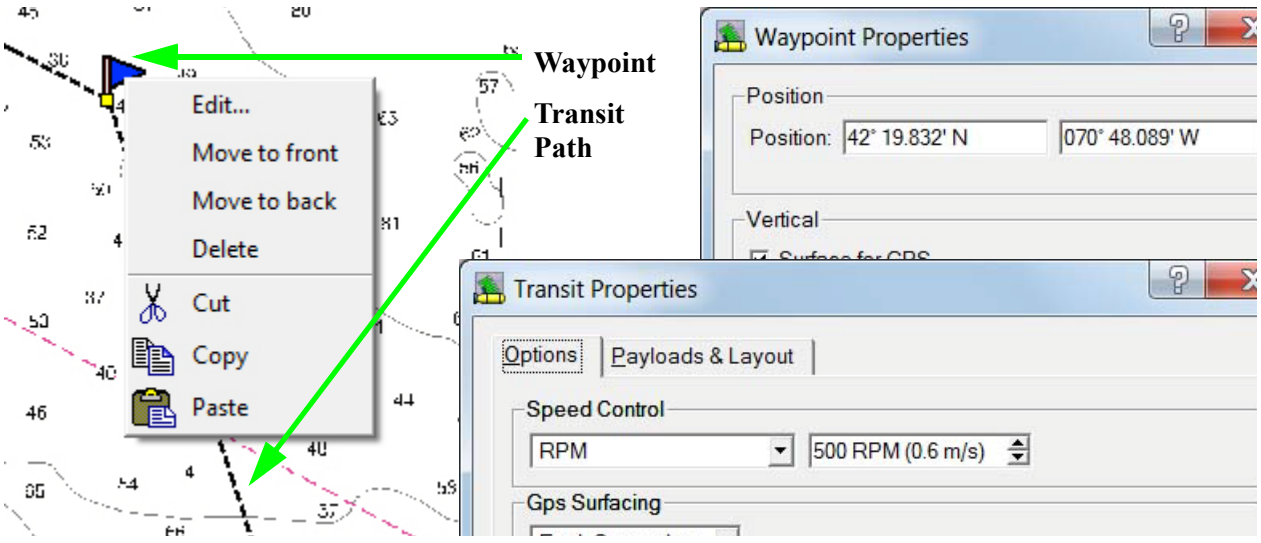


Figure 57: Editing the Transit Path

NOTE: *You can also move a waypoint element by dragging the element to a new location on the chart.*


Caution

•Editing the settings for a transit path may affect the duration of the mission.

Survey Rectangle

The survey rectangle element creates a rectangular, lawn-mower-patterned survey that covers a specified area, allowing for complete sonar coverage with no blind spots. The survey area is defined by the user positioning the rectangle on the chart. Planner then calculates the optimal layout of the survey, based on the requirements of the AUV's payload sonar.

A rectangular survey (Figure 58) consists of a number of tracklines that are spaced out to achieve complete sonar coverage of the area. The user can specify trackline spacing and the vertical range scale to optimize sonar collection. The user can also edit other survey properties, such as survey name, when and where the AUV surfaces for GPS, at what speed the AUV covers the survey area, and the size, orientation, and, if required, exact coordinates of the survey area.

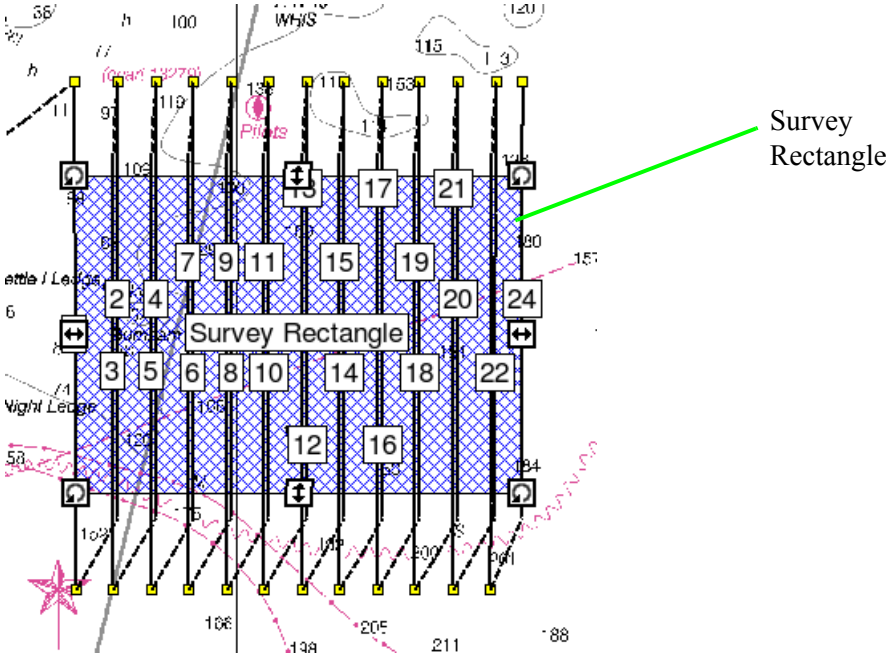


Figure 58: Rectangular Survey

>> *For a description of how to create a survey rectangle, see the sample mission in Chapter 11: "Planner: The Basics: Creating a Mission".*

>> *For detailed information about editing survey rectangle elements, see "Editing a Survey Rectangle" on page 147.*

Freeform Survey

The Freeform survey element creates a single trackline, or series of connected tracklines in an arbitrary, user-selected pattern. Each trackline covers a specific area once.

Freeform surveys are ideal for surveying channels or shipping routes, or for operating in constrained areas or around obstacles. They are ideal for AUVs equipped with Synthetic Aperture Sonars (SAS) that have full area coverage without a blind spot.

The properties of a Freeform survey can be edited by the user, including survey name, exact location of the start and endpoints of the tracklines, thruster speed, GPS surfacing, and payload settings.

Plotting a Freeform Survey

To plot a Freeform survey:

1. Select the Freeform element tool from the tool bar, or select **Mission > Add Freeform Survey**.
2. Click on the chart to place the first point of the survey.
3. Move the cursor to the second point of the survey, and click to place.
4. Continue placing survey points until you reach the final point of the survey, then right-click to place the final point.
5. Planner generates and displays the completed survey.

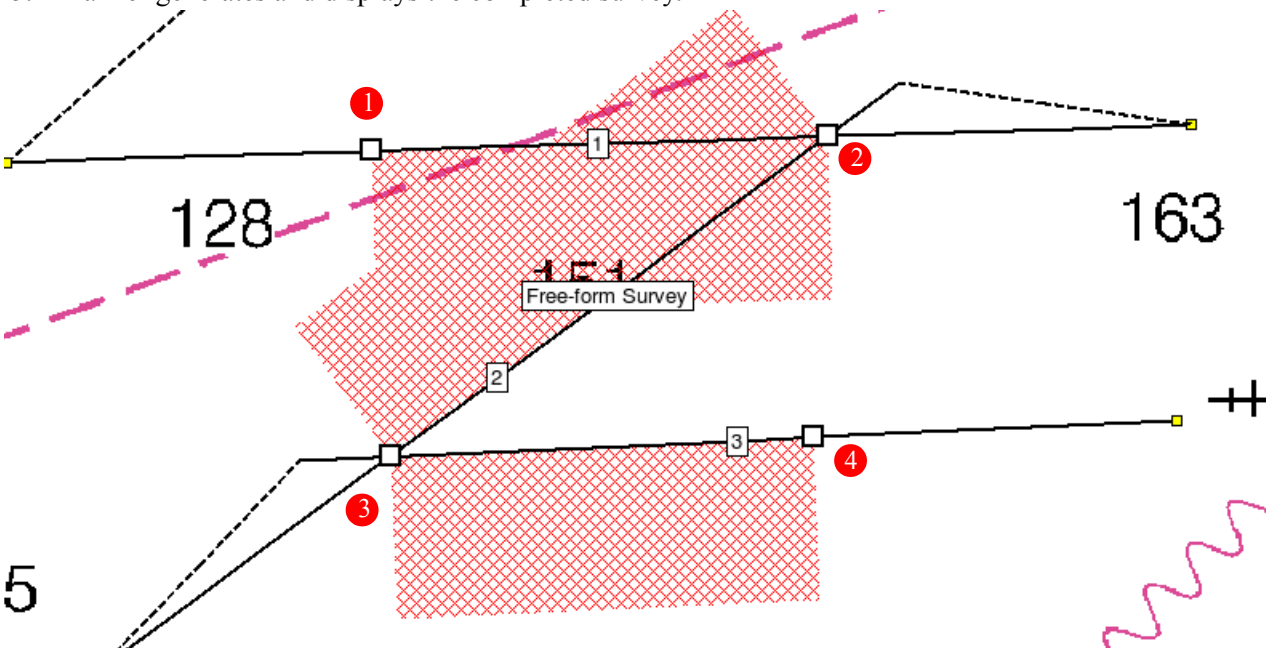


Figure 59: Completed Freeform Survey

6. (Optional) You can edit the layout and payload properties of the Freeform survey by right-clicking the survey in the chart section and selecting **Edit** from the drop-down menu to access the survey properties window.

>> For detailed information about editing Freeform Surveys, see "Editing the Layout of a Freeform Survey" on page 153.

Q-Route Survey

The Q-Route survey element creates an outbound and inbound trackline, or series of outbound and inbound tracklines that can be plotted individually or in succession by the user on the chart.

A Q-Route survey is ideal for surveying channels, or shipping routes, in that it gathers sonar on both the outbound and inbound tracklines, thereby compensating for the nadir of side scan sonar systems.

The properties of a Q-Route survey can be edited by the user, including survey name, exact location and spacing (horizontal and vertical) of tracklines, thruster speed, GPS surfacing, and payload settings.

Changing the survey name changes the survey's base logging tag to include the new survey name in the logfile name: **YYYY-MM-DD-hh-mm-ss_survey name.**

Plotting a Q-Route Survey

To plot a Q-Route survey:

1. Select the Q-Route element tool from the tool bar, or select **Mission > Add Q-Route Survey**.
2. Click on the chart to place the first (outbound) point of the survey.
3. Move the cursor to the second (outbound) point of the survey, and click to place.
4. Continue placing outbound points until you reach the final point of your survey, then right-click to place the final outbound point. Planner generates and displays the completed survey (Figure 60).

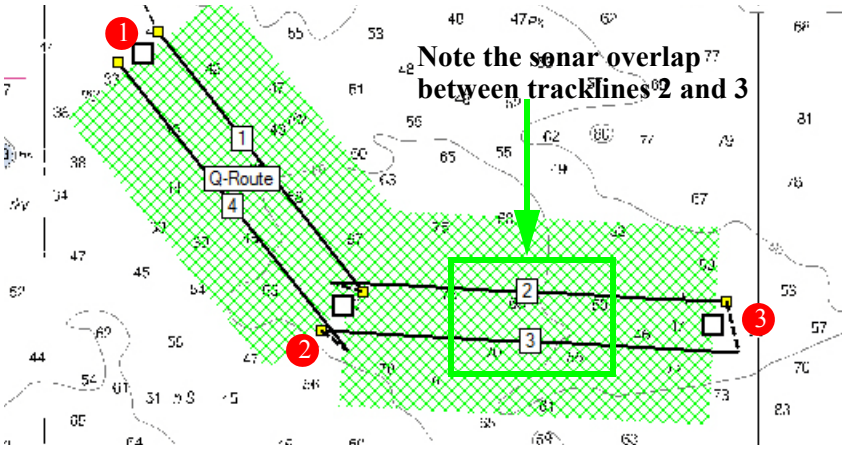


Figure 60: Completed Q-Route Survey

5. (Optional) You can edit the layout and payload properties of the Q-Route survey by right-clicking the survey in the chart section and selecting **Edit** from the drop-down menu to access the survey properties window.

>> *For detailed information about editing Q-Route Survey elements, see "Editing the Layout of a Q-Route Survey" on page 157.*

Trackcircle Survey

The Trackcircle survey element creates a circular survey that can be used to gather sonar data about an object from all sides.

In order to gather optimal sonar data, the trackcircle survey type should be used with sonar and other systems that face toward the center of the circle, like side scan sonar, for example.

The Trackcircle survey is ideal for relocating and positively identifying a contact made during, for example, a rectangular survey. Having performed a survey of a mission area, you may have marked a number of probable contacts on the mission chart (see “Adding Annotation Marks” on page 102). Using a trackcircle, or series of trackcircles, you can then collect 360 degree sonar images of the contact(s) in order to positively identify them.

Changing the survey name changes the survey’s base logging tag to include the new survey name in the logfile name: **YYYY-MM-DD-hh-mm-ss_survey name.**

Plotting a Trackcircle

To plot a Trackcircle survey:

1. Select the Trackcircle element tool from the tool bar, or select **Mission > Add Trackcircle**.
2. Click on the chart to place the trackcircle survey. The location you click on will be the center of the trackcircle.
3. Planner draws a circle around the center point, and displays the survey as shown in Figure 61.

NOTE: *The red square in the center of the circle is an existing annotation, not a part of the trackcircle. The trackcircle is the orange circle around it.*

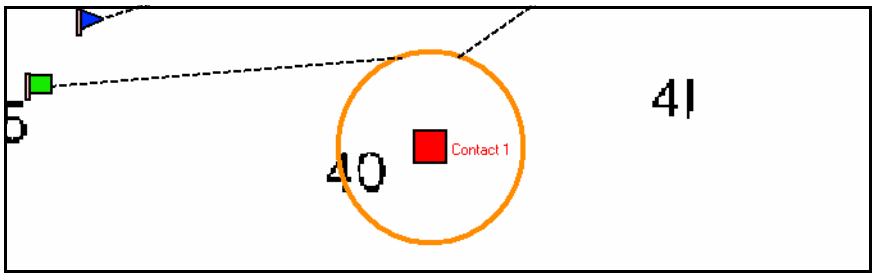


Figure 61: Completed Trackcircle in Planner

4. (Optional) You can edit the layout, radius, and payload properties of the Trackcircle survey by right-clicking the survey in the chart section and selecting **Edit** from the drop-down menu to access the survey properties window.

>> *For detailed information about editing Trackcircle Survey elements, see “Editing the layout of a Trackcircle Survey” on page 159.*

Compass Star 

NOTE: *Performing a compass star mission for GPS calibration is not required for AUV systems that are equipped with Inertial Navigation Systems. Vehicles using DrabNav or GNav also do not require a compass star mission. When in a new geographical location the vehicle will have to relearn its compass bias, and while a compass star mission can speed up the process, running survey rectangles in various headings will also work.*

The Compass Star element creates a star shaped pattern on a designated location on the chart. The compass star element is used for calibration of the AUVs navigation devices. When performing a compass star mission, the AUV follows the tracklines, surfacing for GPS at precisely defined locations, i.e., the points of the star pattern.

Bluefin recommends performing a compass star mission every time the AUV is deployed in a new geographical region. Calibrating the AUVs navigation devices by executing a compass star mission will help to compensate for local geomagnetic variations.

You can edit the survey name, location, layout, and payload settings for the compass star element. For example, you can change the number of legs, edit the length of the tracklines, and specify the speed of the AUV.

Changing the survey name changes the survey's base logging tag to include the new survey name in the logfile name: **YYYY-MM-DD-hh-mm-ss_survey name.**

Unless you are operating in an area with geographical restrictions that prevent you from using the default settings, Bluefin recommends that you use the default compass star settings, as these are optimized to produce accurate navigation calibration

Plotting a Compass Star Element

To plot a compass star:

1. Select the Compass Star element tool from the tool bar, or select **Mission > Add Compass Star**.
2. Click on the chart to place the compass star.

NOTE: *The location you click on will be the first point of the first leg of the compass star.*

3. Planner generates an eight-legged compass star starting at the first point (Figure 62).

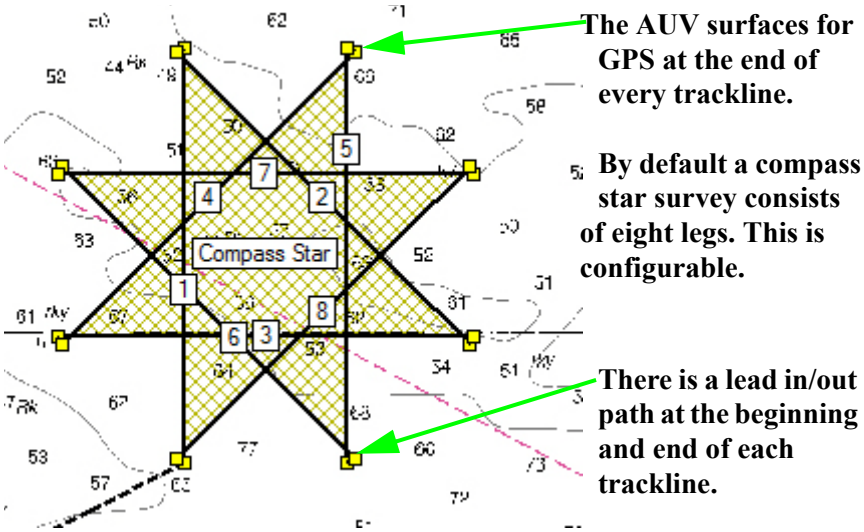


Figure 62: Compass Star Survey

4. (Optional) To ensure optimal performance, you can edit the layout of the compass star. To access the properties window, right click the compass star and select **Edit** from the drop-down menu.

>> *For detailed information about editing Compass Star elements, see "Editing the Layout of a Compass Star" on page 162.*

Setpoint

•The Setpoint tool is an advanced feature that should only be used by operators who have been fully trained in AUV operations and have experience in AUV operations. Contact General Dynamics Mission Systems for information about operator training.

The setpoint tool is intended for specialized use for in-water vehicle tests, such as dynamic control tuning. The Setpoint tool allows the operator to create a mission segment during which the AUV follows a specific heading, or maintains a specific pitch or rudder angle.

>> For information about using the setpoint feature, see Chapter 14: "Planner: Using the Setpoint Tool".

Mission Bounding Region

The mission bounding region outlines the area outside of which the AUV may not travel. The mission bounding region can be used to force the AUV to abort the mission before traveling into unsafe waters or outside of the communications range of the support ship.

When the mission aborts, the vehicle will float to the surface. It will drift until the operator establishes communications and sends a new mission.

Creating a Mission Bounding Region

A mission bounding region can be set before or after creating the survey. It must, however, be created prior to exporting the mission to the AUV. The bounding region is a rectangle that is drawn by placing a diagonal line on the chart.

To add a mission bounding region:

1. Select the bounding region tool from the tool bar.
2. Click to place the first corner of the bounding region.
3. Move the cursor to the opposite corner of the intended bounding region. (A diagonal line appears on the chart as you move the cursor.)
4. Click again to create the bounding region. The bounding region is displayed on the chart as a green shaded box (Figure 63).

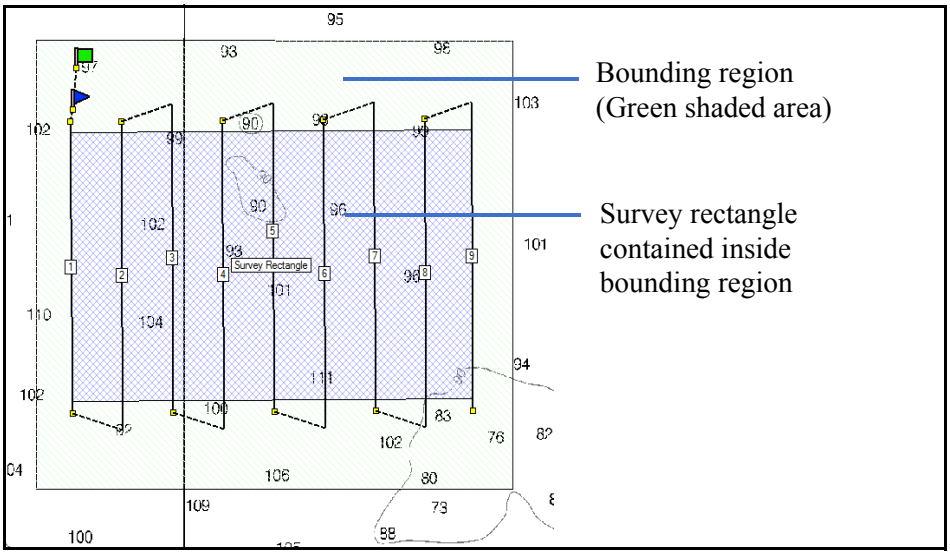


Figure 63: Mission Bounding Region

NOTE: *The region can be edited by clicking on the region and moving any of the corners.*

>> For more information about editing the bounding region, see "Editing a Bounding Region" on page 172.

Keep-In Zone 

The Keep-In Zone outlines an area where the mission should be plotted through. It provides guidance for the user plotting the mission and has no effect on the AUV.

Creating a Keep-In Zone

1. Select the keep-in zone tool from the tool bar.
2. Left-click to place the first corner of the zone.
3. Left-click to place the second corner.
4. Left-click for each corner to place as many corners as needed to define the zone.
5. Right-click near the first corner to create the keep-in zone. The keep-in zone is displayed on the chart as a green shaded area (Figure 63).

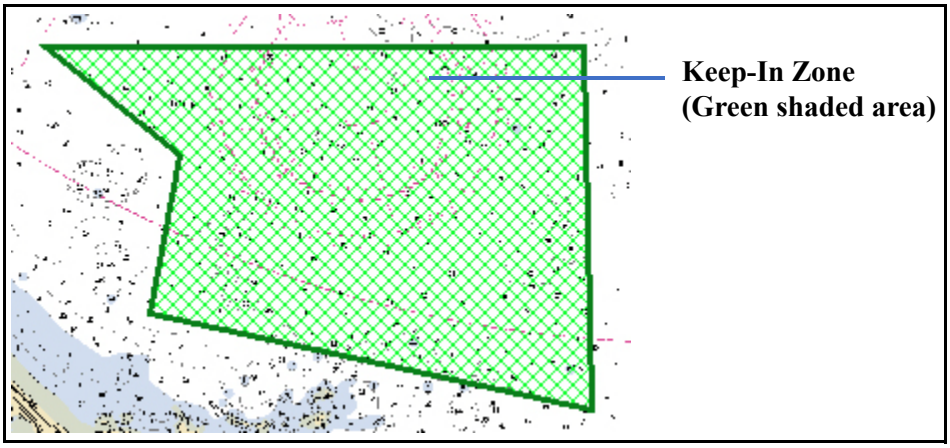


Figure 64: Keep-In Zone

NOTE: *The zone can be edited by clicking on the region and moving any of the corners.*

>> For more information about editing the keep-in zone, see "Editing a Bounding Region" on page 172.

Keep-Out Zone 

The Keep-Out Zone outlines an area where the mission should not be plotted through. It provides guidance for the user plotting the mission and has no effect on the AUV.

Creating a Keep-Out Zone

1. Select the keep-out zone tool from the tool bar.
2. Left-click to place the first corner of the zone.
3. Left-click to place the second corner.
4. Left-click for each corner to place as many corners as needed to define the zone.
5. Right-click near the first corner to create the keep-in zone. The keep-out zone is displayed on the chart as a red shaded area (Figure 63).

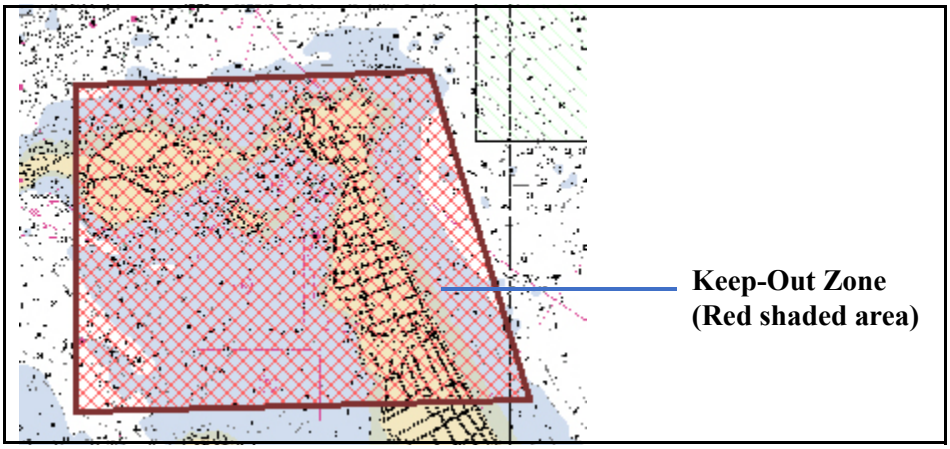


Figure 65: Keep-Out Zone

NOTE: *The zone can be edited by clicking on the region and moving any of the corners.*

>> For more information about editing the keep-in zone, see "Editing a Bounding Region" on page 172.

11

PLANNER: THE BASICS: CREATING A MISSION

This chapter will guide you through the basic steps involved in creating a simple mission in Planner. In this example, a mission will be created consisting of a starting point, a survey rectangle, and two waypoints defining the transit to the pick up site.

In this example the mission will not be extensively edited – Planner's default settings will be used. You can find detailed information on editing missions in *Chapter 12: "Planner: Editing Mission Elements"*.

The steps involved in creating a mission are as follows:

- Starting Planner
- Loading the Mission Area Chart
- Setting Default Mission Properties
- Plotting the Start Point
- Plotting the Survey
- Plotting the Waypoint(s)
- Verifying Mission Layout
- Setting Mission Safety Parameters
- Saving the Mission

Planner will automatically populate several of the parameters based on the type of mission elements, and location of your mission. You can edit some of the parameters set by Planner after creating your mission.

Make sure that you have all of the information needed to plan a mission before you start. For more information, see the next section.

Before You Begin

Planner automatically makes important safety calculations and populates a number of operational parameters for the mission. In order to do this accurately, there are several pieces of information you need to have in order to successfully create a mission in Planner.

Before you begin to create a mission using Planner, ask yourself the following questions.

What Type of Mission are You Planning?

Planner comes bundled with a number of mission elements to help you quickly create a mission. Which type of survey is appropriate depends upon the type of operation you are performing.

>> For a description of the available Mission Elements, see Chapter 10: "Planner: Mission Elements".

What is the Maximum Time Available for Your Mission?

A strength of the Planner is that it computes, in advance, an estimate of the total time which will be required for the vehicle to complete the mission. This time includes all survey elements, transits, descents, and ascents, as well as any wrapup.

Besides informing the operator of the estimated time, Planner also sets the value for a timer which will be used when the mission is actually run. If the mission takes substantially longer than expected, it will automatically abort, on the assumption that something has gone wrong.

By default, the mission timer is set to a time 40% greater than the estimated mission time. It is possible to adjust this "margin of error" up or down, or to enter an explicit value for the mission timer. However, General Dynamics Mission Systems recommends using the timer value generated by Planner to ensure accurate and successful completion of the mission.

NOTE: *If the operator sets the mission timer lower than the calculated time, a warning dialog will appear to let the operator know.*

Setting the mission timer manually will not affect the speed of the AUV during the mission. If the mission takes longer than the specified time, the vehicle will automatically abandon the mission and transition to the selected wrap-up behavior.

What is the Maximum Depth in the Mission Area?

In order for Planner to accurately calculate the times for ascents and descents, as well as properly configuring the safety parameters for your mission, you must enter the maximum expected water depth in the area you are operating. Enter this information in the Depth Settings window. Access the Depth Settings window by selecting **Safeties > Set Depth/Altitude Limits** from the menu bar.

Do You Have the Chart(s) You will be Using to Plan the Mission?

Planner plots your mission on a chart of the area. This requires that you have a chart for the area available.

>> For information about loading charts, see “Loading a Chart” on page 97.

Are Some Mission Elements Pre-Planned in Another Mission Format?

In the File menu, select Import... and the Select File to Import window opens. Set the file type to all files and select a line importer file. Click open to add those elements to the current mission.

Starting Planner

To start Planner:

1. Select Start > All Programs > Bluefin Robotics > Planner, or click on the Planner icon located on your desktop.
2. The program launches, displaying the vehicle selection window. Enter the operator information:
   - Operator Name
   - Ship's Name
   - Cruise (Deployment) Name
   - Location Name
3. Select your vehicle from the recent vehicles list and click **OK**. Planner opens with the most recently viewed chart displayed. If this is the first time that Planner is launched, the default chart is a map of Boston Harbor.

Loading the Mission Area Chart

NOTE: *By default Planner opens with the most recent chart displayed in the chart area. This may not be the chart on which you want to plan your mission.*

To load the chart of the mission area:

1. Select **Chart>Select Chart** from the menu bar to open the browser window. (Or select a chart from the list of recently used charts at the bottom of the **Chart** menu, and proceed to step 4.)

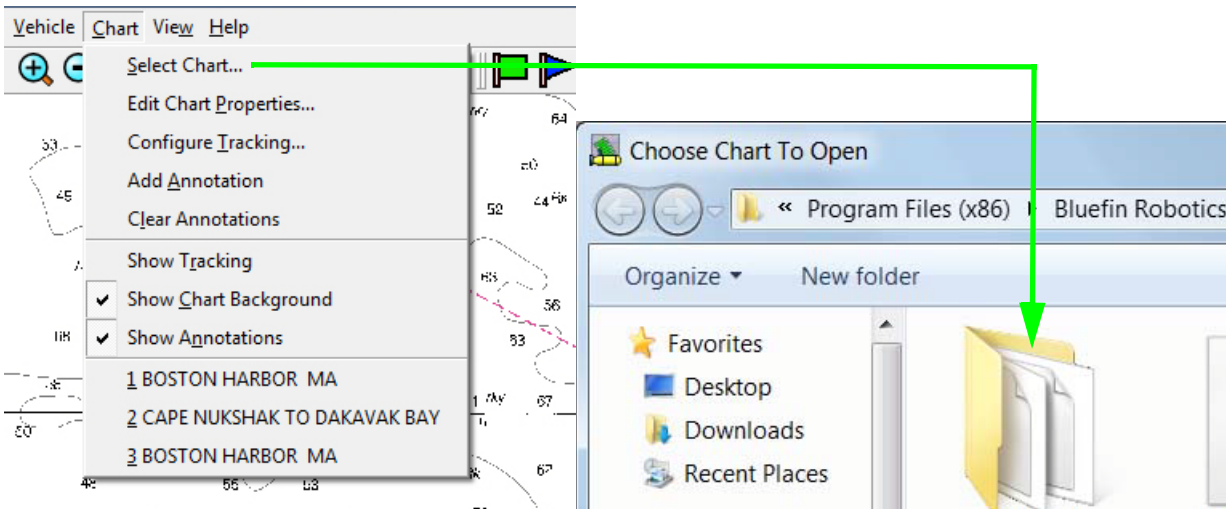
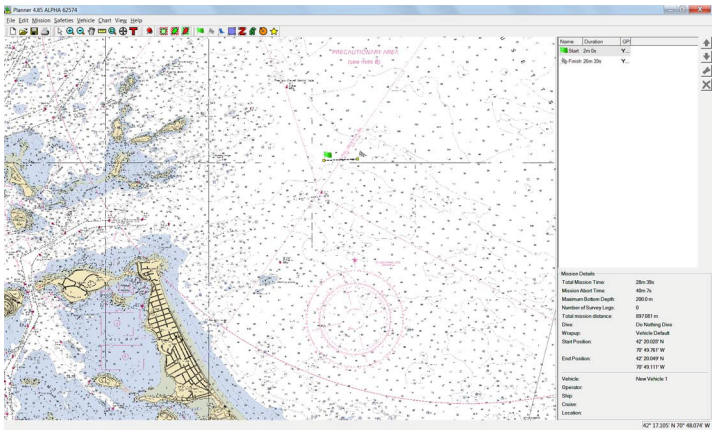


Figure 66: Selecting a Chart for the Mission

2. Select a chart in the browser window.

Click Open to open the chart in the Chart Section. The selected chart displays in the Chart Section.



You can change the name of the chart and configure the chart's projection properties in the Edit Chart Properties window. Access the window by selecting **Chart > Edit Chart Properties** from the menu bar.

Figure 67: Selected Chart Displayed in Planner

3. Use the **Zoom In** tool to zoom in on the operational area.

Setting Default Mission Properties

When creating a mission, Planner automatically populates the mission with default mission settings for each survey type and each vehicle. The default properties may not be appropriate for your needs. You should review the mission properties and adjust them as required.

To access the mission properties window, select **Vehicle>Default Mission Properties** from the menu bar. The Default Mission Properties window opens:

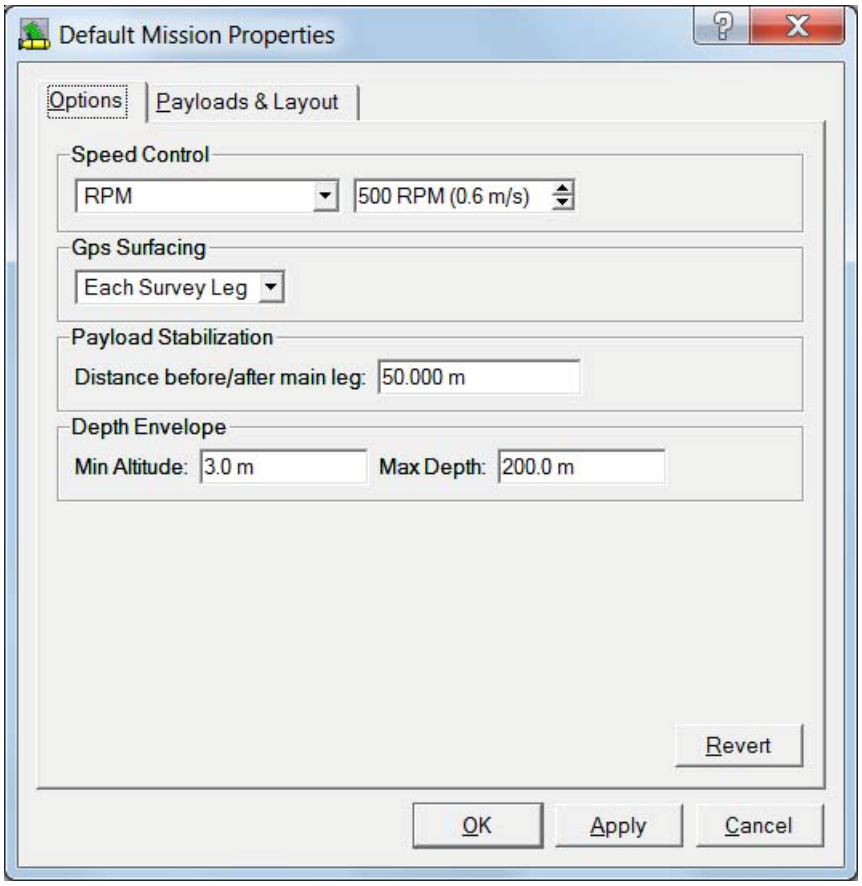


Figure 68: Default Mission Properties Window–Options Tab

The window contains two tabs: Options, and Payloads & Layout. Under the options tab, you can set the defaults for speed (in rpm or m/s), GPS surfacing frequency (each survey leg or never), payload stabilization, and depth envelope. These settings are applied to all missions planned during the current Planner session. Under the Payloads & Layout tab, you can set the defaults for payload control.

See “Planner: Payload Properties” on page 175 for information on payload settings.

To change the values in a section, make your changes then click Apply.

Plotting the Start Point

After loading the chart and selecting the operational area, you are ready to plot the start point of the mission. The start point should be placed at (or near to) the location where you intend to deploy the AUV.

To place the start point:

1. Select the start point tool in the tool bar or select **Mission > Set Start Point** from the menu bar.

NOTE: *To assist you in plotting the start point, the coordinates of the cursor are displayed in the bottom right corner of the Main Window.*

2. Click a point on the chart to place the Start Point. The start point appears as a small green flag on the chart as shown below.

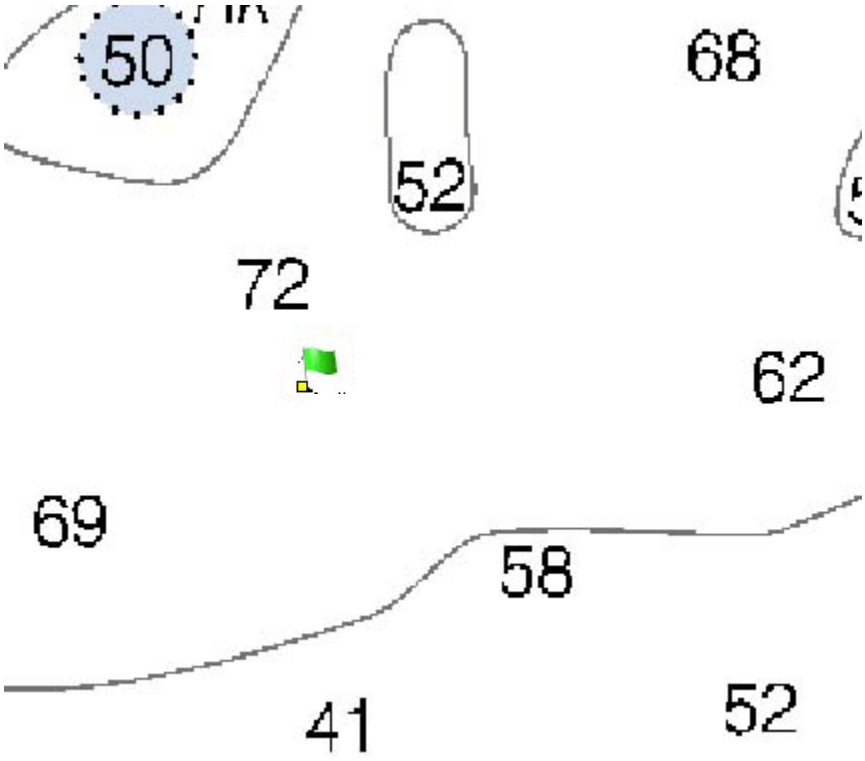


Figure 69: Start Point Plotted

NOTE: *The yellow box at the base of the Start Point indicates that the AUV will surface for GPS here.*

Plotting the Survey

Having plotted the start point, you are now ready to select a survey element and plot it on the chart. (In this example a survey rectangle is plotted, which is a basic, multi-leg, lawn-mower pattern survey.)

NOTE: *In this example, the survey will not be edited. For detailed instructions on editing s survey rectangle, see "Editing a Survey Rectangle" on page 147.*

To plot a survey rectangle:

1. Select the survey rectangle tool in the tool bar.
2. Place the cursor on the chart at the desired location of the first point in the rectangle and click to plot the first point.
3. Move the cursor to the desired second corner of the survey rectangle and click to plot the second point.
4. Move the cursor to determine the width of the rectangle and click to create the rectangle.

>> *See "Changing the Direction of the Tracklines in a Survey Rectangle" on page 148 for an explaination of the numbered points*

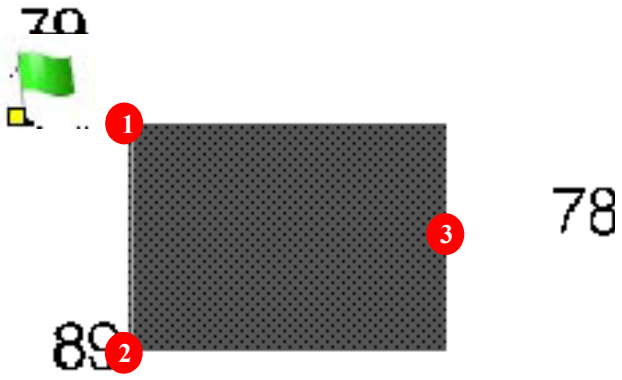


Figure 70: Plotting the Survey Rectangle

5. If sonar coverage area has been selected in Preferences, Planner draws a yellow crosshatched rectangle indicating the sonar coverage of the survey rectangle. Otherwise, Planner draws a blue crosshatched

rectangle indicating the bounds of the vehicle's travel.The list section is updated with the survey rectangle, and the mission duration value in the mission details area is updated.

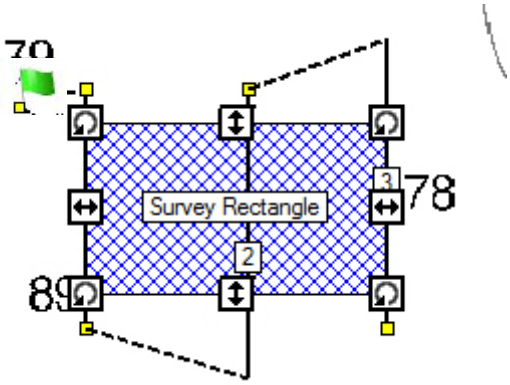


Figure 71: Completed Survey Rectangle

Plotting the Waypoint(s)

When you have plotted the survey, you can also plot a transit route to the pickup location. The transit route is set using Waypoints which determine the path to the pickup location. The AUV surfaces for GPS at each waypoint, or at intervals along the transit route (this can be customized using the Waypoint Properties window), and stops at the final Waypoint.

Waypoints can also be set to customize the transit(s) between mission elements.

NOTE: *In this example, the waypoints will not be edited. For detailed instructions on editing waypoints and transit paths, see "Editing the Start Point and Waypoints" on page 146 and "Editing Transit Path Properties" on page 170.*

To place a waypoint:

1. Select the waypoint tool in the tool bar or select **Mission > Add Waypoint** from the menu bar.
2. Click a point on the chart to place the waypoint. Planner generates a transit path, and displays the waypoint (a blue flag) and the transit path from the end of the survey rectangle to the waypoint. The list section is updated with the new feature, and the mission duration value in the mission details area is updated.

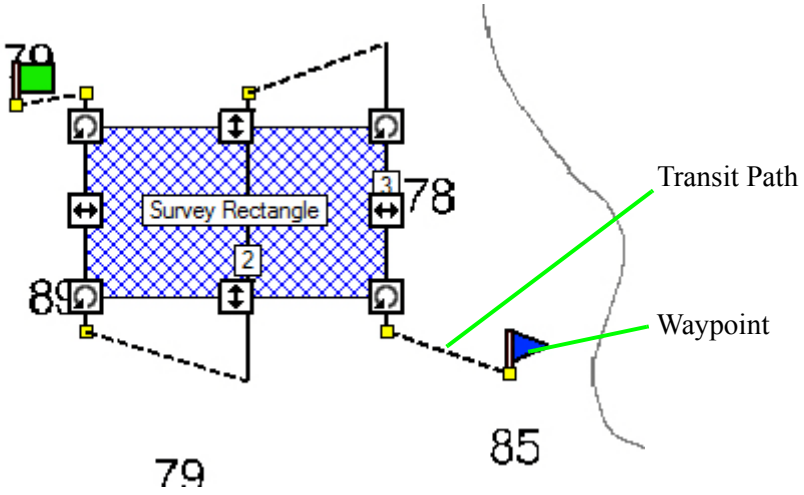


Figure 72: Waypoint and Transit Path

Verifying Mission Layout

Having completed the layout phase, you can now verify the parameters of the mission and decide whether to save it or continue working with it.

The completed sample mission is shown below. The mission elements are displayed in order in the List Section, and the details of the mission are displayed in the Mission Details area. The sample mission contains the following elements:

- Start Point
- Survey
- Transit Path/Waypoint

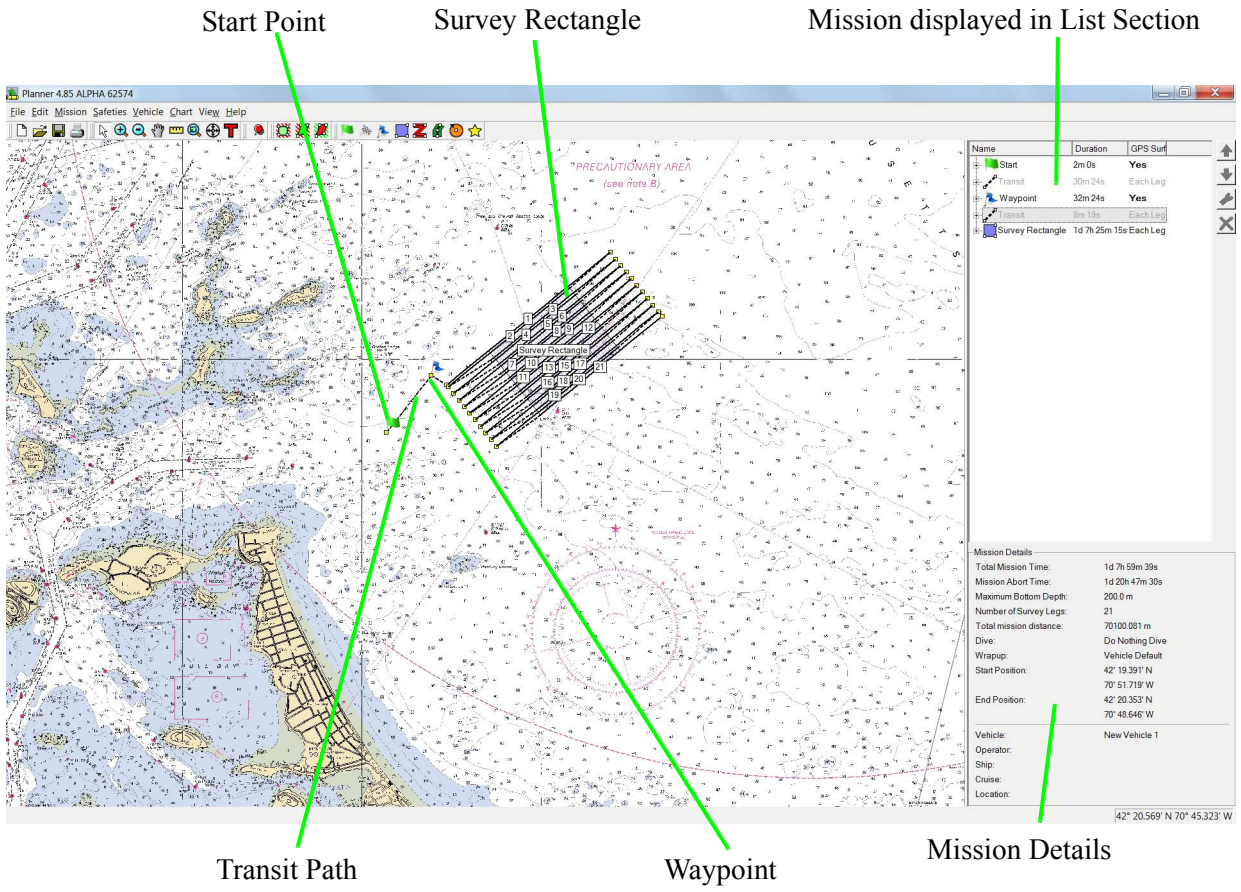


Figure 73: Completed Mission

Each mission element, including the transit path, can be edited. For more information about editing mission elements, see Chapter 12: "Planner: Editing Mission Elements".

NOTE: *The Mission Abort time in the Mission Details window is larger than the Total Mission Time. The mission abort time is a very important safety setting. This and other safety settings must* ***always*** *be checked before saving a mission to be executed by a Bluefin AUV.*

Setting Mission Safety Parameters

Before you can save and run the mission you have created, it is critical that you verify the safety settings for the mission.

There are four safety settings that you must enter and verify before you save the mission:

- Mission Timer
- Depth/Altitude
- Dive
- Wrapup

Setting the Mission Timer

To set the mission timer:

1. Select **Safeties > Set Mission Timer** from the menu bar. The Mission Timer window opens, allowing you to set the time parameters for the mission. The *Estimated Mission Time* field shows the estimated mission time calculated by Planner.

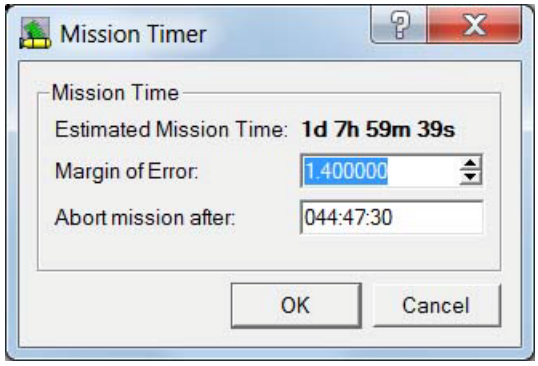


Figure 74: Mission Timer Window

2. In the *Margin of Error* field you can multiply the pre-calculated mission time by the value in the field to avoid premature termination of the mission.
3. In the *Abort Mission After* field enter the time from the start of the mission after which the mission will abort.

NOTE: *Only one of "Margin of Error" and "Abort Mission After" can be set. The other is automatically calculated.*

Setting the Depth/Altitude Safety

The Depth/Altitude Safety setting is critical, because Planner calculates lead in and lead out lengths for GPS surfacings as well as the depth abort safety with it.

To specify the depth settings:

1. Select **Safeties > Set Depth/Altitude Safety** from the menu bar. The Depth Settings window opens.

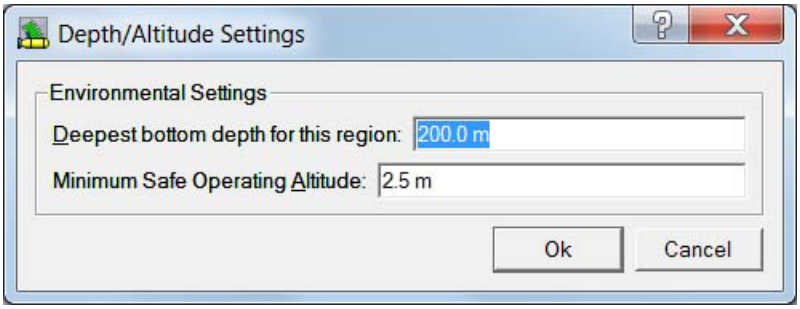


Figure 75: Depth Settings Window

2. Verify the deepest bottom depth in this region against the chart or another source of information, and enter that value in the depth field.
3. Enter the minimum safe operating altitude for this mission in the altitude field.
4. Click OK.

Dive Configuration

Bluefin vehicles can descend from the surface using different dive types.

To configure the dive type:

1. Select **Safeties > Configure Dive** from the menu bar. The Dive Configuration window opens.

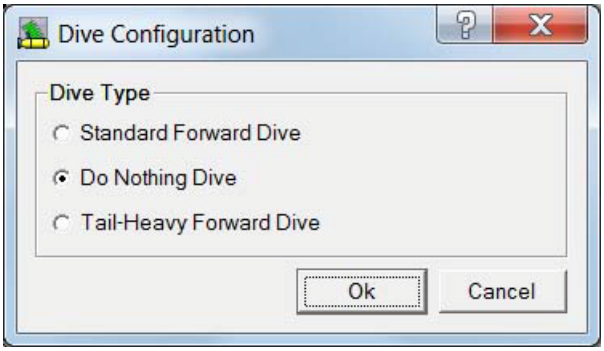


Figure 76: Dive Configuration Window

2. In the dive configuration window, select a dive type:

- **Standard Forward Dive**–Standard forward dive, accelerate on surface and pitch down nose first.
- **Do Nothing Dive**–If the vehicle is close to neutrally buoyant, it can gradually descend while swimming to the first waypoint.
- **Tail-Heavy Forward Dive**–If the vehicle is very positively buoyant or tail heavy, it needs more speed and momentum to pitch forward and dive. The fins keep the propeller under water until the vehicle is moving fast enough to pitch forward and dive.

Wrapup Configuration

The wrapup configuration settings determine how the AUV behaves at the end of the mission during normal operations, when the operator requests an early wrapup, or when the vehicle aborts due to an error.

To configure the wrapup settings:

1. Select **Safeties > Configure Wrapup** from the menu bar. The Wrapup Configuration window opens.

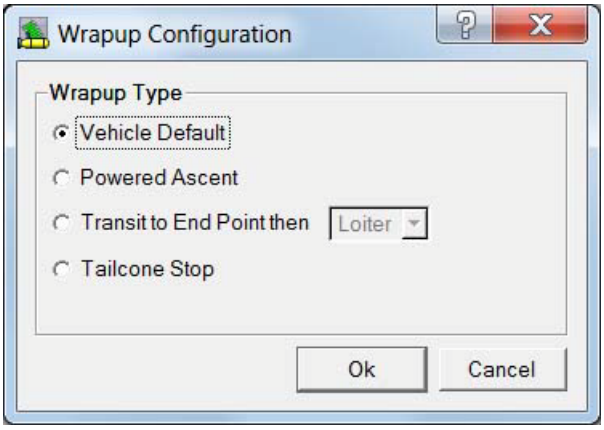


Figure 77: Wrapup Configuration Window

2. In the Wrapup Configuration window the following options are available:

- **Vehicle Default**–the vehicle performs the default wrapup mission
- **Powered Ascent**–the vehicle travels to the surface, stops, and waits with the propeller turned off (it may drift, depending on currents) until new mission commands are sent from the operator or it is recovered
- **Transit to End Point then**
    - **Loiter**–the vehicle transits to the end point (the final waypoint in the mission plan) and then stays in that location under power
    - **Stop**–the vehicle transits to the end point (the final waypoint in the mission plan) and then turns off the propeller
- **Tailcone Stop**–the vehicle turns off the propeller (and floats to the surface)

NOTE: *You should consider the operational conditions in the area (particularly weather conditions and currents) carefully before making a selection.*

Saving the Mission

When you are satisfied with the layout of the mission, and have verified the safety settings, save the mission to the operator laptop so that it can be uploaded to the AUV for execution.

To save the mission:

1. Select **File > Save As** from the menu bar.
2. Browse for the location in which you want to save the mission.
3. Enter the filename for the mission and click **Save**. The file saves in .bm2 format, which is the format used by the AUV to execute the mission.

The mission can now be uploaded to the AUV using Dashboard.

Opening an Existing Mission File

Planner allows you to open existing mission files created in previous Planner sessions. These missions can then be edited in Planner.

Opening a Planner Mission File

NOTE: *Opening a mission file will close down the currently active mission file. If you want to open multiple mission files, you need to use the tabs feature in the list section, and open a new tab first. For more information, see "Creating Multiple Missions in a Planner Session (Using Tabs)" on page 107.*

To open a mission file created in Planner (.bm2 format):

1. Select **File > Open** from the menu bar. The Choose Mission to Open window appears.
2. Select the mission file you want to open and click **Open**. The mission file opens in Planner.

12

PLANNER: EDITING MISSION ELEMENTS

The mission elements in Planner are configured for the selected vehicle. You may want to adjust the settings of a particular survey rectangle, transit path, or trackline. Each mission element has an associated Properties window in which you can specify exactly how you want the vehicle to behave during that particular part of the mission.

A mission created in Planner can be edited in a variety of ways by the user. For most mission elements, the following can be edited:

- Location
- Layout
- Speed
- GPS Surfacing
- Payload Stabilization
- Payload Properties

This chapter describes how to edit most of these settings. Editing payload properties is discussed in Chapter 13: "Planner: Payload Properties".

NOTE: *For start- and waypoints, only the location and GPS surfacing can be edited. For transit paths, speed, GPS, and payload properties can be edited.*

NOTE: *Individual smaller elements in a larger mission element are locked to prevent editing by default. To unlock the smaller elements in a larger mission element, select the larger mission element and click the wrench button. The larger mission element's properties window opens. Click OK to close the window and unlock the individual smaller elements.*

Editing the Start Point and Waypoints

To edit the location of a Start point and/or Waypoint element:

1. Select the start point or waypoint in the chart view and right-click on it.
2. Select **Edit** from the pop-up menu.
3. The element properties window opens.

NOTE: *The figure below shows the Waypoint Properties window. The options are the same in the Start Point properties window.*

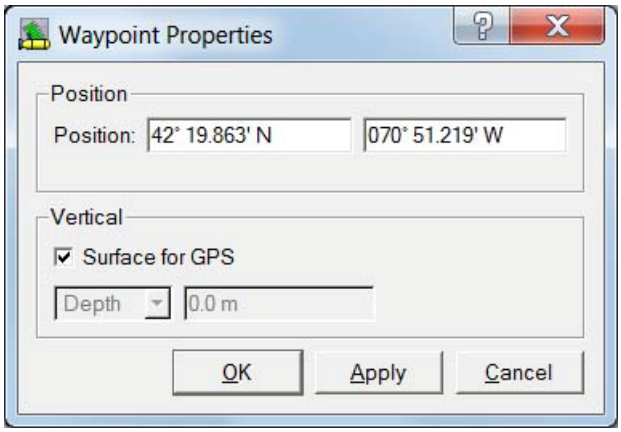


Figure 78: Waypoint Properties Window

4. If the existing coordinates created by clicking on the chart are not correct, then specify exact coordinates for the start point or waypoint.
5. Check or Uncheck the **Surface for GPS** checkbox. If the box is checked, the AUV will surface for GPS at the start/waypoint. If the box is unchecked, you must specify a depth or altitude that the AUV will maintain at the start/waypoint.

NOTE: *It is recommended to always have the start point selected as surface for GPS to ensure good navigation for the duration of the mission. If this is unchecked, navigation accuracy is not guaranteed.*

6. Click **Apply** and then **OK** to apply the changes and exit the properties window.

Editing a Survey Rectangle

A survey rectangle can be edited in a number of ways. The survey can be edited directly on the chart, or in the survey properties window. You can of course make preliminary edits in the chart, and then refine your work in the survey properties window.

Once you have drawn a survey rectangle in the chart section, you can move, rotate, resize, and change the direction of the survey directly in the survey using your mouse.

Naming a Survey Rectangle

Right-click on a survey rectangle and select **Edit...** to open the survey properties window. Edit the **Name:** field and click **OK** to change the name of the survey rectangle. The new name appears on the chart and in the list. Depending on the payload, the name may be used as part of the payload data file name.

Moving a Survey Rectangle

You can easily move a survey rectangle by clicking and dragging it to a new location on the chart.

Rotating a Survey Rectangle

You can rotate a survey rectangle by grabbing a rotation handle located on each corner of the survey box. and turning it. You must first click in the survey to make it active.

NOTE: *When you rotate a survey rectangle, it turns around its center point.*

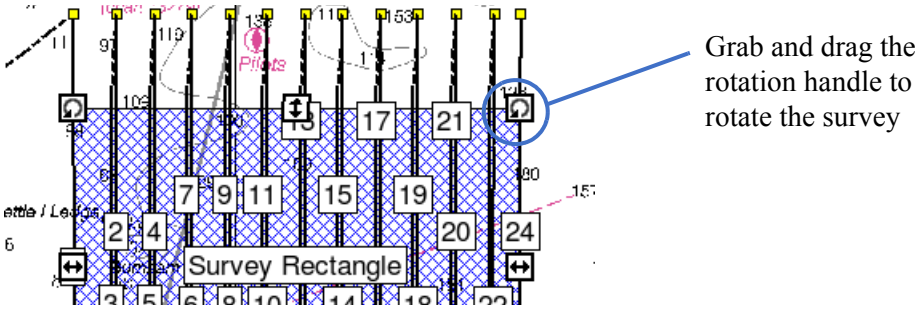


Figure 79: Rotating a Survey Rectangle

Resizing a Survey Rectangle

You can resize a survey rectangle by grabbing a resizing handle on the survey and dragging it to increase or decrease the size of the survey. You must first click in the survey to make it active.

NOTE: *There is one resizing handle on each side of a survey rectangle.*

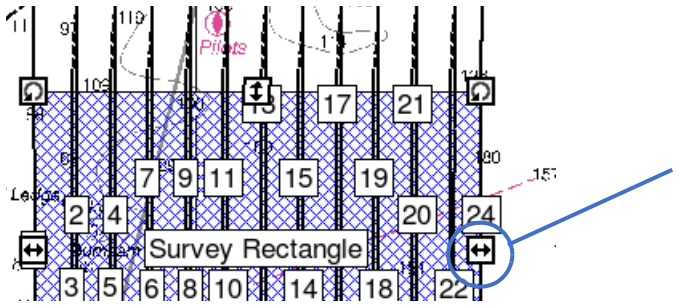


Figure 80: Resizing a Survey Rectangle

Changing the Direction of the Tracklines in a Survey Rectangle

When you draw a survey rectangle, the tracklines run lengthwise. By default a rectangular survey is drawn such that the first point of the survey is the starting point of the first trackline. The second point of a survey is the end point of the first trackline.

The length of the rectangle is the distance between the first and the second point plotted (start corner and second corner). If you want the tracklines to run along the width of the survey instead, you can right-click on any active corner of the survey and change it to a start or second corner.

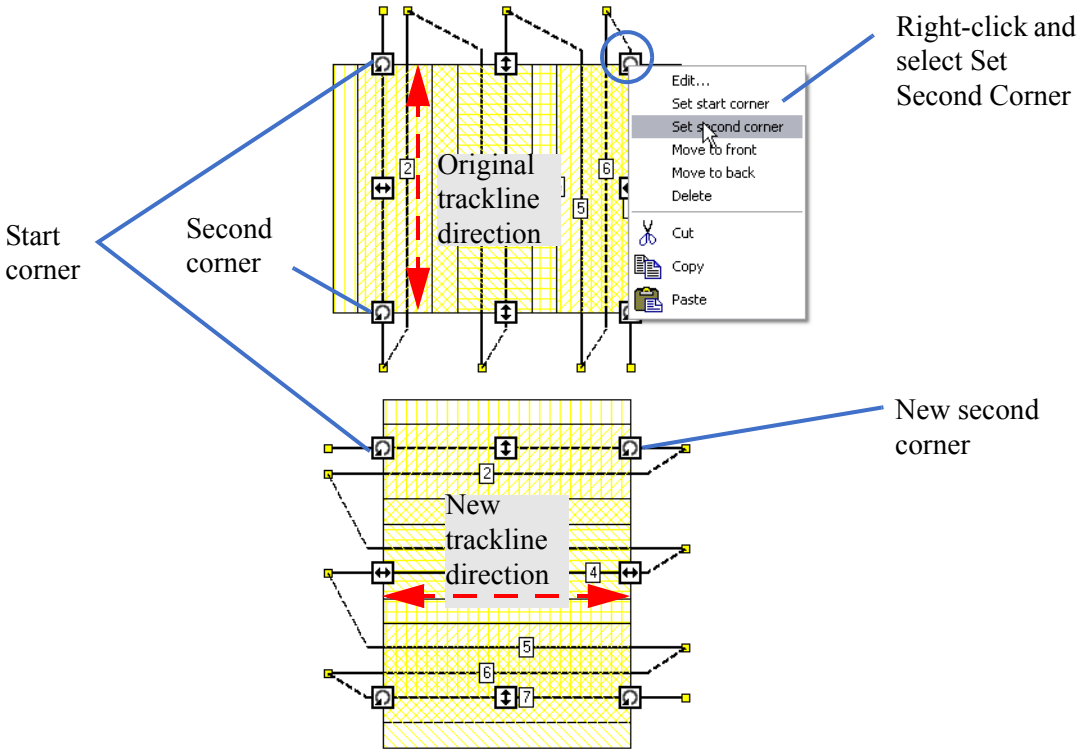


Figure 81: Changing the Direction of the Tracklines

Editing the Layout of a Survey Rectangle

The survey tab in the survey properties window contains a number of editable fields for precisely specifying the name, layout, and location of the survey.

If you are specifying a survey rectangle's layout using the survey rectangle properties window you can also specify how you want to define the rectangle. There are three available options: by start point and dimensions (useful if you want to make the survey a particular size); by midline (if you want to cover a certain midline); and by two or three corner points (if you are importing a plan from MEDAL, or want to cover a precisely defined area).

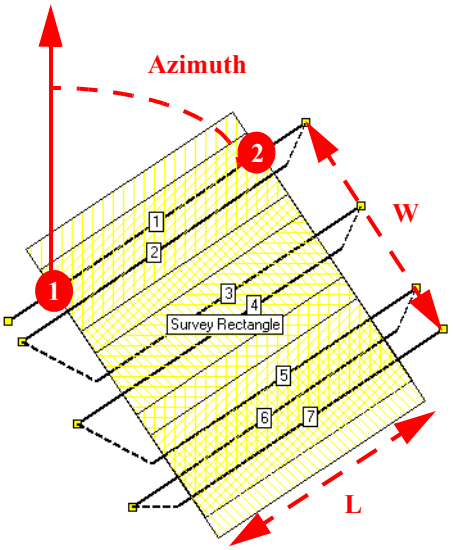
To access the survey properties window, double-click the survey in the chart or select the survey in the list section and click the wrench button. In the survey properties window, ensure that the survey tab is displayed.

Defining a Survey Rectangle by Specifying the Start Point and Dimensions

1. Select **Start point and dimensions** in the survey tab of the Survey Properties window.
2. In the **Start point and dimensions** area, define the following:

- **Start Point**–the first point of the survey

- **Azimuth**–orientation of the survey (in degrees relative to North)
- **Direction**–direction of survey about the first trackline: changing from clockwise to counter-clockwise flips the survey about the first trackline (between the first point and second point)
- **Length**–length of the survey (distance from the first point to the second point)
- **Width**–width of the survey (distance from the first trackline to the last trackline)



1–First point

2–Second point

A–Azimuth

Figure 82: Defining a Survey Rectangle by Start Point and Dimensions

3. Click **Apply** to view the survey in the chart section.
4. Click **OK** to save the changes.

Defining a Survey Rectangle by Specifying a Midline

NOTE: *The midline of a survey rectangle bisects the rectangle lengthwise. The first and second points of the survey establish the midline.*

1. Select **Midline** in the survey tab of the Survey Properties window.
2. In the **Midline** area, specify the following:

- **First Point**–coordinates of the first point of the Midline.
- **Second Point**–coordinates of the second point of the Midline.
- **Direction**–Sets the start corner via clockwise or counter clockwise choice.
- **Width**–the total width of the survey.

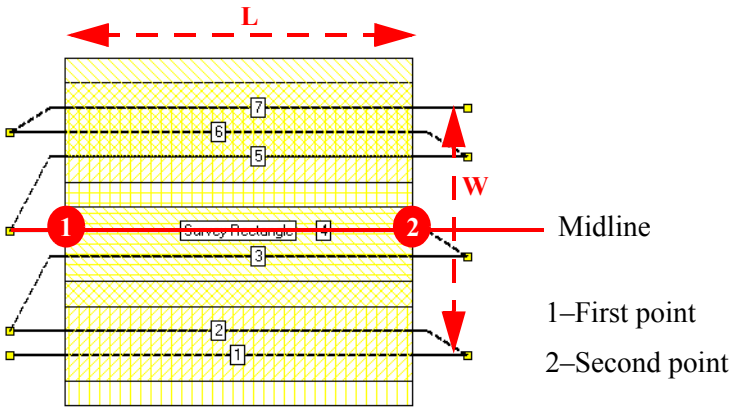


Figure 83: Defining a Survey Rectangle by a Midline

3. Click **Apply** to view the survey in the chart section.
4. Click **OK** to save the changes.

Defining a Survey Rectangle by Specifying Two Corner Points and Width or Three Corner Points

1. Select **Two or Three Corner Points** in the survey tab of the Survey Properties window.
2. In the Two or Three Corner Points area, specify the following:

- **Start Point**–coordinates of the first point of the survey.
- **Second Point**–coordinates of the second point of the survey.
- **Third Point**–coordinates of the third point of the survey
  or:
- **Width**–width of the survey

and:

- **Direction**–direction about the first trackline.

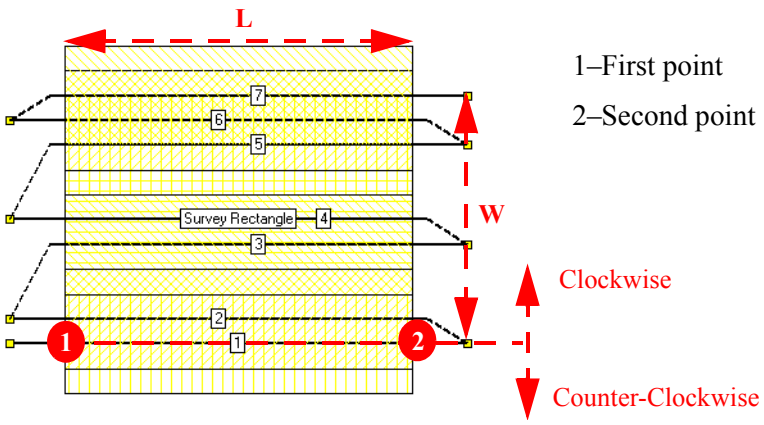


Figure 84: Defining a Survey Rectangle by Two Corner Points and Width or Three Corner Points

3. Click **Apply** to view the survey in the chart section.
4. Click **OK** to save the changes.

Editing the Layout of a Freeform Survey

The layout of a freeform survey can be edited by moving the whole survey, moving individual points, and adding or removing points. In a freeform survey, every point defines the start or end of a trackline.

The survey section in the Freeform Survey Properties window contains a number of editable fields for precisely specifying the location of each survey point, adding and removing points, and changing their relative positions.

NOTE: *Coordinate formats can be changed in the Preferences window. To open, in the* ***Edit*** *menu, select* ***Preferences****.*

Survey layout changes can also be performed directly on the graphical representation of the survey in the chart area.

Once you have drawn a Freeform survey in the chart section, you can move the survey, move individual points, and add or delete points.

Naming a Freeform Survey

Right-click on a freeform survey and select **Edit...** to open the survey properties window. Edit the **Name:** field and click **OK** to change the name of the freeform survey. The new name appears on the chart and in the list. Depending on the payload, the name may be used as part of the payload data file name.

Moving an Entire Freeform Survey

You can move a Freeform survey easily by clicking and dragging it to a new location on the chart.

Moving Individual Points in a Freeform Survey

You can move individual points in a Freeform survey either directly in the chart section or in the survey properties window.

In the Chart Section:

1. Click the survey to make it active. The survey points display as white squares with black borders.
2. Grab a survey point and drag it to the new location. The survey is redrawn.

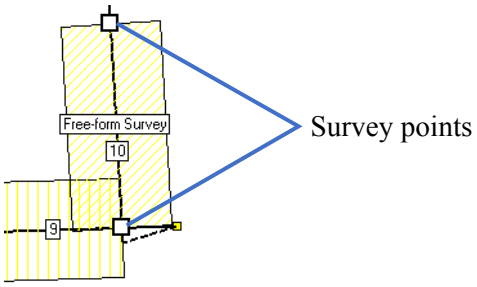


Figure 85: Freeform Survey Point

In the Survey Properties Window:

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.

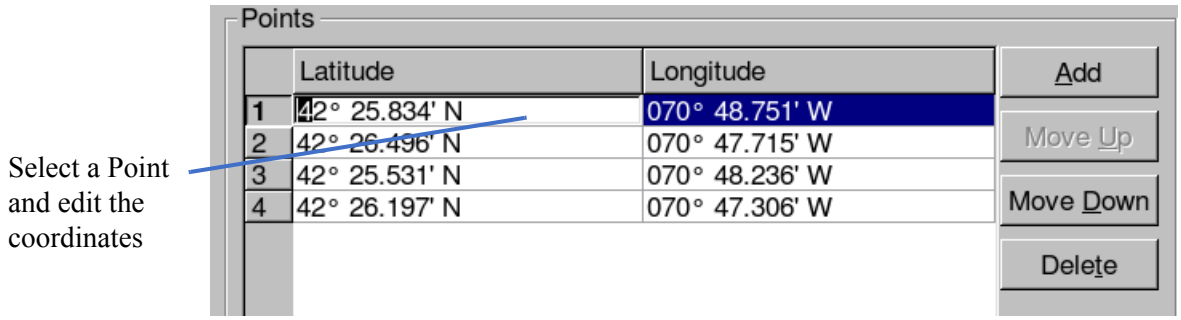


Figure 86: Moving a Freeform Survey Point in the Survey Properties Window

3. Select the point you want to move.
4. Specify the new coordinates for the point, and click **Apply**. The survey is redrawn.
5. Click **OK** to save the changes and exit the survey properties window.

Adding Points to a Freeform Survey

You can add points to a freeform survey either directly in the chart section or in the survey properties window.

In the Chart Section:

1. Click the survey to make it active. The survey points will display as white squares with black borders.
2. Right click at the location in the survey where you want to place a new point (typically between two existing survey points), and select **Insert Point** from the drop-down menu. The point is added and the survey is redrawn.

NOTE: *The point may not be in the precise location where you want it, but you can move it as described in "Moving Individual Points in a Freeform Survey" on page 153.*

In the Survey Properties Window:

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.
3. In the Points area, select the point above which you want to place the new point. (i.e. If you want to place a new point between points 3 and 4, select point 4 in the list.)
4. Click **Add**. A new point is created with the same coordinates above the selected point.
5. Specify the new coordinates for the point, and click **Apply**. The survey is redrawn.
6. Click **OK** to save the changes and exit the survey properties window.

Removing Points from a Freeform Survey

You can remove points from a freeform survey either directly in the chart section or in the survey properties window.

In the Chart Section:

1. Click the survey to make it active. The survey points display as white squares with black borders.
2. Right click on a point and select **Remove Point** from the drop-down menu. The point is removed without confirmation and the survey is redrawn.

In the Survey Properties Window:

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.
3. In the Points area, select the point you want to delete.
4. Click **Delete**. The point is deleted from the list.
5. Click **Apply**. The survey is redrawn.
6. Click **OK** to save the changes and exit the survey properties window.

Changing the Order of Points in a Freeform Survey

NOTE: *Changing the order of points in a freeform survey can only be done in the survey properties window. You cannot perform this task in the chart.*

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.

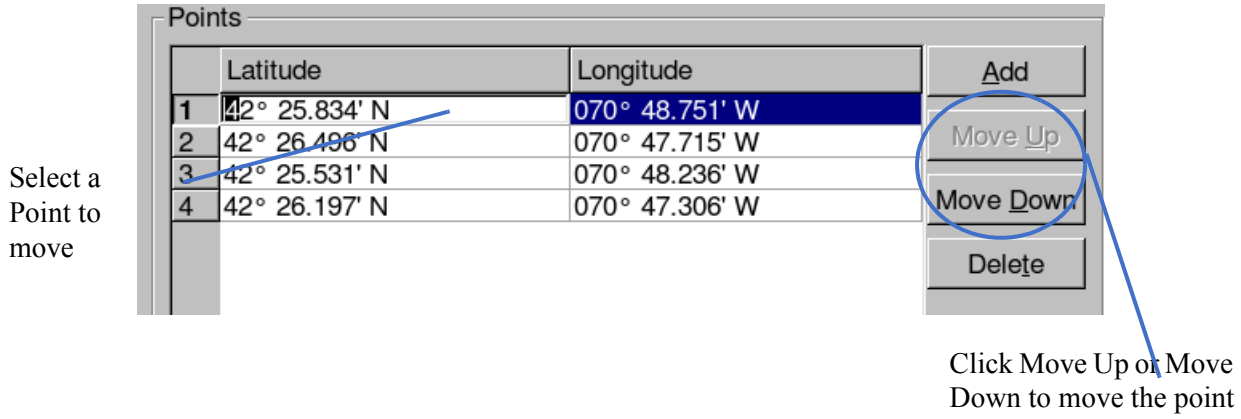


Figure 87: Changing the Order of Points in a Freeform Survey

3. Select the point you want to move, and click **Move Up** or **Move Down** as appliacable. The selected point moves up or down in the list.
4. Click **Apply**. The survey is redrawn.
5. Click **OK** to save the changes and exit the survey properties window.

Precisely Specifying Points in a Freeform Survey

When you create a freeform survey in the chart section it may be difficult to place the points in exactly the correct place. Once you have created the survey, you can use the options under the survey tab in the freeform survey properties window to precisely define the points.

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.
3. In the Points area, select the point you want to edit.
4. Enter the applicable coordinates and click **Apply**. The survey is redrawn.
5. Repeat for all the remaining survey points, or click **OK** to save the changes and exit the survey properties window.

Editing the Layout of a Q-Route Survey

The layout of a Q-Route survey can be edited by moving the whole survey, moving individual points, and adding or removing points. In a Q-Route survey, every point defines the start point and endpoint of an inbound and outbound trackline.

The survey section in the Q-Route Survey Properties window contains a number of editable fields for precisely specifying the location of each survey point, adding and removing points, and changing their relative positions.

Survey layout changes can also be performed directly on the graphical representation of the survey in the chart area.

Moving an Entire Q-Route Survey

You can move a Q-Route survey easily by clicking and dragging it to a new location on the chart.

Moving a Single Point in a Q-Route Survey

A single Q-Route point is moved in the same way that a freeform survey point is moved. For detailed instructions, see “Moving Individual Points in a Freeform Survey” on page 153.

Adding Points to a Q-Route Survey

A Q-Route point is added in the same way that a freeform survey point is added. For detailed instructions, see “Adding Points to a Freeform Survey” on page 154.

Removing Points from a Q-Route Survey

A Q-Route point is removed in the same way that a freeform survey point is removed. For detailed instructions, see “Removing Points from a Freeform Survey” on page 155.

Changing the Order of Points in a Q-Route Survey

Changing the order of Q-Route points is done in the same as in a freeform survey. For detailed instructions, see “Changing the Order of Points in a Freeform Survey” on page 155.

Precisely Specifying Points in a Q-Route Survey

Points in a Q-Route survey are specified in the same way as in a freeform survey. For detailed instructions, see “Precisely Specifying Points in a Freeform Survey” on page 156.

Editing the layout of a Trackcircle Survey

The layout of a Trackcircle survey can be edited by moving the whole survey in the chart area, or by editing the center point, radius, direction, number of orbits, and the start angle in the survey tab of the Trackcircle Properties window. For a trackcircle survey, the only coordinate you need to specify is the center point of the circle.

Naming a Trackcircle Survey

Right-click on a trackcircle survey and select **Edit...** to open the survey properties window. Edit the **Name:** field and click **OK** to change the name of the trackcircle survey. The new name appears on the chart and in the list. Depending on the payload, the name may be used as part of the payload data file name.

Moving a Trackcircle Survey

You move a trackcircle survey either directly in the chart section or in the survey properties window.

In the Chart Section:

You can move a Trackcircle survey easily by first clicking the survey to make it active, then grabbing it and dragging it to a new location on the chart.

In the Survey Properties Window:

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.
3. In the *Geometry* area, enter coordinates for the center of the Trackcircle.
4. Click **Apply**. The Trackcircle will be moved to this location.
5. Click **OK** to save the changes and exit the survey properties window.

Changing the Radius, Direction, Number of Laps, and Start Point of a Trackcircle Survey

By default, a Trackcircle survey is created with a radius of 100m, performing three counter-clockwise orbits starting from the top (0 degrees) of the circle, as shown in the illustration below. As can be seen in the illustration, the approach to the starting point of the trackcircle is unnecessarily long. This can be edited by changing the starting point of the survey.

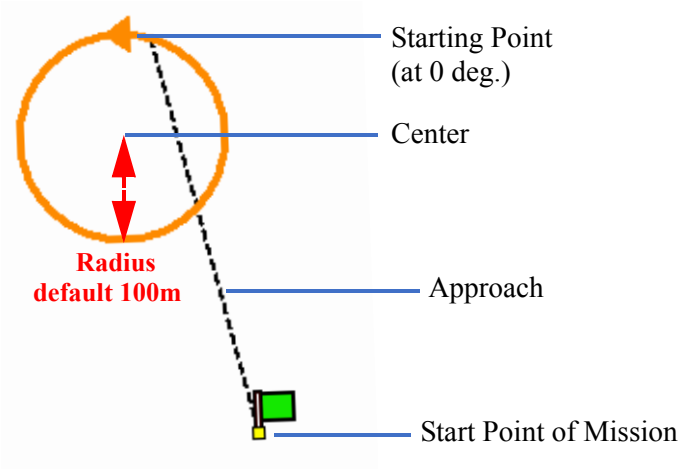


Figure 88: Trackcircle Survey

NOTE: *Changing the survey layout will affect the duration of the mission. Verify the mission duration in the mission details area of the Planner window. The minimum radius for this system is 15m.*

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.

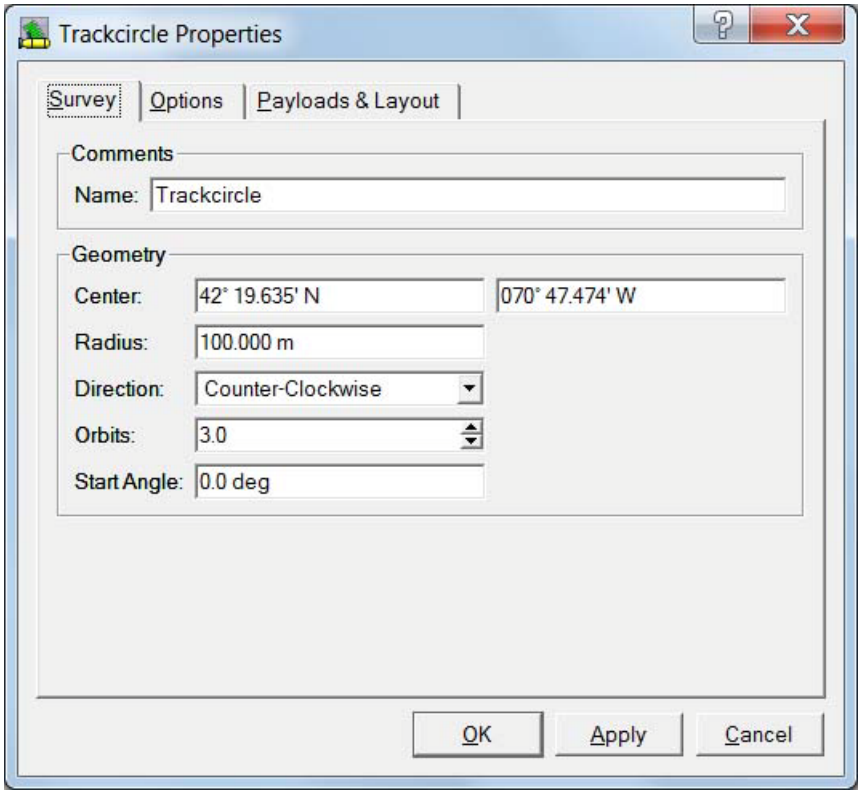


Figure 89: Editing the Trackcircle in the Survey Properties Window

3. To change the size of the circle, edit the **Radius** field.
4. To change the direction of the survey, select clockwise or counter-clockwise from the pull-down menu in the **Direction** field. This vehicle has starboard-looking sonar, so the trackcircle should be clockwise to look at the center of the circle.
5. To change the number of orbits performed during the survey, change the value in the **Orbits** field. The value changes by increments of 0.5 orbits.
6. To change the location of the starting point, edit the value in the **Start Angle** field.
7. Click **Apply**. The survey is redrawn.
8. Click **OK** to save the changes and exit the survey properties window.

Editing the Layout of a Compass Star

NOTE: *This vehicle does not require compass star navigation calibration.*

NOTE: *The default compass star settings provide the most effective navigation calibration. Bluefin strongly recommends using the default settings whenever possible.*

The layout of a Compass Star can be edited by moving the whole compass star in the chart area, or editing the first/center point, and the length, direction, and number of tracks in the survey properties window. For a compass star element, the only lat./lon. coordinate you need to specify is the first/center point of the location.

Moving a Compass Star

You can move a Compass Star easily by clicking and dragging it to a new location on the chart.

Changing the First Point, Track Length, Number of Legs, and Initial Azimuth of a Compass Star

NOTE: *The default compass star settings provide the most effective navigation calibration. Bluefin strongly recommends using the default settings whenever possible.*

NOTE: *Changing the survey layout will affect the duration of the mission. Verify the mission duration in the mission details area of the Planner window.*

By default, a compass star is generated with eight 1200m legs departing at an initial angle of 0 degrees from the point where the compass star was plotted. All of these values can be edited in the survey properties window.

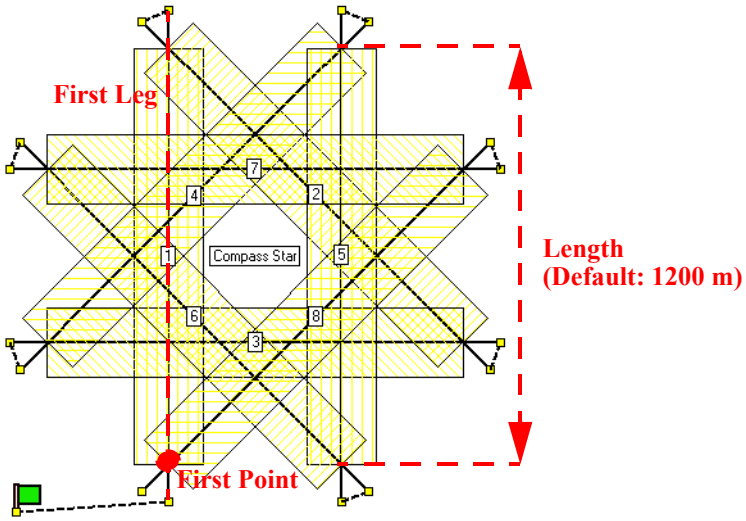


Figure 90: Compass Star Survey Layout

1. Double-click the survey, or select the survey in the list section and click the wrench button. The survey properties window opens.
2. Select the Survey tab.

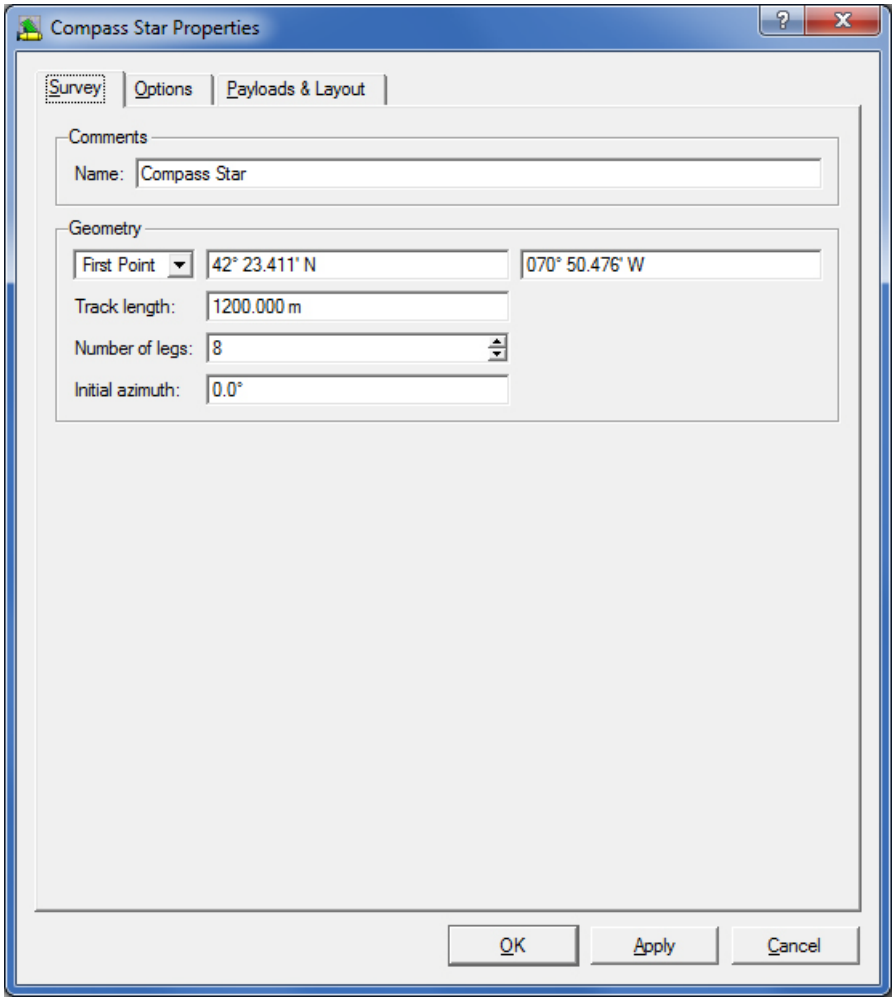


Figure 91: Editing a Compass Star Survey in the Survey Properties Window

3. To specify the location of the compass star, select *First Point* or *Center* from the pull-down menu and set the coordinates of the first point or the center point as applicable.
4. To change the track length, edit the value in the **Track Length** field.

NOTE: *Bluefin recommends using the default setting. At a minimum, the track length should be 1000 m.*

5. To change the number of legs, set the value in the **Number of legs** field
6. To change the angle of the compass star, edit the value in the **Initial azimuth** field. (The initial azimuth is the angle at which the first leg departs from the first point.)
7. Click **Apply**. The survey is redrawn.
8. Click **OK** to save the changes and exit the survey properties window.

Editing Survey Options

The options tab in the survey properties window contains a number of editable fields for determining how the AUV behaves during a survey. You can configure AUV speed during the survey, frequency of GPS surfacing, the payload stabilization lead-in distance, the depth envelope, and strobe behavior.

NOTE: *Changing the survey options settings will affect the duration of the mission. Verify the mission duration in the mission details area of the Planner window.*

To access the survey properties window, double-click the survey in the chart or select the survey in the list section and click the wrench button. In the survey properties window, select the options tab.

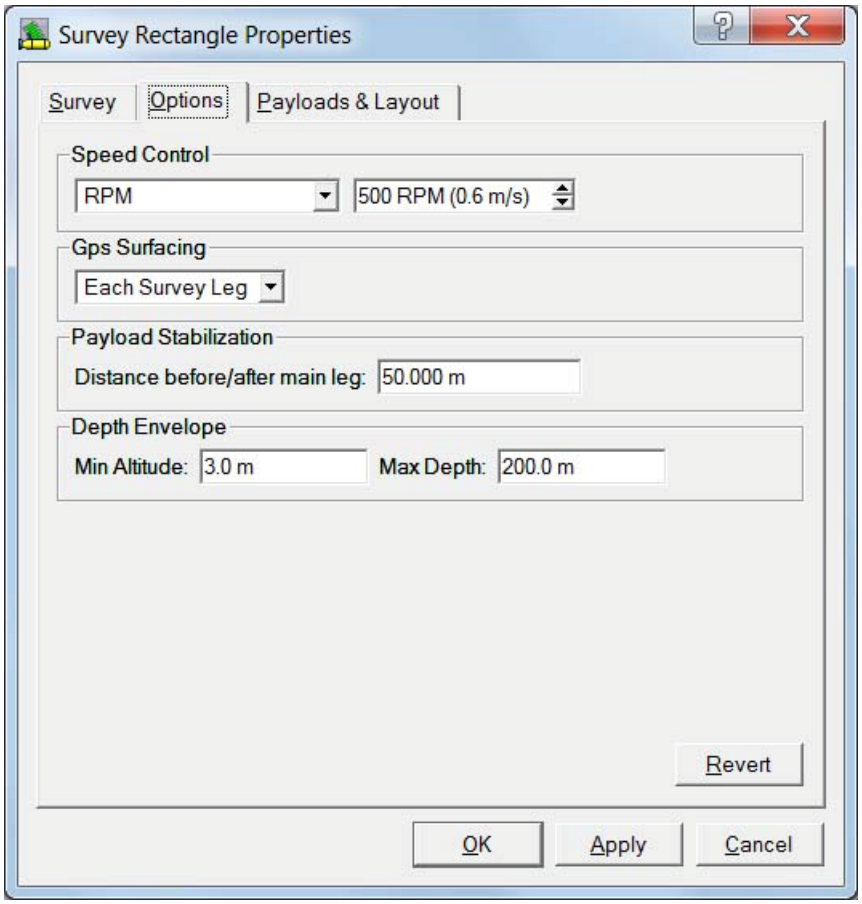


Figure 92: Survey Properties Window–Options Tab

The options tab contains the following fields:

- **Speed Control**–There are two modes of speed control:
  - RPM mode, in which the vehicle maintains a constant thruster rotational velocity (see Figure 93). Next to the RPM value is an estimate of how fast the vehicle will be moving at that thruster RPM.

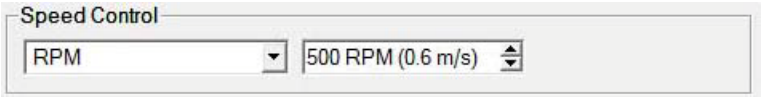


Figure 93: RPM Mode

  - Speed mode, where the vehicle automatically varies the thruster RPM to maintain a constant forward speed.

- **GPS surfacing**–determines when the AUV surfaces for GPS during the survey. The available options are:
  - *Each Survey Leg*: the AUV surfaces for GPS at the beginning and/or end of each individual survey leg (this is the default setting).
  - *Never*: the AUV does not surface for GPS during the survey.
  - (Some Systems) *Survey Leg or Distance*: If you specify a value in the distance field, the AUV will surface at that distance, along the survey legs as well as at the end of the legs.

NOTE: *General Dynamics Mission Systems recommends surfacing for GPS at the end of every trackline when performing a rectangular survey (unless USBL is being used). If the survey legs are longer than 2 km, you will get better results if you select survey leg or distance, and set the distance to 2 km.*

NOTE: *If USBL is used, the vehicle does not need to surface. USBL provides navigational information.*

- **Payload Stabilization**–determines how long the lead in distance is between survey legs. The default setting is recommended for optimal performance.
- **Depth Envelope**–Sets the maximum depth below the surface and the minimum altitude above the sea floor that the vehicle will operate in.

Editing Individual Survey Tracklines

In addition to specifying the properties of entire survey elements, individual tracklines within the survey element can be configured. This is useful for running particular tracklines at a different speed, with the sonar turned off, or for running specific logging strings.

NOTE: *Before you can edit individual tracklines, ensure that the Show Full Tree checkbox in the Preferences window is checked. To access the preferences window, select* ***Edit > Preferences*** *from the menu bar.*

NOTE: *Individual smaller elements in a larger mission element are locked to prevent editing by default. To unlock the smaller elements in a larger mission element, select the larger mission element and click the wrench button. The larger mission element's properties window opens. Click OK to close the window and unlock the individual smaller elements.*

In the list section, click on the + sign next to a survey to expand the survey to show the survey legs. This allows you to select individual tracklines to edit (Figure 94).

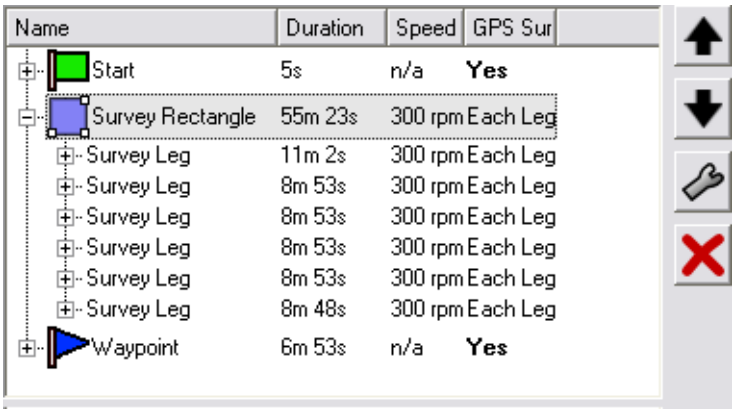


Figure 94: List Section Showing Full Element Tree

To edit an individual trackline, double-click on a survey leg in the list section or select the survey leg from the list view and click the wrench button. The Edit Survey Leg window opens in which an individual survey leg can be edited to override the parent survey settings. This window contains two tabs: Options, and Payloads & Layout. The options tab is described in this section.

>> For more information about the payload tab, see Chapter 13: "Planner: Payload Properties".

In this example, the speed control value has been increased to 1000 RPM.

GPS surfacing has been changed to *never*, meaning that the AUV will not surface at the end of the trackline.

The changes can be seen in the entry for that survey leg in the list section.

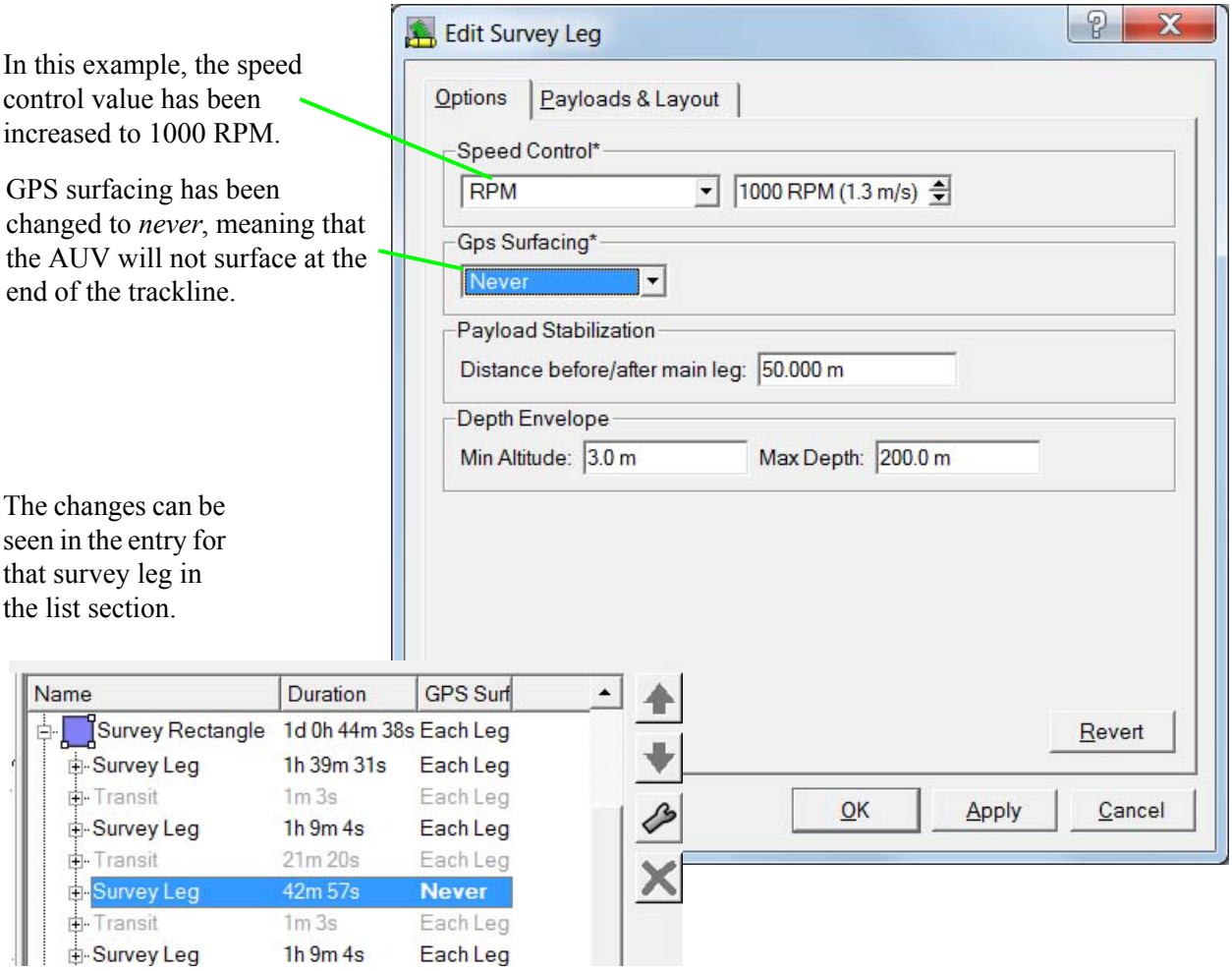


Figure 95: Survey Leg Properties Window and Updated Survey Leg in the List Section

Changes to individual survey legs can also be made directly in the list section entry. Click on a survey leg to select it, and then click a property (such as Speed or GPS surfacing). Tools appear which allow you to edit the property directly, as shown below.

NOTE: *To add/remove property columns in the list view, go to the View menu in the menu bar and select or deselect the applicable properties.*

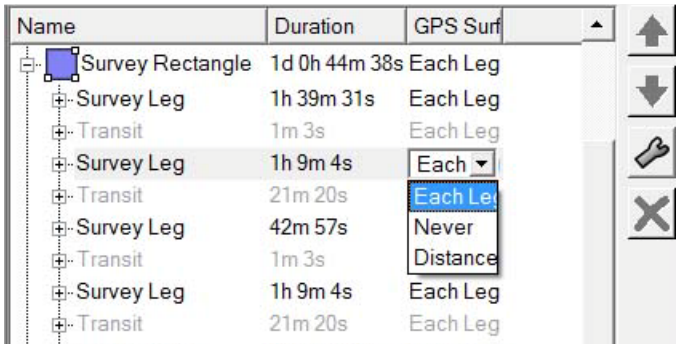


Figure 96: Editing the Survey Leg directly in the List Section

Editing Transit Path Properties

Transit paths connect mission elements such as surveys or transit waypoints. While the location, length, and orientation of the transit path is dependant on the elements at either end, you can configure the AUV's behavior during transit. Editing a transit path is done in the Transit Properties window.

1. Double-click the transit path in the chart section. The Transit Properties window opens.
2. Select the Options tab. For more information about the payload tab**,** see Chapter 13: "Planner: Payload Properties".

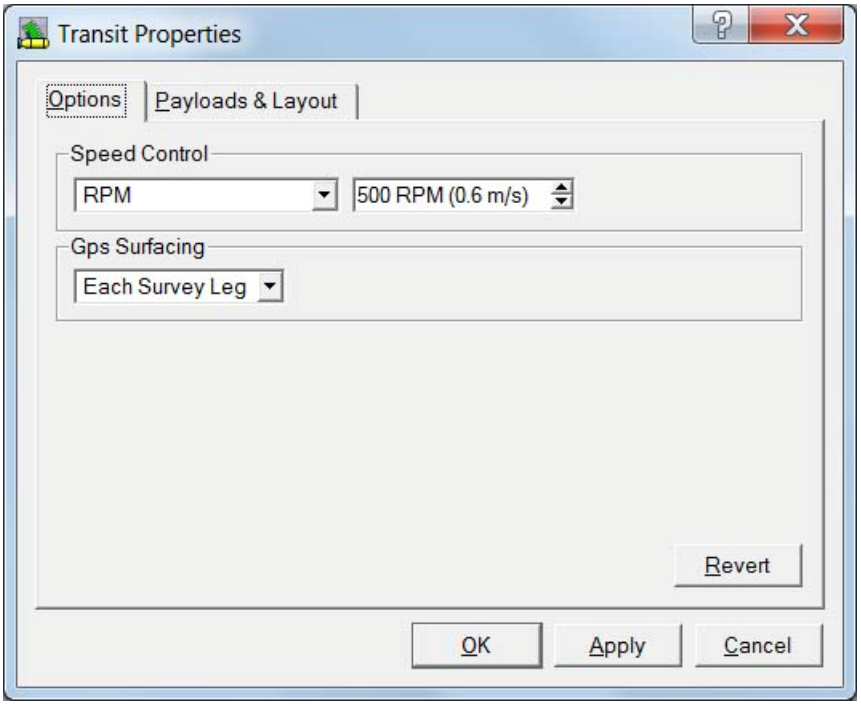


Figure 97: Transit Properties Window–Options Tab

3. Under the options tab you can change the transit speed of the AUV, configure how and when it surfaces for GPS, and change the strobe behavior.

Caution

•The Strobe settings can override the vehicle's default safety settings.

NOTE: *Once the transit path has been edited, it appears as an entry in the list section. It can then be edited by double-clicking it in the list section, or by selecting it and clicking the wrench icon.*

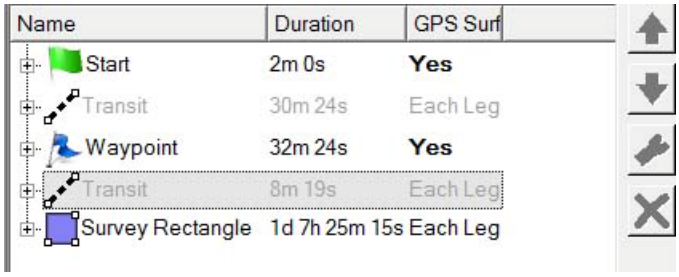


Figure 98: Transit Path in the List Section

4. (If available) You can also change the properties directly in the transit path entry in the list view. Click on the transit path in the list to select it, and then click on a property. If it is editable, a drop-down menu, or up/down arrow will appear allowing you to edit the transit path directly.

Editing a Bounding Region

The size of the bounding region can be edited at any point during mission planning. The bounding region is always a rectangle. The orientation and shape of the bounding region cannot be changed, only the size and location.

To edit the bounding region:

1. Select **Safeties > Edit Bounding Region** from the menu bar. The bounding region will become active on the chart view.
2. Grab any corner of the bounding region and drag it to a new location. (In the example below, the bounding region is being redrawn to accommodate the survey rectangle.)

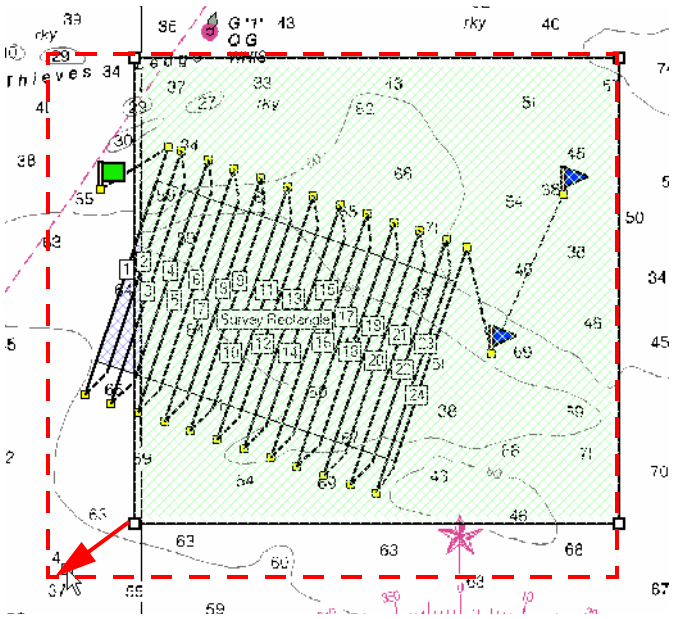


Figure 99: Increasing the Size of the Bounding Region

3. The bounding region is redrawn based on the new corner point.

NOTE: *The bounding region can be deleted by selecting* ***Safeties > Clear Bounding Region*** *from the menu bar.*

Deleting a Survey, Start Point, or Waypoint

An element can be deleted in either of the following ways.

- Right-click on the element in the chart section and select **Delete** from the pop-up menu.
- Select the element in the list section, and click the  button.

NOTE: *There is no confirmation of the delete function. If you accidentally delete a mission element, you can restore it by pressing CTRL + Z or by selecting* ***Edit > Undo*** *from the menu bar.*

13

PLANNER: PAYLOAD PROPERTIES

Payload properties can be set both as default mission properties (in the default mission properties window, see “Setting Default Mission Properties” on page 133) and for individual surveys or tracklines. Payload properties are configured in the survey properties window under the **Payloads & Layout** tab. To access the survey properties window for a survey or transit path, double-click the survey or transit path in the chart section or list section, or select the element in the list section and click the wrench button.

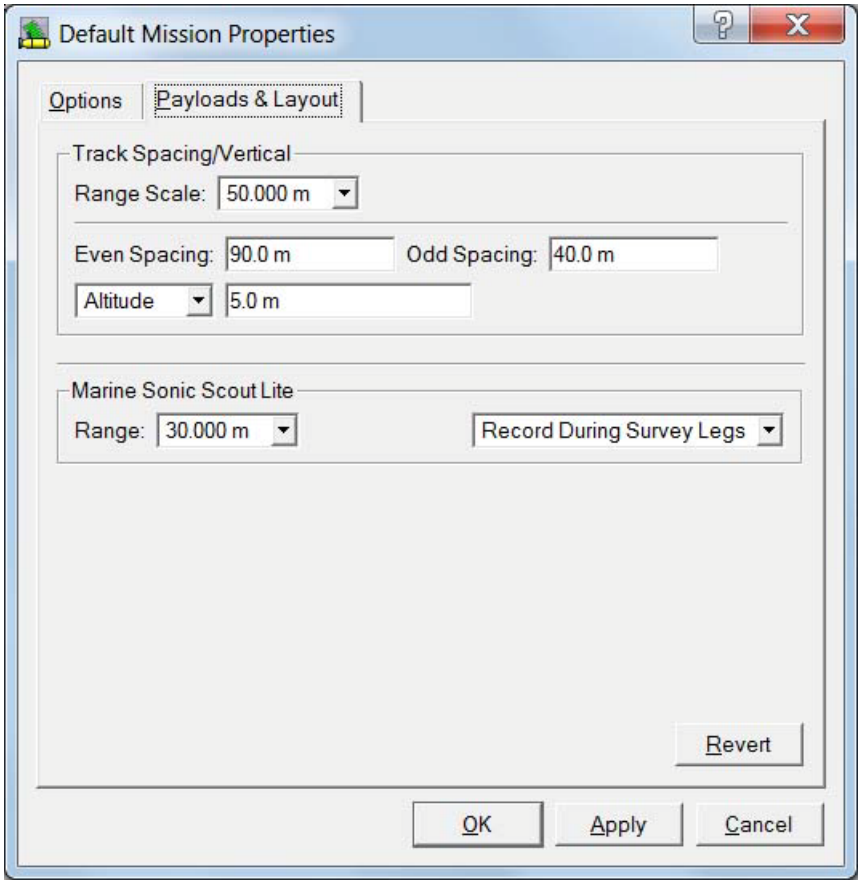


Figure 100: Default Mission Properties Payloads & Layout Tab

Configuring Range Scale and Track Spacing or Altitude/Depth

Under the *Track Spacing/Vertical* group in the Payloads & Layout tab, you can specify the behavior of the vehicle as it gathers sonar data during the survey. For survey types that run parallel tracklines, you configure the range scale, altitude or depth, and the spacing of tracklines. For survey types that run non-parallel tracklines, only the range scale and altitude or depth can be configured.

Configuring the Range Scale

When you set a range scale value, Planner automatically populates the track spacing or depth/altitude fields with the optimal values for collecting the best quality data. These fields can then be edited to meet your specific survey requirements, but Bluefin recommends using the automatically generated values unless there are operational reasons for changing them.

NOTE: *Changing the track spacing does not change sonar ranges. Sonar ranges must be set individually.*

NOTE: *The track spacing option is only available for survey types which create parallel tracklines. Other survey types will display only a depth/altitude setting.*

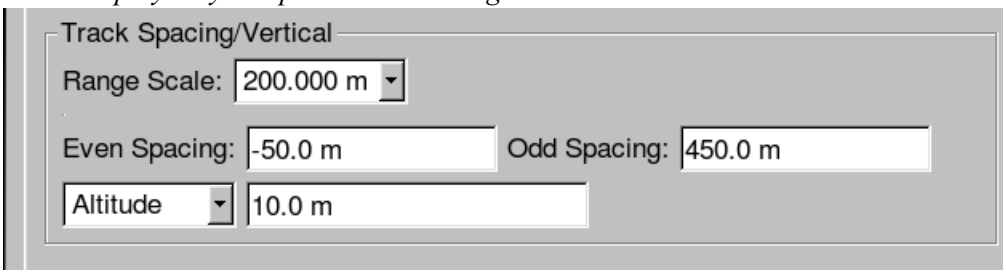


Figure 101: Track Spacing/Vertical Area in Payloads & Layout Tab

Changing the range scale of the sonar payload will affect the sonar coverage in terms of area and resolution. A higher value range scale will produce a wider swath, but will decrease the resolution of the image. Conversely, a low range scale value will reduce the swath width, but improve resolution.

An example of the predicted coverage for a single, non-parallel survey leg in Planner for two different range scale settings is shown in Figure 102.

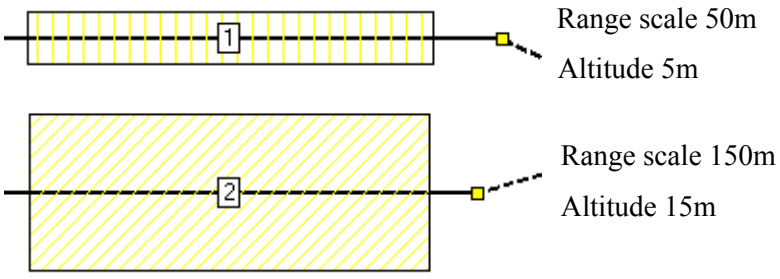


Figure 102: Planned Sonar Coverage at Two Different Range Scales

NOTE: *When you set the range scale for the whole survey, you can still override it on an individual survey leg by selecting the leg in the list section. For more information, see "Editing Individual Survey Tracklines" on page 167.*

Configuring Trackline Spacing

When creating a survey type that consists of parallel survey legs, or tracklines, Planner will space the tracklines to optimize coverage for the vehicle's payload, or according to the settings you entered in the default mission properties window (see "Setting Default Mission Properties" on page 133). Track spacing can still be configured manually according to special requirements of the payload or the mission plan.

To override the default trackline spacing, enter new values in the Even Spacing and Odd Spacing fields in the Track Spacing/Vertical area. (See "Track Spacing/Vertical Area in Payloads & Layout Tab" on page 177.) Even spacing refers to the space adjacent to an even numbered trackline; odd spacing refers to the space adjacent to an odd numbered trackline as shown in the illustration below.

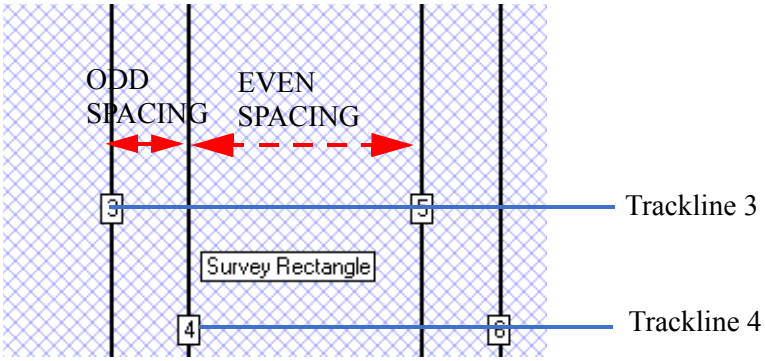


Figure 103: Trackline Spacing (Odd and Even)

NOTE: *When you set the trackline spacing for the whole survey, you can still override it on an individual survey leg by selecting the leg in the list section. For more information, see "Editing Individual Survey Tracklines" on page 167.*

NOTE: *Note: The even and odd spacings are set differently so that every other trackline has extra overlap to fill in the nadir.*

Configuring the Sonar

Not used by this vehicle

The operation of the sonar can be configured for an entire survey, a transit point, or an individual trackline. Configuration of the sonar is done in the Properties window, under the Payloads & Layout tab in the Sonar group.

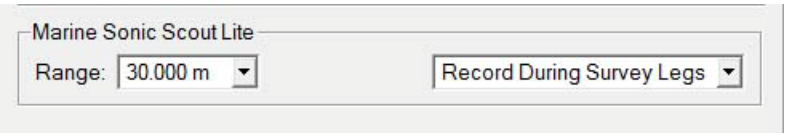


Figure 104: Payload Sonar Controls

The options are:

- Record During Survey Legs
- Always Record
- Never Record

14

PLANNER: USING THE SETPOINT TOOL

The setpoint tool is a specialized engineering tool intended for in-water vehicle tests, such as dynamic control tuning. The Setpoint tool allows the operator to create a mission segment, or behavior, during which the AUV follows a specific heading, or maintains a particular rudder angle, without creating a full mission with start points, waypoints and endpoints. A setpoint is usually not location dependent, i.e. you do not plot a setpoint on a particular location on a chart. The setpoint is run wherever the AUV is launched or deployed. This can be in open water, but can be performed in a large test tank or dock side.

•The Setpoint tool is an advanced feature that should only be used by operators who have been fully trained in AUV operations and have experience in AUV operations. Contact General Dynamics Mission Systems at bluefin_support@gd-ms.com for information about operator training.

Adding a Setpoint

To add a setpoint:

1. Select **Mission > Add Setpoint** from the menu bar.
2. A setpoint is added to the list section next to the chart.

NOTE: *If possible, an icon will be used to indicate the approximate location of the setpoint behavior on the chart.*

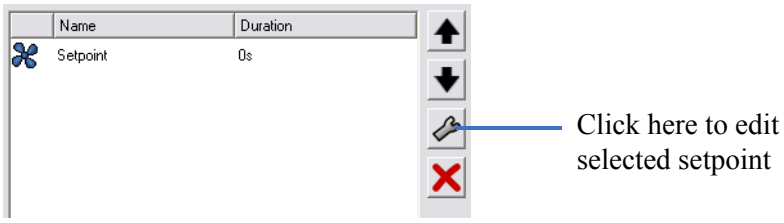


Figure 105: Setpoint in the Chart Section

3. The setpoint can be configured by double-clicking the setpoint icon or by selecting the icon in the list and clicking the wrench button. This accesses the Setpoint Properties window. For more information, see Editing Setpoint Properties, below.

Editing Setpoint Properties

The setpoint properties window contains three tabs: Survey, Options, and Payloads & Layout. The contents of these tabs are described below.

Setpoint Properties–Terminating Events

In the survey tab of the Setpoint Properties window (Figure 106), you can change the name and set the terminating events for the setpoint. The available terminating event options are described in the table that follows:

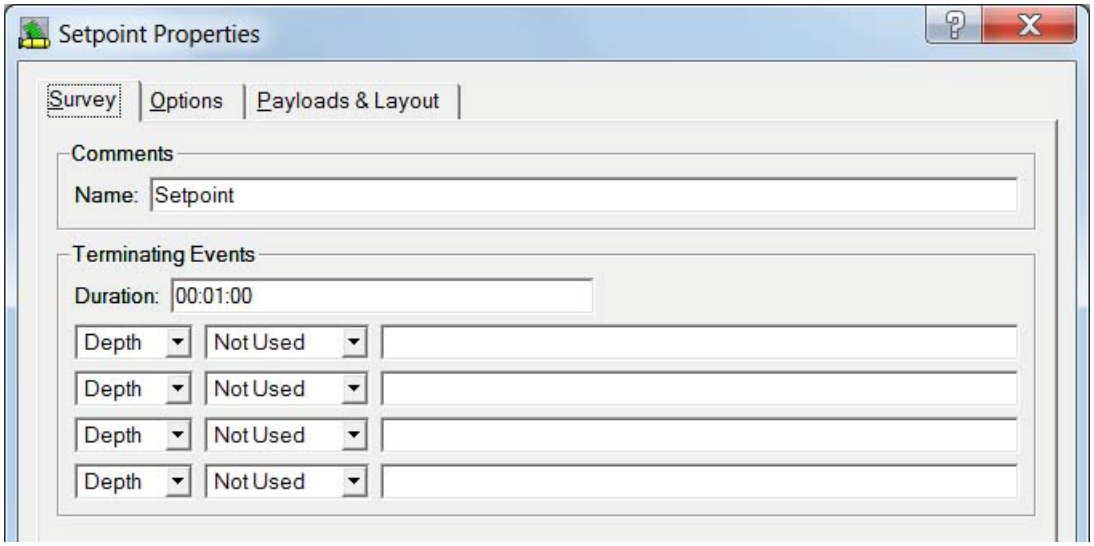


Figure 106: Setpoint Properties Window–Survey Tab

Table 6: Setpoint Properties: Terminating Events

Terminating Event	Description
Duration	Set the duration of the behavior. The behavior will terminate when the timer expires.
Less than Depth	The AUV will terminate the behavior when it transits shallower than the depth specified. This is used for surfacing behaviors.
Greater than Depth	The behavior will terminate when the AUV reaches the depth specified.
Less than Altitude	The behavior will terminate if the AUV flies below the specified altitude.
Greater than Altitude	The behavior will terminate if the AUV flies above the specified altitude.

Setpoint Properties–AUV Behavior

In the Options tab of the Setpoint Properties window (Figure 107), you can precisely specify the behavior of the AUV for the setpoint. The behavior can be specified in the horizontal and vertical mode, and the speed of the AUV set for the setpoint.

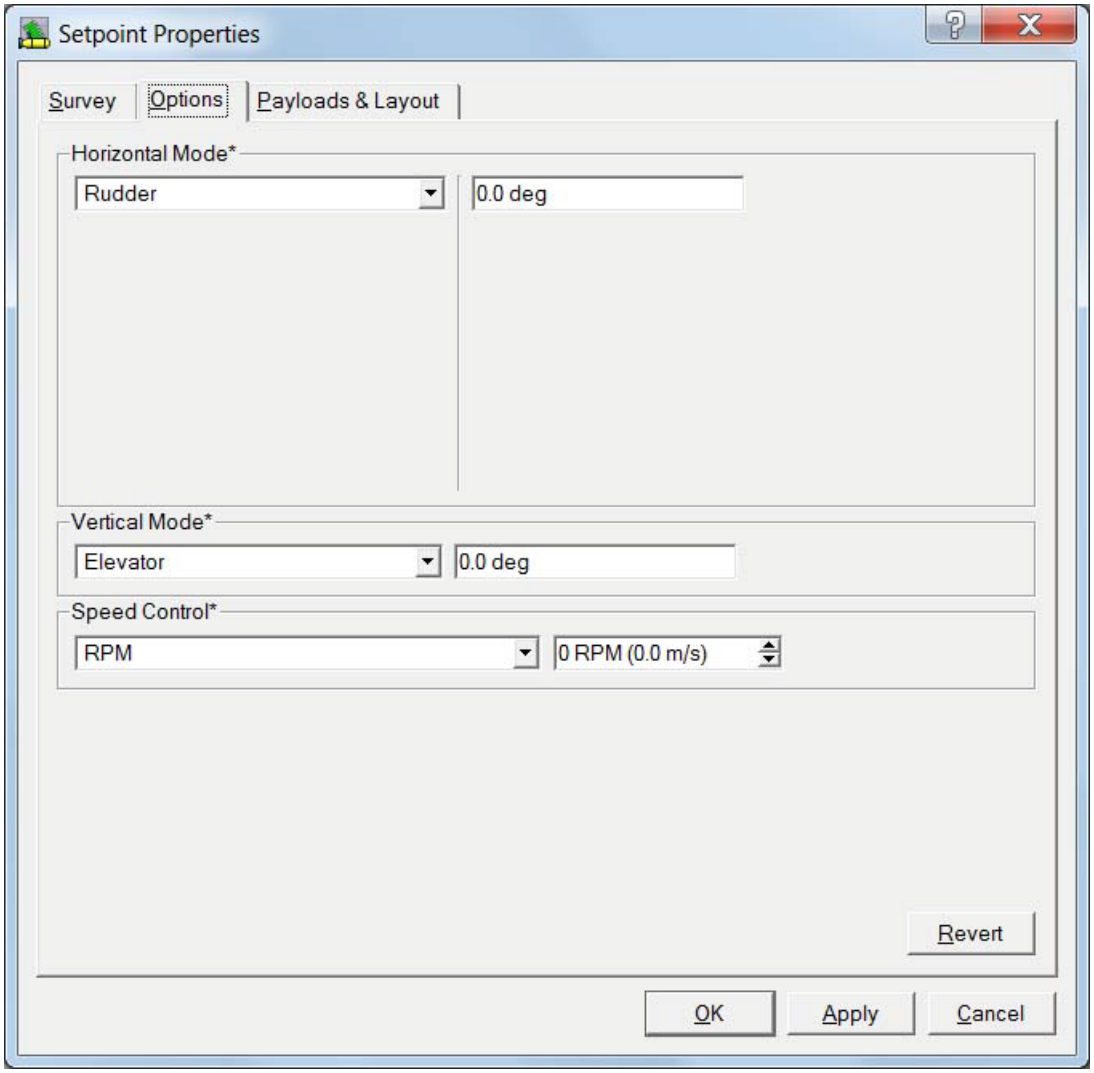


Figure 107: Setpoint Properties Window–Options Tab

There are several behavior options for both the horizontal and vertical modes. These are described in the following sections.

Horizontal Mode Behaviors

To select a horizontal mode behavior, use the pull-down menu to select a behavior. A sample behavior is shown below:

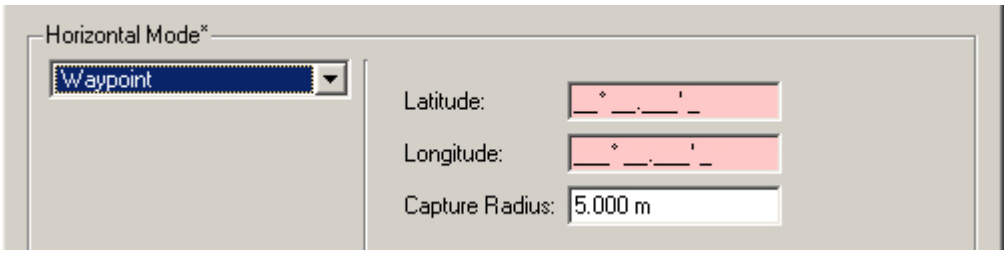


Figure 108: Sample Horizontal Mode Behavior

The horizontal mode behavior options are described in the table below:

Table 7: Horizontal Mode Behavior Options

Behavior	Description	Options
Rudder	The rudder is kept at a constant angle in the horizontal plane.	Enter an angle in degrees.
Heading	The AUV maintains a constant heading.	Enter a heading in degrees.
Waypoint	The AUV travels towards a specified lat./lon.	Enter a lat./lon. value Enter a capture radius, e.g. 12ft., 20m., etc. (i.e. how close to the coordinates the AUV must come.)
Loiter	The AUV travels towards a specified lat./lon. and stays (loiters) there.	Enter a lat./lon. value Enter a capture radius Enter a loiter radius. (i.e. How far the AUV can drift before returning to the specified coordinates.)
Trackline	The AUV travels along a single trackline (survey leg)	Enter coordinates of first and last point. Enter a capture radius.
Trackcircle	The AUV performs a trackcircle.	Enter coordinates of center point. Enter the trackcircle radius. Enter the direction of travel. Enter the number of orbits.
Wiggle	Not used by this vehicle.	

Table 7: Horizontal Mode Behavior Options (Continued)

Behavior	Description	Options
Shore Transit	The vehicle travels towards the shore on the first trackline. It turns around at the set water depth and follows the second trackline away from the shore. It loiters at the end of the second trackline.	Enter coordinates of the track start and end locations. Enter a capture radius. Enter a servo depth and a servo gain.

Vertical Mode Behaviors

To select a vertical mode behavior, use the pull-down menu to select a behavior. A sample behavior is shown below:

Figure 109: Sample Vertical Behavior

The vertical mode behavior options are described in the table below:

Table 8: Vertical Mode Behavior Options

Behavior	Description	Options
Depth	The AUV maintains a constant depth.	Enter a depth value.
Altitude	The AUV maintains a constant altitude.	Enter an altitude value.
Elevator	The elevator is kept at a constant angle. Holding a fixed-elevator for more than a few seconds will result in excessive pitch and an abort.	Enter an angle in degrees.
Pitch	The AUV holds a fixed pitch.	Enter a pitch value (degrees).
Wiggle	Not used by this vehicle.	
Bathymetry	The AUV maintains a specific relative depth in the water column.	Enter a depth reference (%) Enter the offset (m., ft., etc.)

Speed Control

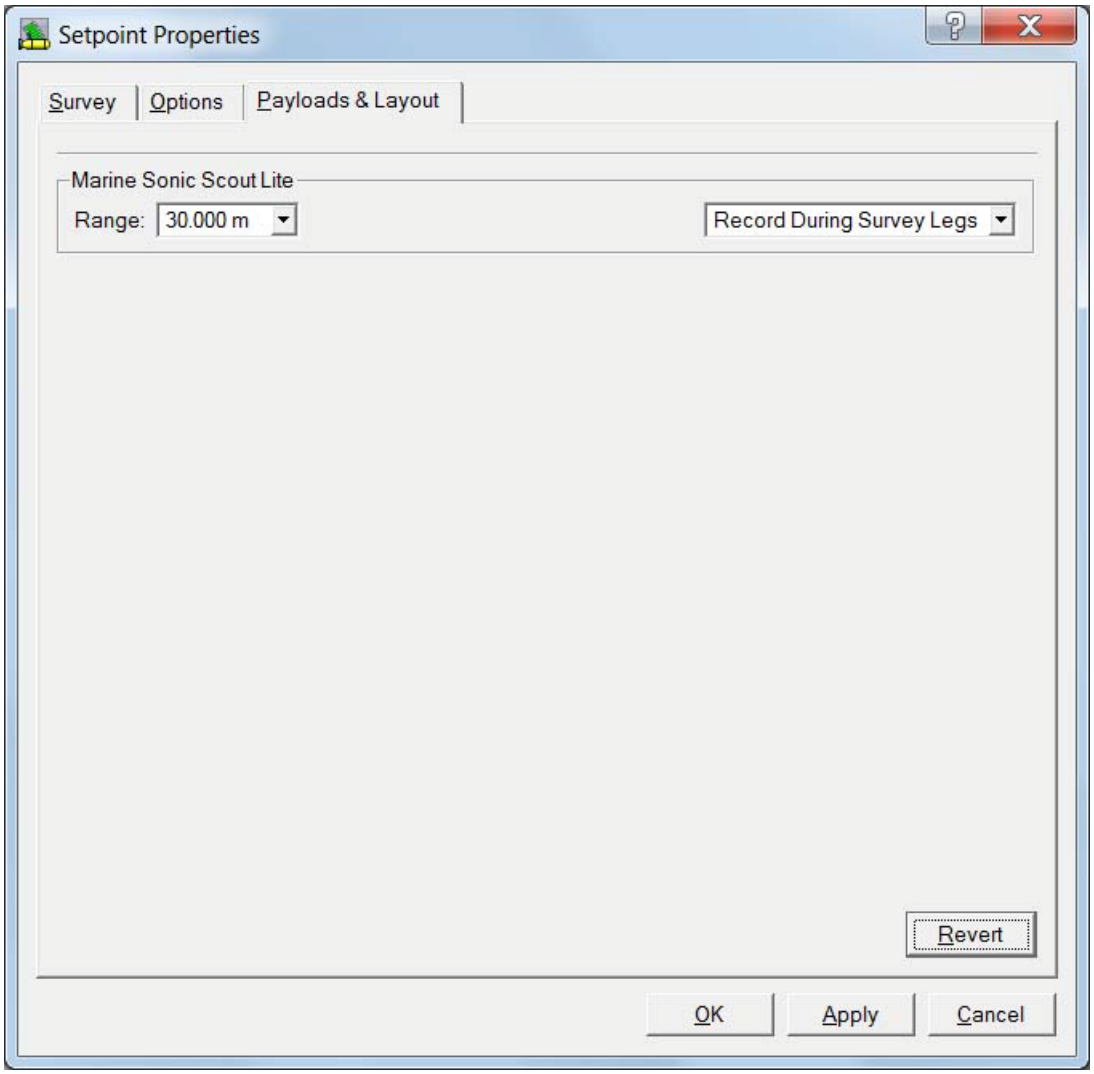
To set the speed of the AUV during the behavior, select Speed or RPM in the dropdown menu and use the arrows to specify the speed.

Figure 110: Sample Speed Control Settings

Payload Settings

Not used by this vehicle.

Setpoint behaviors can incorporate sonar recording. To do this, the payload must be set up using the payload interface in the Payloads & Layout tab in the Setpoint Properties window.



NOTE: *Unlike the Payloads & Layout tab for a typical survey rectangle mission, this tab does not contain options for specifying track spacing.*

>> For information about configuring the payload, see Chapter 13: "Planner: Payload Properties".

15

DASHBOARD: GETTING STARTED

This chapter provides a brief overview of the Dashboard application. It also explains how to install Dashboard, and how to connect the AUV to the Operator Laptop (OL) in preparation for using Dashboard.

Dashboard allows monitoring and checkout of the AUV from an Operator Laptop. Dashboard consists of a number of windows allowing you to monitor both general and specific information on the AUV's status.

Dashboard allows you to perform the following tasks:

- Establish communications with the AUV
- Verify the status of the AUV before, during, and after a dive
- Manage dive and configuration files
- Start a dive
- Monitor a dive in progress
- Track the AUV and support ship overlaid on a chart of the survey area
- Terminate a dive, if necessary

A complete description of Dashboard and the procedures users can perform with it are provided in this manual.

Installing Dashboard

All Topside software, including Dashboard, can be installed from the Operator Tool Suite CD. Users install all the Topside software onto the Operator Laptop (OL) from this CD.

General Dynamics Mission Systems recommends exiting all applications on the Operator Laptop before installing Dashboard.

To install Dashboard:

1. Insert the Operator Tool Suite CD into the CD-ROM drive.
2. Double-click on the Dashboard installer desktop icon to run the installation program.

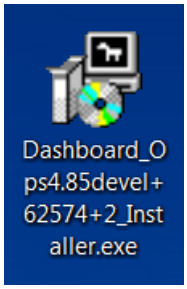


Figure 111: Dashboard Installer Icon on Desktop

3. The installation program starts and takes the user through the installation process. Accept the license agreement.

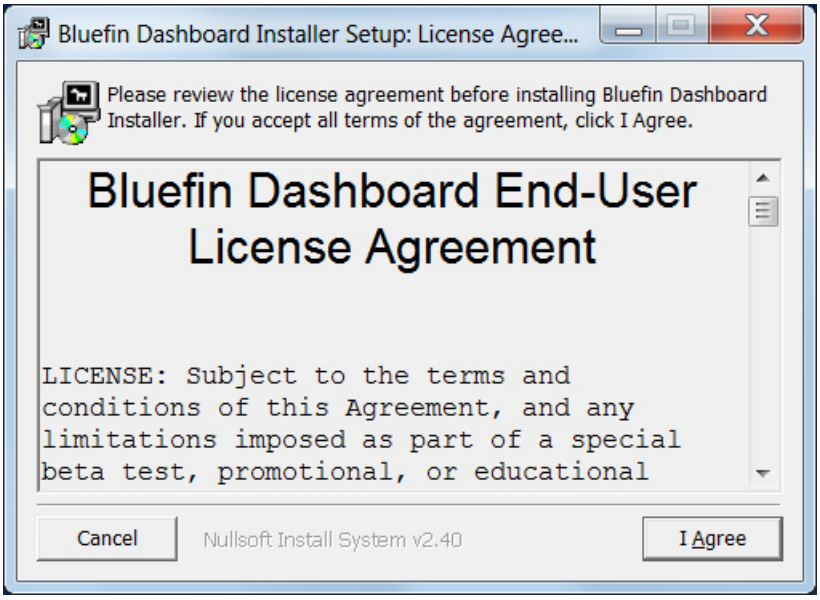


Figure 112: License Agreement

4. In the Installation Options screen, select:
   - Core files
   - (recommended) Start Menu Shortcuts

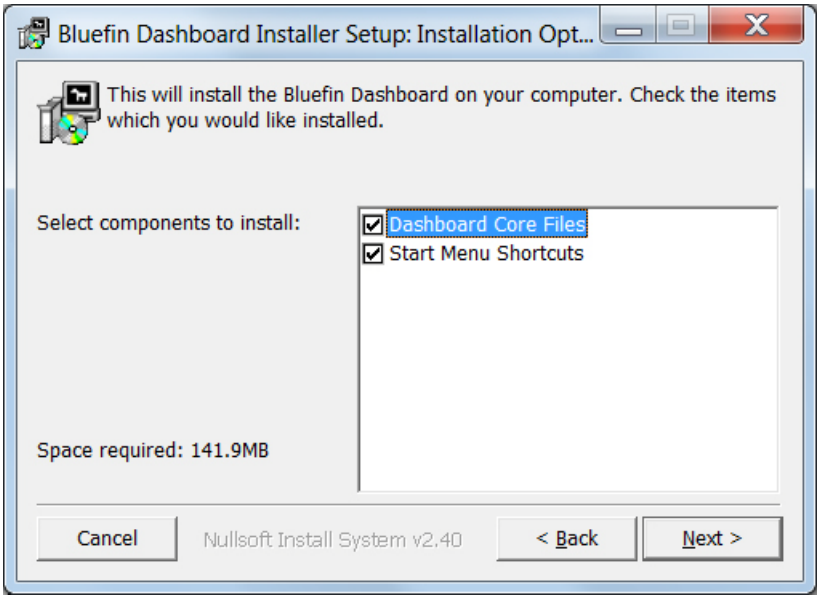


Figure 113: Dashboard Installer Program–Installation Options

5. Click **Next**. The destination folder selection screen displays (Figure 114).

NOTE: *The installer program will automatically install the program files to the default path unless the user selects a different location.*

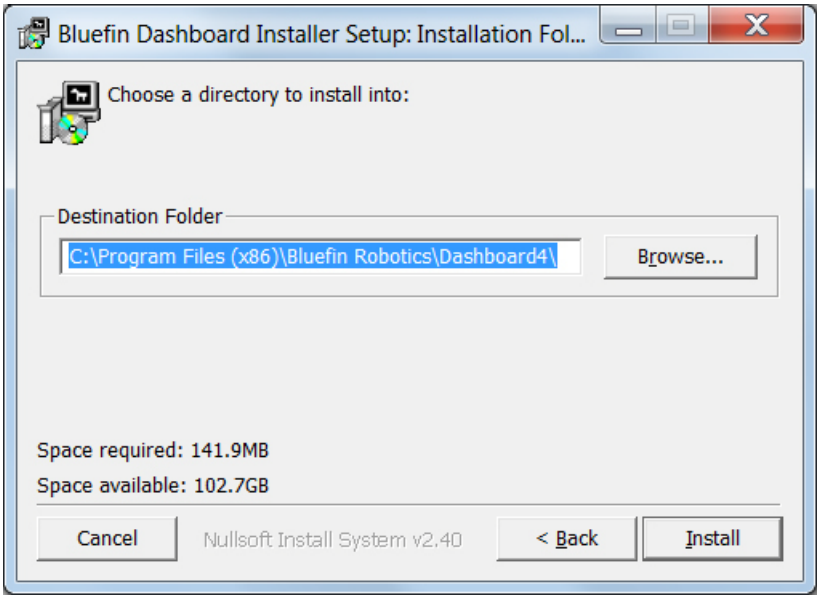


Figure 114: Dashboard Installer Program–Select Destination Folder

6. Select the destination folder. General Dynamics Mission Systems recommends using the default location. The default directory is:
   `C:\Program Files (x86)\Bluefin Robotics\Dashboard4\`
7. Click **Install**. The installer begins installing application files. A progress bar is displayed indicating the progress of the installation process.

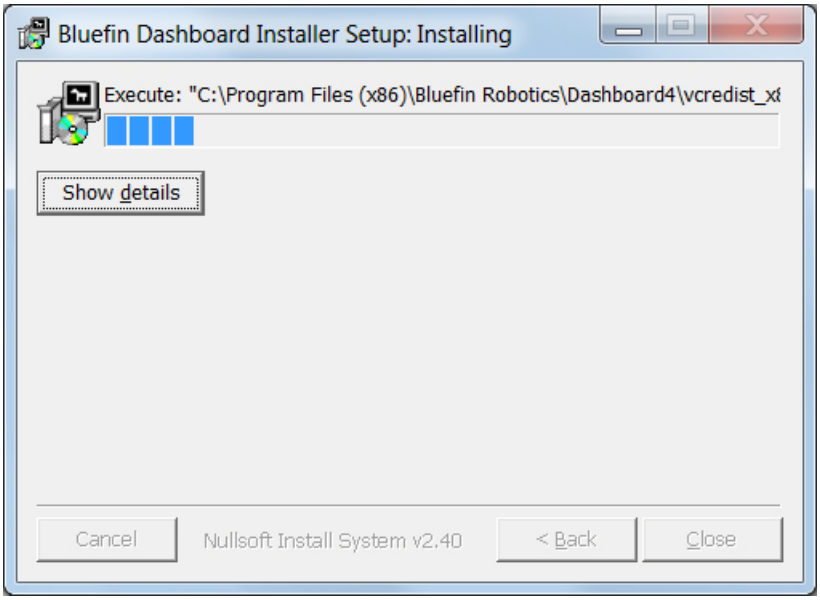


Figure 115: Installation Progress Bar

8. When the installation is complete, the window displays an installation complete message (Figure 116).

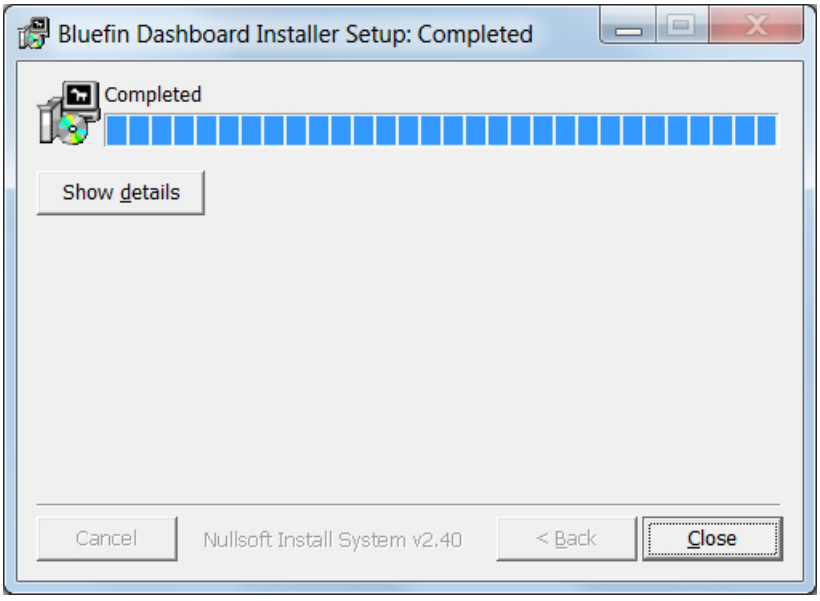


Figure 116: Dashboard Installer Program–Installation Completed

9. Click **Close** to exit the installer.

10. If the Windows Program Compatibility Assistant pop-up window opens, click **Reinstall using recommended settings** and repeat the installation process.

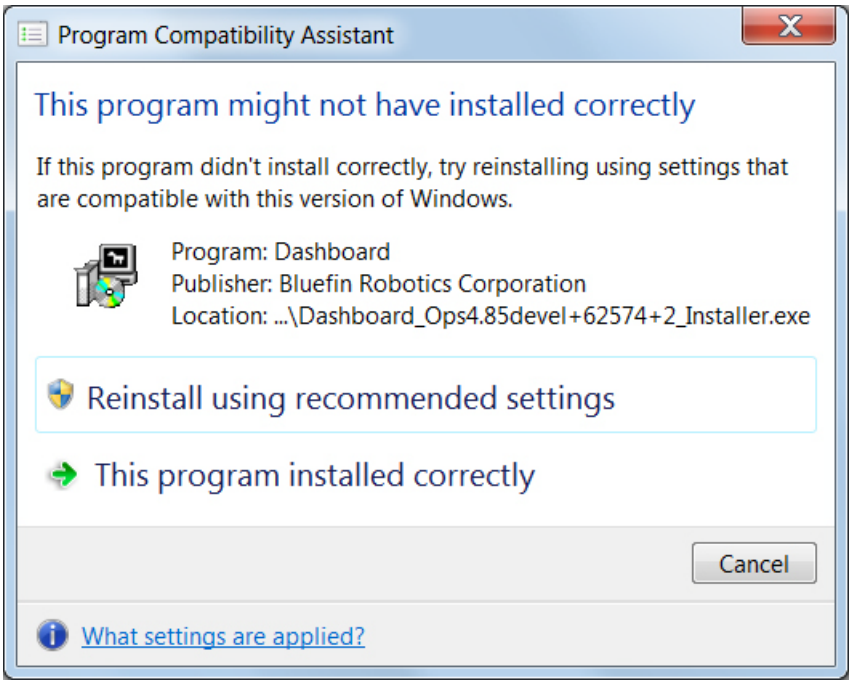


Figure 117: Program Compatibility Assistant

Dashboard is now installed.

Connecting to the AUV

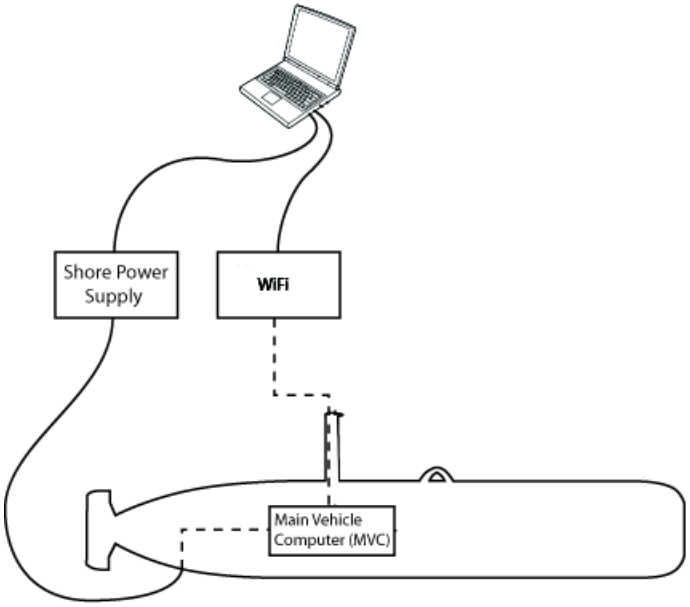


Figure 118: Communications Network

Dashboard communicates with the AUV using one of the following links.

NOTE: *Not all AUV systems utilize all of these communications links.*

- Shore Cable–This connection provides a high bandwidth ethernet communications link. The vehicle must be on shore or on deck to utilize this connection.
- WiFi–This connection provides a high bandwidth WiFi link. This connection can be used when the AUV is in the water at the surface, on shore, or on the deck of the support ship.

To connect to the AUV using the shore cable:

1. Set up the Operator Laptop.
2. Connect the Operator Laptop to the appropriate ethernet communications hub (the exact configuration depends upon the AUV system configuration.).
3. Connect the shore cable to the charger, connect the charger to the hub, and connect the shore cable to the shore power stub on the AUV.

NOTE: *The Operator Laptop can connect directly to the charger without using a hub. A hub is only required if multiple computers need to connect to the vehicle or the operator laptop is physically distant from the vehicle.*

4. Turn the charger main power switch to ON.
5. Turn the AUV ON.
6. Launch Dashboard.

To connect to the AUV via the WiFi link:

1. Set up the Operator Laptop.
2. Launch Dashboard. The WiFi link is pre-configured.

Dashboard uses a link-switching system. It is normal operating procedure to have multiple communications links activated at the same time. Dashboard will first try to use the Ethernet link. If that link is unavailable or if it fails, Dashboard will automatically swap to the WiFi link. When Dashboard is running, the status of the current connection (Ethernet or WiFi) is displayed in the comms area in the Dive Monitor*:*

Figure 119: Comms Area in the Dashboard Dive Monitor

The status indicator can have the following values:

- **Blue square**–indicates communications established
- **Grey square**–indicates no communications established

NOTE: *If users experience problems connecting to the AUV, please contact Customer Service at Bluefin_Support@gd-ms.com.*

Getting Started

Starting Dashboard

Users start Dashboard by double-clicking the application icon located on the desktop or by finding the Dashboard application in the Start menu.

When Dashboard starts, the user will be prompted to fill in operator information that is used to identify the mission, and the user will also select the vehicle system from a list of AUVs so that Dashboard will be configured to work with your particular system. Users must enter this information every time a Dashboard session starts, although Dashboard does remember the most recently entered options.

To start Dashboard:

1. Double-click the Dashboard icon on the desktop, or select **Start>All Programs>Bluefin Robotics>Dashboard**. The vehicle selection window opens.

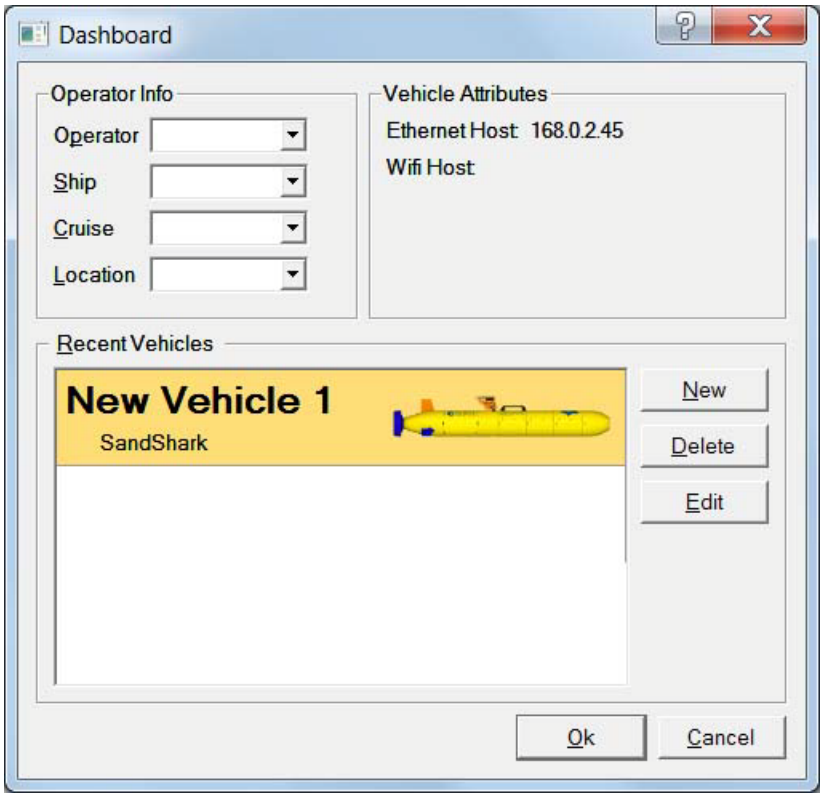


Figure 120: Dashboard Vehicle Selection Window

2. Enter the following information in the operator information area (optional):

- Name of the Operator
- Name of the support ship.
- Identifying information for the cruise/deployment.

- Location of the mission.

3. Select the vehicle from the Recent Vehicles list.

NOTE: *If the vehicle does not appear in the list, see "Adding a New Vehicle or Editing an Existing Vehicle" on page 197.*

4. Click **OK**. The Dashboard interface opens to the main window. Dashboard will open with the most recently viewed chart displayed in the chart view. If this is the first time that Dashboard is opened, a world map will display in the chart view.

NOTE: *If users are unable to start Dashboard, contact Customer Service at Bluefin_Support@gd-ms.com.*

Adding a New Vehicle or Editing an Existing Vehicle

If you have more than one AUV that you use Dashboard with, you can add more vehicles to the recent vehicles list in the vehicle selection window.

NOTE: *You can run multiple instances of Dashboard on the same computer, each communicating with an AUV.*

To add a vehicle:

1. In the vehicle selection window, click the **New** button next to the recent vehicles list. The **Vehicle Edit** window opens.

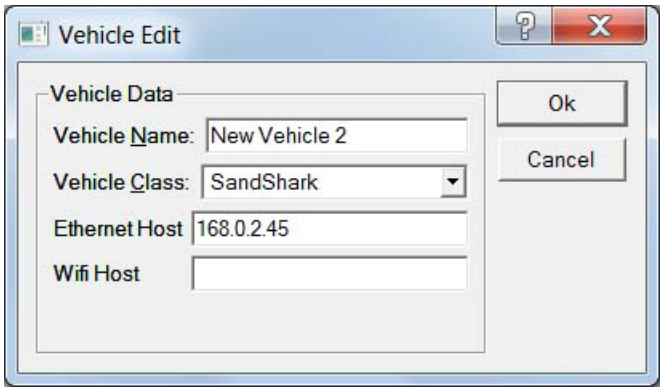


Figure 121: Vehicle Edit Window

2. In the Vehicle Name field, enter a name for the new vehicle.
3. Use the pull-down menu in the vehicle class field to select the vehicle type (SandShark).
4. Enter the IP and other addresses for the various communications links in the communications device fields.
5. Click **OK** to save the settings and return to the vehicle selection window.

To edit a vehicle:

1. In the vehicle selection window, select the vehicle you want to edit from the recent vehicles list.
2. Click the **Edit** button next to the recent vehicles list. The **Vehicle Edit** window (see Figure 121) opens.
3. Edit the fields you want to change, and click **OK** to save the changes and return to the vehicle selection window.

Deleting a Vehicle from the Vehicle Selection Window

If you want the Dashboard vehicle selection window to display only the vehicles that you have, you can delete vehicles from the recent vehicles list.

To delete a vehicle:

1. Select the vehicle from the recent vehicles list.
2. Click the **Delete** button next to the recent vehicles list. A confirmation dialog opens.
3. Click **YES** to delete the vehicle from the list, or click **NO** to return to the vehicle selection window without deleting the vehicle.

NOTE: *Deleting a vehicle from the list does not remove that vehicle type from the list of available vehicle classes in the Vehicle Edit window. You can always create a new vehicle if you accidentally deleted one.*

Setting Application Preferences

In the preferences window you can change the measurement units used in Dashboard, change the font used in the interface, and select to turn audio alerts on or off.

NOTE: *General Dynamics Mission Systems recommends using the default font settings. In any event, do not set a font size larger than 12pts or smaller than 7 pts, as this will adversely affect visibility.*

To change Dashboard preferences, select **Edit > Preferences** from the menu bar. The Dashboard Preferences window opens.

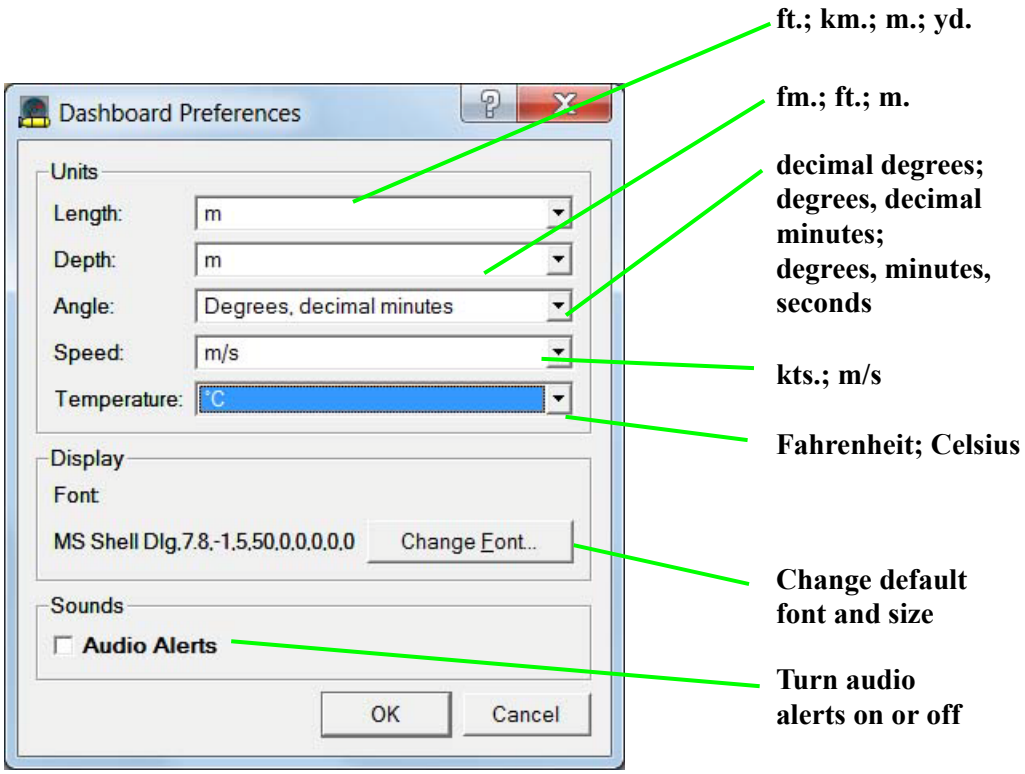


Figure 122: Dashboard Preferences Window

Exiting Dashboard

To exit Dashboard, you must first close all open Dashboard component windows and then close the main Dashboard window.

To exit Dashboard:

- Select **File > Exit** from the menu bar, or
- Click on the X in the top right corner of the main window.

If a vehicle is connected via any of the communications channels a dialog box will appear asking to confirm closing as the vehicle is still on. Otherwise Dashboard will close with no additional input needed.

Getting Help

This document is available in pdf format under the Help menu in the Dashboard menu bar. To access this document, from the menu bar, select **Help>User Guide**.

NOTE: *If you need further assistance, please do not hesitate to contact customer service at Bluefin_Support@gd-ms.com.*

16

DASHBOARD: INTERFACE

This chapter provides a general overview of the windows comprising the Dashboard user interface. The primary Dashboard interfaces are the Dive Monitor and the Chart View.

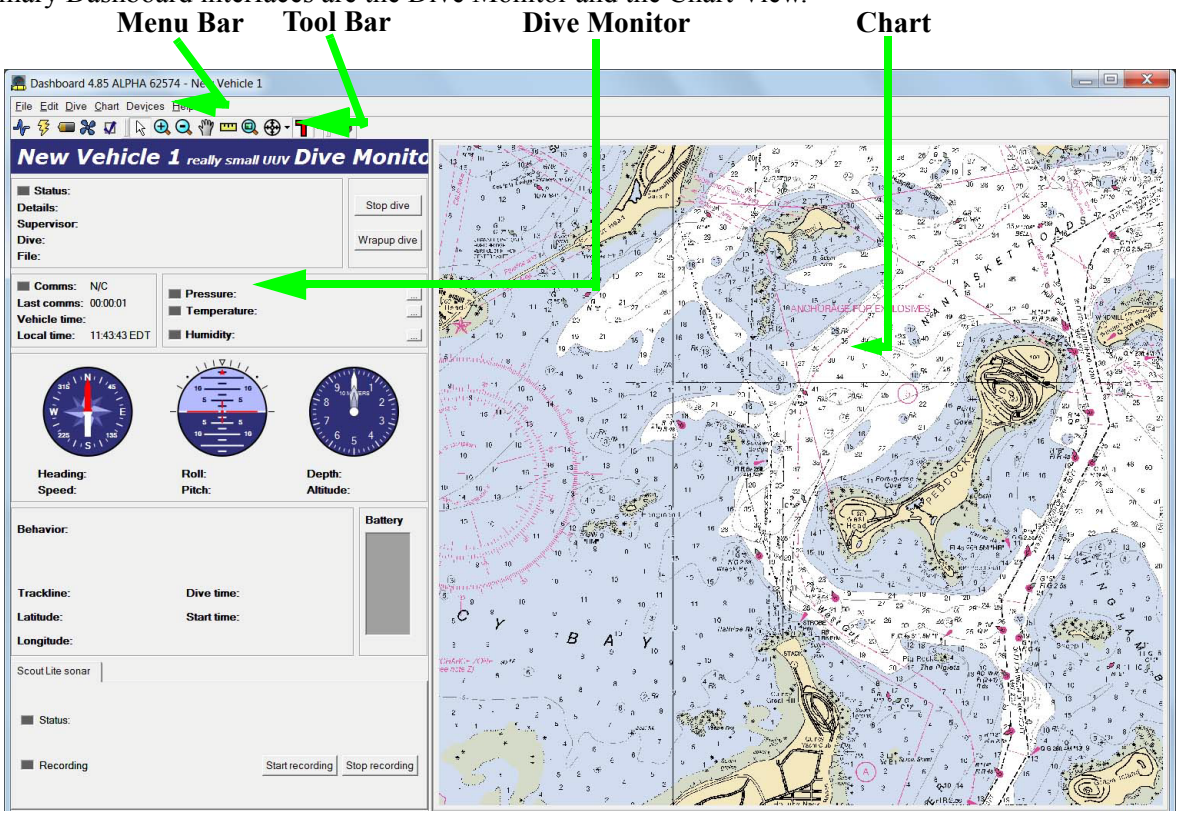


Figure 123: The Dashboard Interface

The Dive Monitor displays summary information about the AUV and its incorporated devices. From the Dive Monitor you can access a number of other component windows. The Dive Monitor and component windows provide detailed status information, allow you to perform tests, start and end missions, and configure the functionality of Dashboard. The information displayed in the various Dashboard windows and areas can be in the form of text, graphical representations, or status indicators.

>> For more information about status indicators, see "Status Indicators" on page 229.

The Chart View provides a graphical interface for real-time tracking of the AUV on a chart of the survey area. The chart view can also be used as an aid during AUV location procedures.

The Dive Monitor

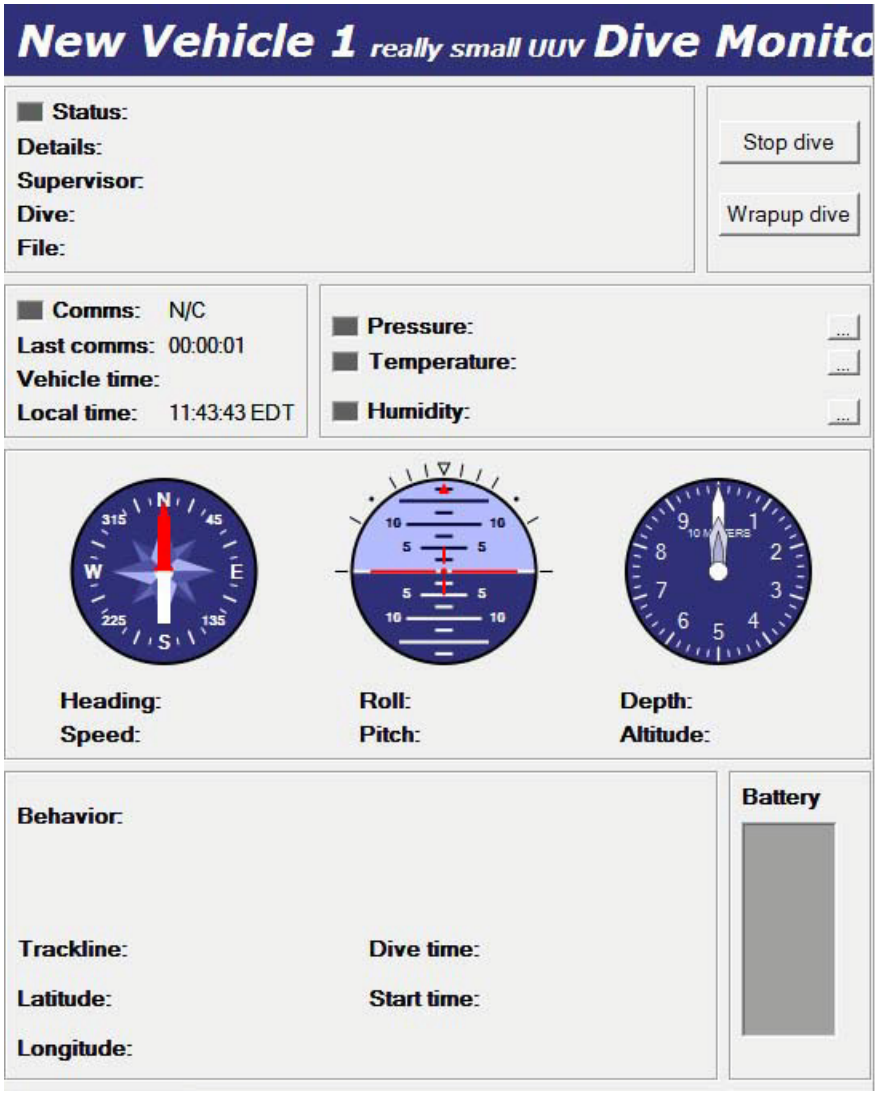


Figure 124: The Dive Monitor

The Dive Monitor is the part of the Dashboard interface used for viewing summary status information for the AUV, and for monitoring the AUV when it is executing a dive. From this window you can monitor the heading, speed and depth of the vehicle, the status of its major devices, and initiate wrapup and emergency procedures. The Dive Monitor is divided into several groups of information for ease of use.

The contents of these groups are described in the following sections.

Dive Status Group

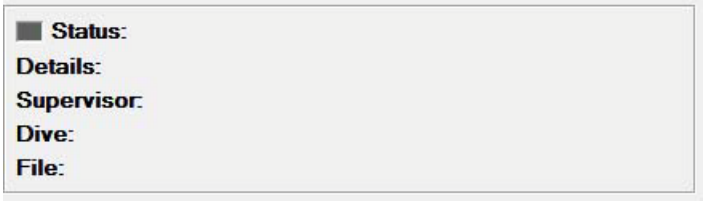


Figure 125: Dive Monitor: Dive Status Group

The dive group provides continuous status information about the dive, including the following information:

- **Status**–the operational status of the current mission. Also shown with a status indicator. Possible values are: Offline, Ready, Running, Stopped, and Aborted
- **Details**–additional information about the mission status (e.g. in case of error, the error source will be listed)
- **Supervisor**–displays the name of the supervisor file
- **Dive**–the name of the current dive
- **File**–the name of the current dive file

Dive Control Group

Figure 126: Dive Monitor: Dive Control Group

The group contains buttons for controlling the dive. Once pressed, the command is sent to the vehicle via all communications devices at once.

- **Stop dive**–Stops the dive immediately. The propeller stops spinning and the AUV floats to the surface
- **Wrapup dive**–Stops the main part of the mission and initiates the wrapup mission


Caution

•The Wrapup mission is configurable in Planner. Be sure you know what the vehicle will do before clicking Wrapup dive.

Communications Group

The communications group provides information about the communications links between Dashboard and the AUV.

Figure 127: Dive Monitor: Communications Group

The group lists the following:

- **Comms**–Shows the current mode of communication.
- **Last comms**–Shows either that the AUV is connected, or the time of the most recent connection.
- **Vehicle time**–Displays the vehicle's clock in UTC format.
- **Local time**–Displays the local (Dashboard) time from the operator laptop's system clock.

Vehicle and topside clocks are normally kept synchronized. If they are not synchronized, an alert message appears in Dashboard.

Environmental Status Group

The environmental status group displays summary information about the pressurized and environmentally sealed components in the AUV.

Figure 128: Dive Monitor: Environmental Status Group

The group lists the following, and the **...** buttons open pop-up windows with more detail:

- **Pressure**–status of pressurized components.

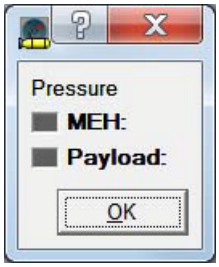


Figure 129: Pressure Pop-up Window

- **Temperature**–temperature of monitored components.

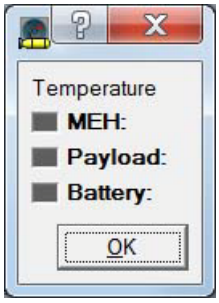


Figure 130: Temperature Pop-up Window

- **Humidity**–Leak status of environmentally sealed components.

Figure 131: Humidity Pop-up Window

AUV Behavior Group

The AUV behavior group provides graphical and textual status information about the behavior of the AUV.

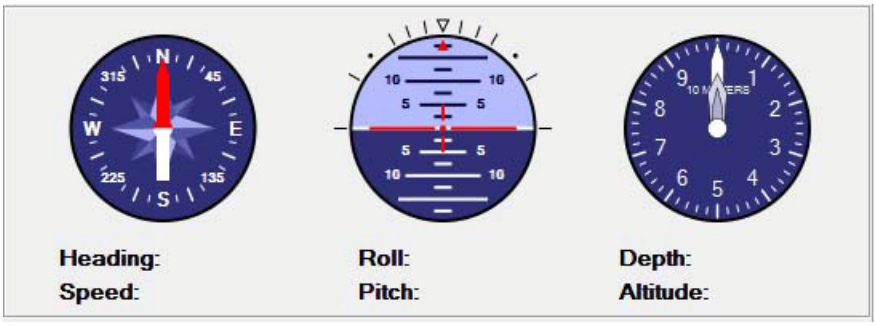


Figure 132: Dive Monitor: AUV Behavior Group

The behavior group lists the following:

- **Heading**–The heading of the AUV.
- **Speed**–The speed of the AUV over ground.
- **Roll**–The roll of the AUV with respect to the horizontal.
- **Pitch**–The pitch of the AUV with respect to the horizontal.
- **Depth**–The depth of the AUV below the water's surface.
- **Altitude**–The height of the AUV above the seabed.

NOTE: *These values will appear during operations.*

Mission Progress Group

The mission progress group provides information about the exact location and progress of the AUV in its mission. This information is based on the calculations of the AUV's on-board navigation devices and the last reported position.

Figure 133: Dive Monitor: Mission Progress Group

The Mission Progress group lists the following:

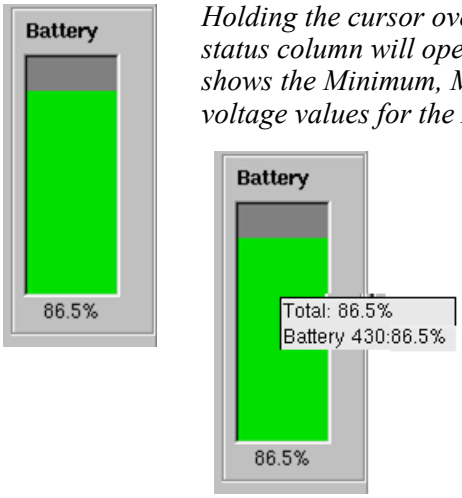
- **Behavior**–current activity of the AUV
- **Trackline**–the number of the mission trackline the AUV is on (not available on all AUV systems)
- **Latitude**–last valid reported latitudinal coordinate of the AUV
- **Longitude**–last valid reported longitudinal coordinate of the AUV
- **Dive Time**–time elapsed since the start of the dive
- **Start Time**–the start time of the dive (Operator Laptop clock time)

Latitude and **Longitude** will display at all times, however they will only update when the vehicle is on the surface and has WiFi communications. **Behavior** and **Trackline** will update with WiFi communications, but will only display for a few moments.

Battery Status

The battery status area provides information on the status of the AUV's main battery. A graphical representation of the total state of charge is provided. Detailed information about the battery can be accessed by clicking the battery icon in the tool bar, or double-clicking the battery charge level indicator in the Dive Monitor.

Summary information about the battery can be viewed by hovering the cursor over the battery charge level indicator. See Figure 134 on page 209.



Holding the cursor over the battery status column will open a pop-up display that shows the Minimum, Maximum, and Total voltage values for the AUV battery.

Figure 134: Dive Monitor: Battery Status

Payload Group

The Payload Group displays the payload status.

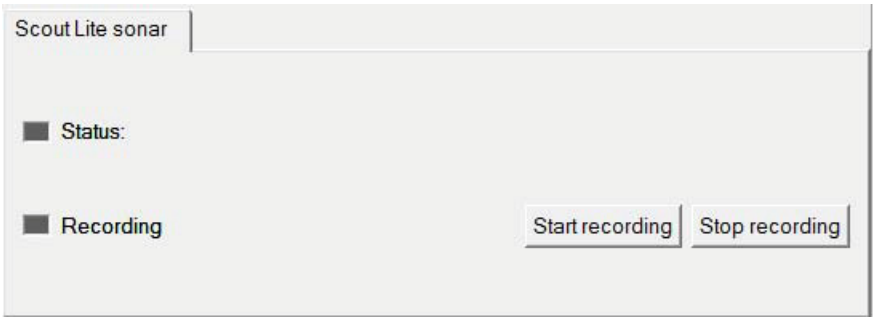


Figure 135: Payload Group

Not used on this vehicle.

The Chart Section

In the Chart section, you can load a chart to aid in plotting your mission, or to use when tracking a mission. You use the tool bar buttons to plot and edit mission elements, and to manipulate the chart. As you create a mission, a graphical representation of the mission displays on the chart. The mission can be edited directly in the chart section or it can be fine-tuned in the list section.

Dashboard supports the following chart formats:

- Geo-Referenced Chart (.JPG, .TIF)
- Geo-Referenced Raster Chart Images (.BMP, .PNG)
- Raster Nautical Charts (RNC): BSB format, file extensions .KAP or .CAP
- Vectorized Chart (VPF): file extension .DHT

Information about TIFF charts output from the NOAA Chart Reprojector can be found at the following web site:
https://coast.noaa.gov/digitalcoast/tools/chartreprojector

NOAA TIFF charts may be downloaded here:
https://www.nauticalcharts.noaa.gov/mcd/Raster/download_agreement.htm

Information about Digital Nautical charts can be found at the following web site:
https://dnc.nga.mil/DNCdb.php

Most of the information you will need is found on these web sites, including chart conversion, applying patches, etc. Please contact Customer Support at bluefin_support@gd-ms.com if you need further assistance with charts.

Loading a Chart

To view a chart of the mission area, you must first load the chart into Dashboard. Your version of Dashboard may come with a number of charts pre-installed. Previously used charts are listed at the bottom of the Chart menu. To choose one of these charts, simply select the Chart menu and scroll down to the chart list and click on the applicable chart.

To load a chart:

1. Select **Chart > Select Chart** from the menu bar. The Choose Chart To Open window opens.
2. Find the chart of the survey area, select it and click Open.

NOTE: *If the chart you have selected requires specifying a particular projection type (e.g. geo-referenced tiff charts), or requires selecting particular features to display (e.g. DNC charts) a window will open in which you do this before the chart loads. For more information, see* *"Editing Chart Properties" on page 212.*

3. The selected chart opens in the chart section.

Editing Chart Properties

When you select a chart for use in Dashboard for the first time, you may have to specify the projection type or select which features of the chart to display. You can also assign a name to the chart which will display in the recently used charts list in the Charts menu.

Setting the Projection Type for an Imported Chart

Depending on the format of the chart you are importing, you may have to set the correct projection type for the chart. There are three available options: Unprojected, Mercator, and UTM. The projection type for the chart will be included in the documentation accompanying the chart

To set the projection type:

1. Select **Chart > Edit Chart Properties** from the menu bar.
2. The Pick Projection window opens (Figure 136).

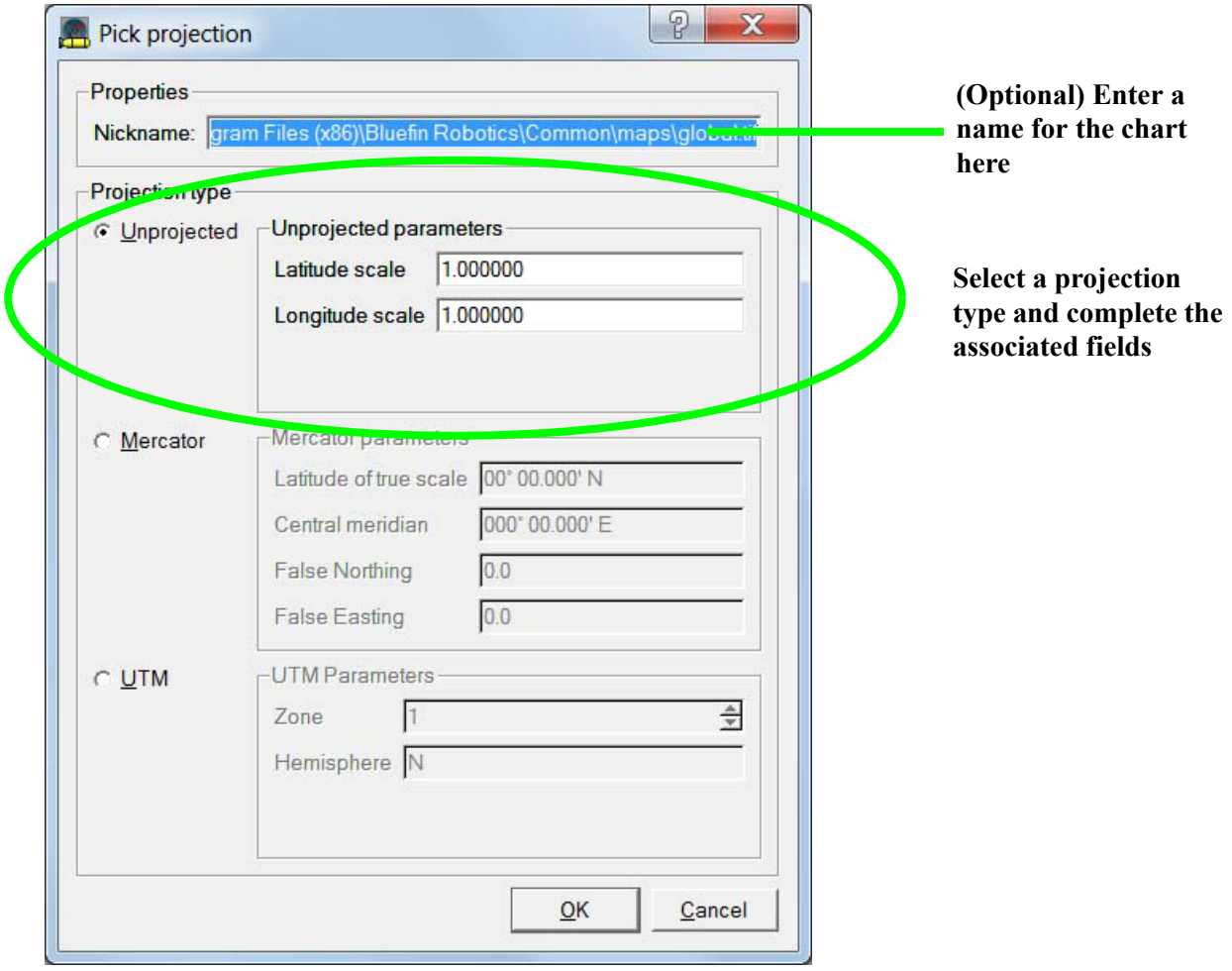


Figure 136: Projection Type Selection Window

3. Select the applicable projection type for the chart and complete the fields associated with that type.

4. Enter a descriptive name for the chart in the Nickname field in the Properties area. This will make it easier to find charts in the future.
5. Click OK to apply the configuration to the imported chart.

Selecting Features When Importing a Digital Nautical Chart (DNC)

When you import a DNC chart into Dashboard, you can select which features of the chart you want displayed in the chart area. This is done in the Import Options window (Figure 137). You can select features to import by checking or un-checking the check box next to individual features.

NOTE: *Displaying all of the features in a DNC may make the mission difficult to view on the chart. You can experiment with which features to view until you find a feature set that is appropriate.*

NOTE: *The available import options vary between DNCs. The Import Options window shown here is an example.*

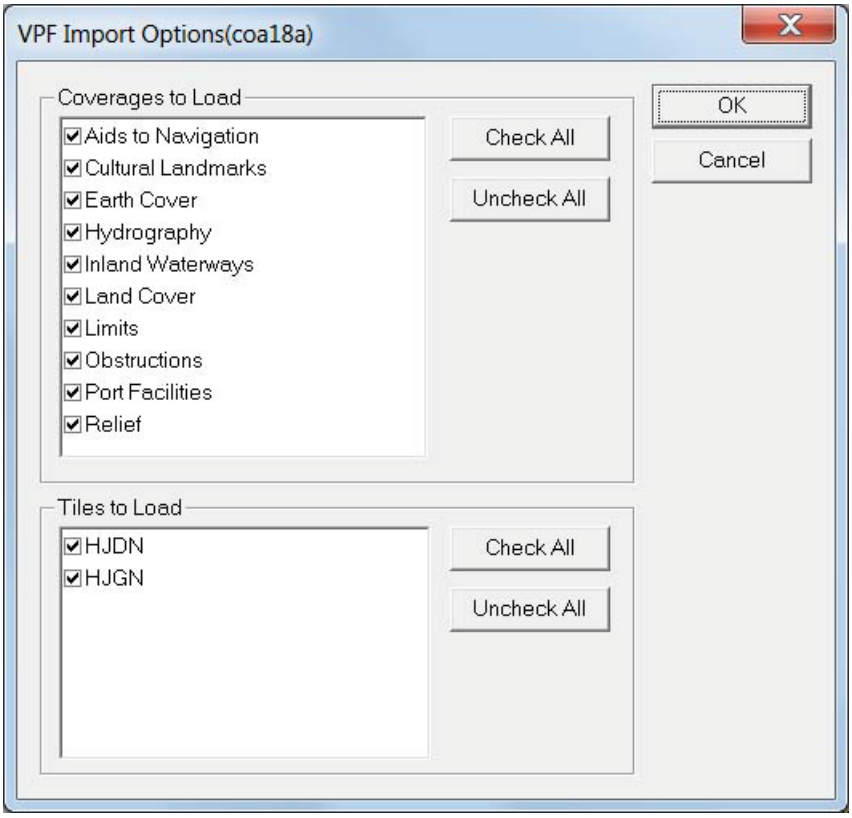


Figure 137: Import Options Window for Digital Nautical Charts

Naming a Chart

The default name of a chart you are using in Dashboard can be changed, so that it can be easily identified and selected from the list of recently used charts in the **Chart** menu.

To name a chart:

1. Select **Chart > Edit Chart Properties** from the menu bar. In the chart information window, you can specify a name for the chart.

NOTE: *Depending on the format of the chart, if this is the first time you are opening the chart in Dashboard, you may have to select the projection type or select features (for a DNC). For more information, see "Setting the Projection Type for an Imported Chart" on page 212, and "Selecting Features When Importing a Digital Nautical Chart (DNC)" on page 213.*

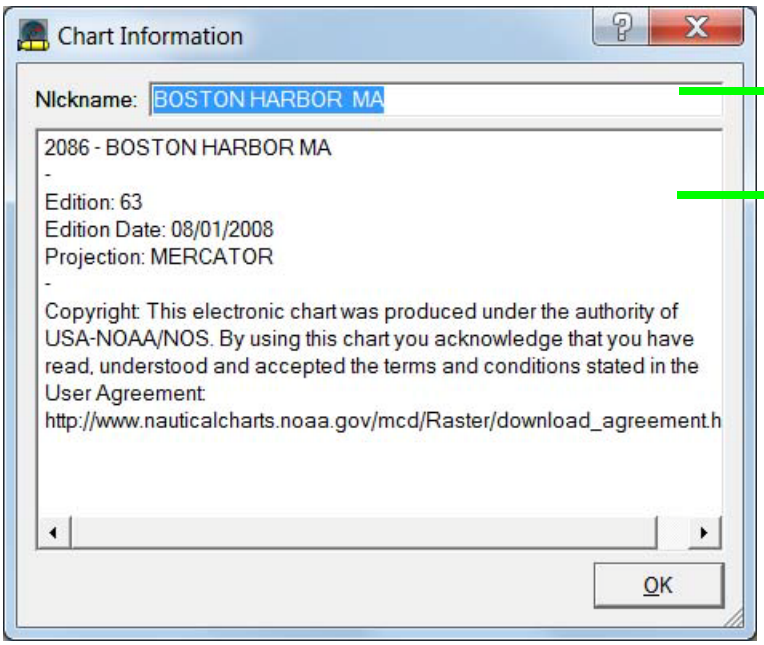


Figure 138: Chart Information Window

2. Enter the name of the chart in the Nickname field, and click **OK**. The chart is named, and the new name will display in the list of charts at the end of the chart menu.

Working in the Chart Section

Dashboard contains a number of tools for working within the chart view while planning missions or tracking vehicles.

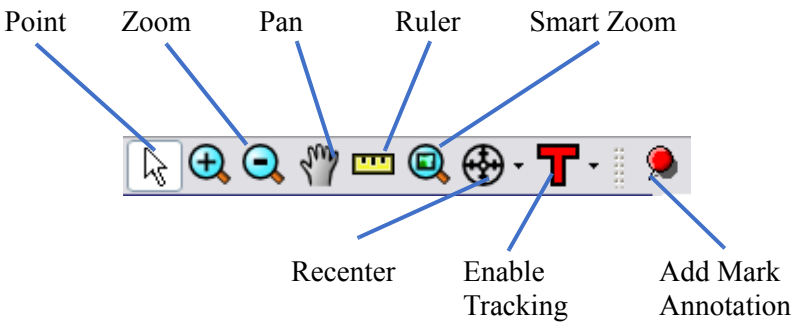


Figure 139: Chart Section Tools

Zooming In or Out on the Chart

If you want to focus on a particular area of the chart, you can use the zoom in or zoom out tools in the tool bar. The zoom in button magnifies a selected area of the chart. To zoom in, select the zoom in tool, then either click on a point in the chart (2x magnification), or click and drag over an area of the chart. To zoom out, select the zoom out tool, and click on a point in the chart.

Moving the Chart

Use the pan tool to move the chart in the chart section. Select the pan tool, then click and hold a point on the chart, and move the chart by moving the cursor.

Taking Measurements in the Chart

The ruler tool allows you to measure distances on the chart. To take a measurement, select the ruler tool, click a point on the chart, then move the cursor to a second point and click again. The distance between the two points will display in the bottom left corner of the Dashboard interface in the measurement unit configured in the Dashboard Preferences (see “Setting Application Preferences” on page 198). The Azimuth (compass heading) between the two points is also displayed.

Using the Smart Zoom Tool

The Smart Zoom tool allows you to zoom in and center the chart on all the annotations on the chart.

Centering the Chart on a Particular Point

The Recenter tool allows you to center the chart on a selected point while retaining the same zoom level. To center the chart on a point, select the recenter tool and click a point on the chart.

Enabling Tracking

Use the enable tracking tool to enable tracking of the AUV or other assets. For more detailed information about tracking, see Chapter 19: "Dashboard and Planner: Tracking, Recovery, Location".

Adding Mark Annotations

You can add mark annotations to any chart to aid in location of the AUV, visually represent obstacles, demarcate areas that have already been surveyed, mark sonar contacts, aid in vehicle recovery, etc. A mark annotation is a mark on the chart accompanied by a short label, and, if desired, surrounded by a number of rings at a configurable distance from the center of the annotation.

NOTE: *Mark annotations are associated with the chart. When mark annotations are added to a chart, and the chart is later opened in a new Dashboard session, the mark annotations will display, unless they have been deleted (see "Deleting Mark Annotations or Mission Annotations" on page 217).*

>> For detailed information about using mark annotations for recovery and location procedures, see "Using Annotation Marks to Aid in Locating an AUV" on page 273.

To place a mark annotation, click the add mark annotation tool (push pin) on the tool bar and click a point on the chart. A mark appears on the chart, labeled with the time it was created.

You can customize the mark, by selecting the pointer tool and double-clicking on the mark. The **Edit Mark Annotation** window (Figure 140) opens in which you can specify the exact appearance of the annotation mark. The available options are as follows:

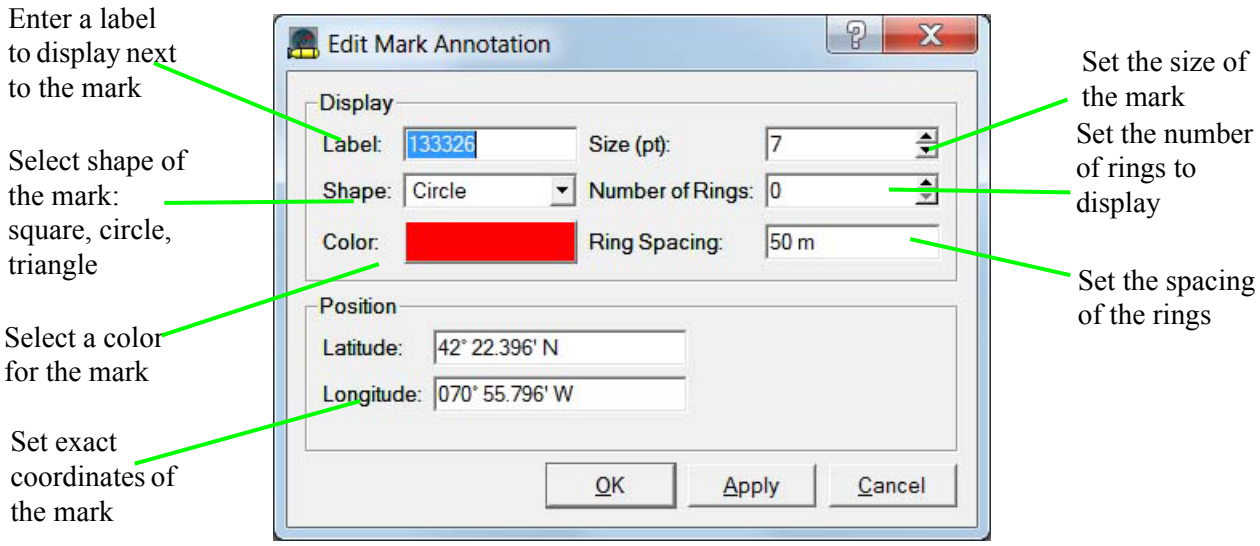


Figure 140: Editing a Mark Annotation

Importing Annotations

Dashboard allows you to import annotations to the chart view. Typically, two types of annotations are useful for tracking the vehicle:

- Importing Iridium Locations (if your vehicle is equipped with Iridium)
- Importing mission files from Planner

To import Annotations to the chart view:

1. Select **Chart > Import Annotations** from the menu bar.
2. A browser dialog appears, prompting you to select a file to import. The allowable file formats are currently: Planner mission files (.mis, .bmll, .bm2) and Iridium coordinate files (.sbd).
3. Select the applicable file, and click **Open**.

The contents of the file appear on the Chart. When you import a Planner mission file, the planned mission appears on the chart. This allows you to view the progress of the mission against the planned mission.

NOTE: *If you import a mission as an annotation, then edit the mission using the Planner application and import the same mission again, the first annotation will be over-written by the new annotation.*

Deleting Mark Annotations or Mission Annotations

You can clear both imported mission annotations and annotation marks from the chart view.

To delete an Annotation Mark or Mission Annotation

1. Select **Chart>Clear Annotations** from the menu bar. The Clear Annotations window opens, displaying the current annotations.

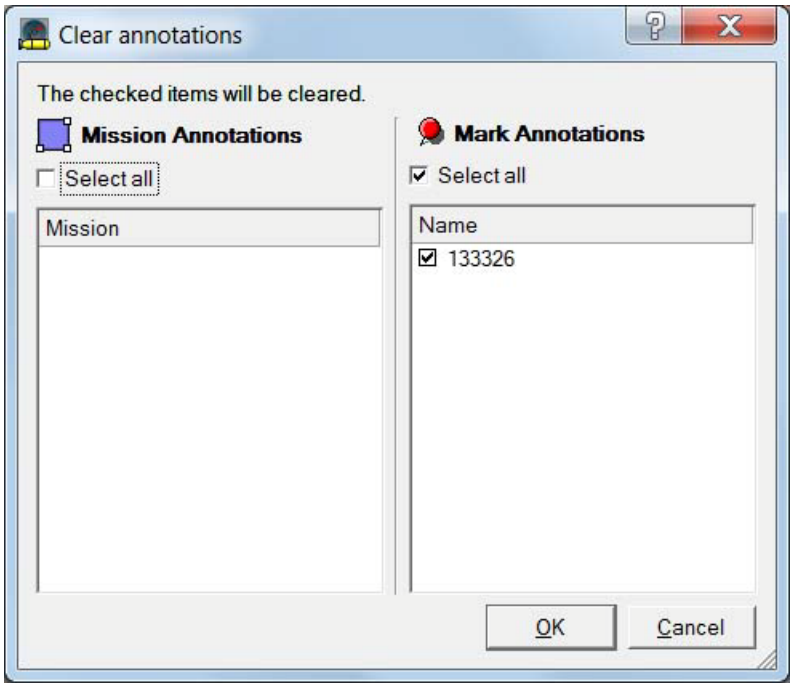


Figure 141: Clear Annotations Window

2. If you want to delete a mission or mark annotation select it from the list, and click **OK**. The annotation is deleted without confirmation. If you want to delete all of the mark annotations (push-pins) created in the current Dashboard session, check the select all box under Mark Annotations and click **OK**. All of the mark annotations (not the mission annotations) are deleted without confirmation.

NOTE: *You can also delete an individual annotated mark (not a mission annotation) by selecting the pointer tool from the menu bar, right-clicking on the mark, and selecting the* ***Delete*** *option in the pull-down menu. The mark is deleted without confirmation.*

Dashboard Device Windows

There are a number of device windows available in Dashboard for viewing detailed status information, controlling and testing devices, and performing pre-dive and post-dive checks. These windows can be accessed by clicking their icons in the tool bar or selecting their name from the devices menu. Details about the component windows are provided in the following section.

Device Status Window

The device status window (Figure 142) provides status information about the AUV's devices (both inside and outside the MEH). You can use the Stop and Restart buttons in the device status window for restarting devices after performing functional or ground fault testing. The device status window contains the following buttons and fields:

- **Status indicator**–provides a visual indication of the device status
- **Name**–the name of the device
- **Status**–describes the status of the device
- **Stop**–stops the software driver for the selected device
- **Restart**–starts/restarts the software driver for the selected device

To access the Device Status window, select **Devices > Device Status** from the menu bar, press **Ctrl + D**, or click the icon.

NOTE: *The window shown below is an example. The devices listed for your AUV system may be different*

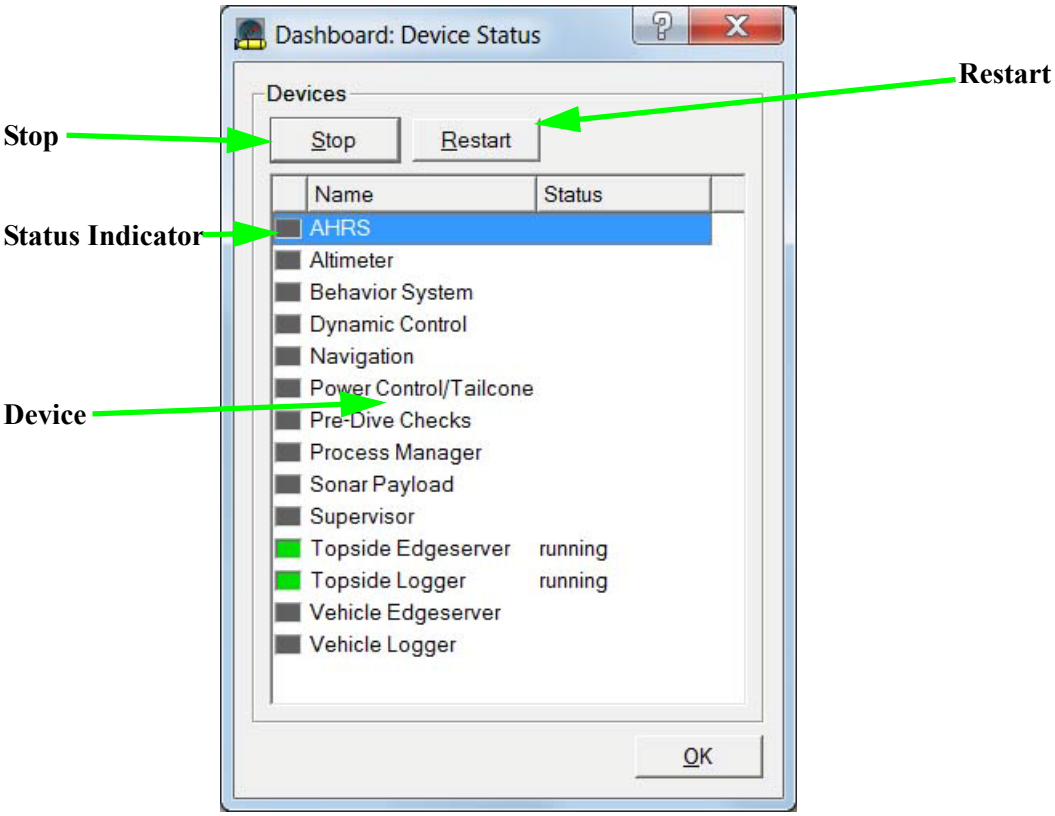


Figure 142: Device Status Window

Power and Ground Faults Window

The power and ground faults window (Figure 143) provides information about the MEH Power Control Board (PCB) circuits and allows you to switch the circuits on and off or restart them by clicking the buttons. It also provides the current for the payload and thruster, and ground fault information for the PCB circuits.

To access the power and ground faults window, click the power and ground faults button on the tool bar,

select **Devices > Power and Ground Faults** from the menu bar, or press **Ctrl+G**.

>> For information about switching circuits, "Switching Circuits On and Off" on page 78

NOTE: *The window shown in* Figure 143 *is an example. The circuits listed for your AUV system may be different.*

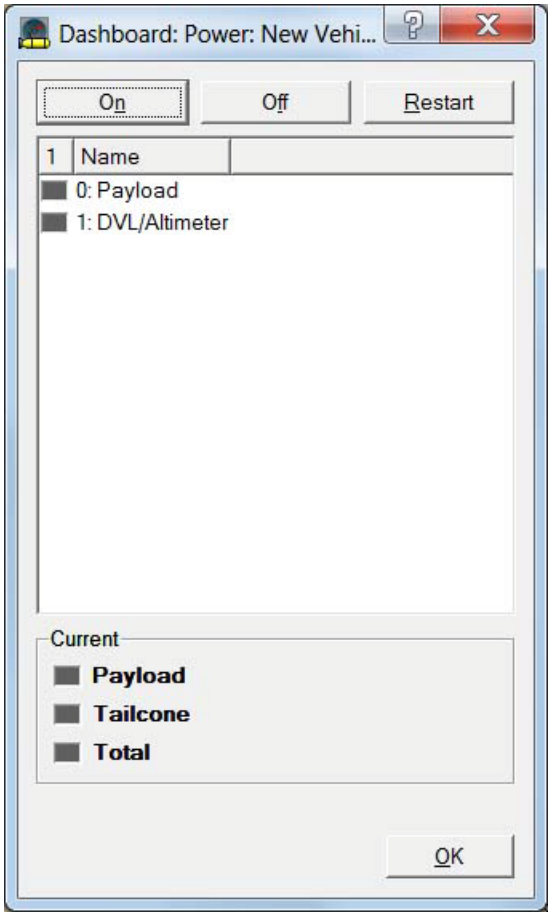


Figure 143: Power and Ground Faults Window

All components are on the 24V circuit.

Battery Status Window

The Battery Status window (Figure 144) provides detailed information about the main AUV battery. The following information is displayed in the window:

- **Voltage**–battery voltage
- **Current**–current output
- **State of Charge–**battery state of charge. Format 0.NN 1 means NN% state of charge.
- **Remaining Capacity**–remainign capacity in amp-seconds.
- **Temperature**–battery temperature

To access the Battery Status window, click the battery button in the tool bar, select **Devices > Battery**

Status from the menu bar., or press **Ctrl**+**B**.

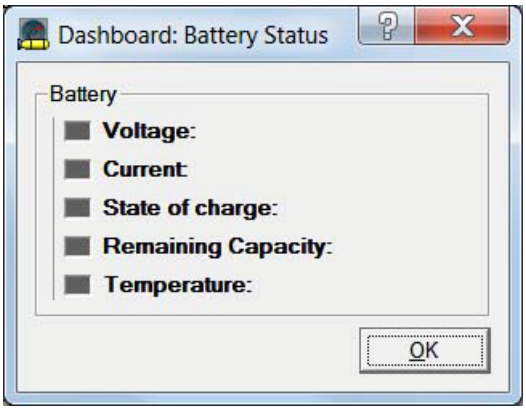


Figure 144: Battery Status Window

Manual Vehicle Control Window

The Manual Vehicle Control window (Figure 145) provides an interface for manually operating the thruster and control fins and confirming their operation. To access the Manual Vehicle Control window, click on the Tailcone Test tool in the tool bar, select **Devices > Tailcone** from the menu bar, or press

CTRL+T.

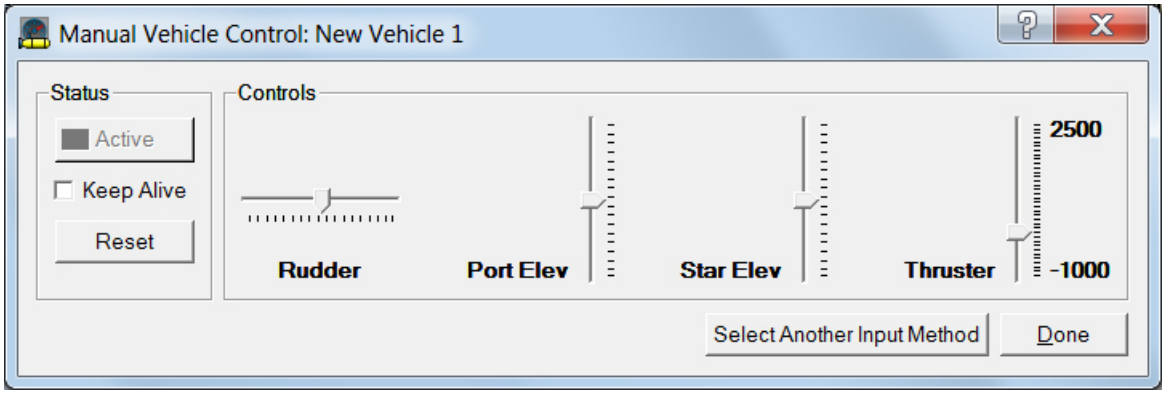


Figure 145: Manual Vehicle Control Window

NOTE: *The fin elevator and rudder ranges are from -25° to 25°. The thruster speed ranges from -1000 rpm to 2500 rpm.*

Pre-Dive Checkout Window

The Pre-Dive Checkout window (Figure 146) provides the status information and controls needed to perform the Dashboard-aided part of a pre-dive checkout test, and to confirm device functionality or troubleshoot problems at any time.

To access the Pre-Dive Checkout window, click the pre-dive checkout tool on the tool bar, select **Devices >**

Pre-Dive Checkout from the menu bar, or press **CTRL**+**K**.

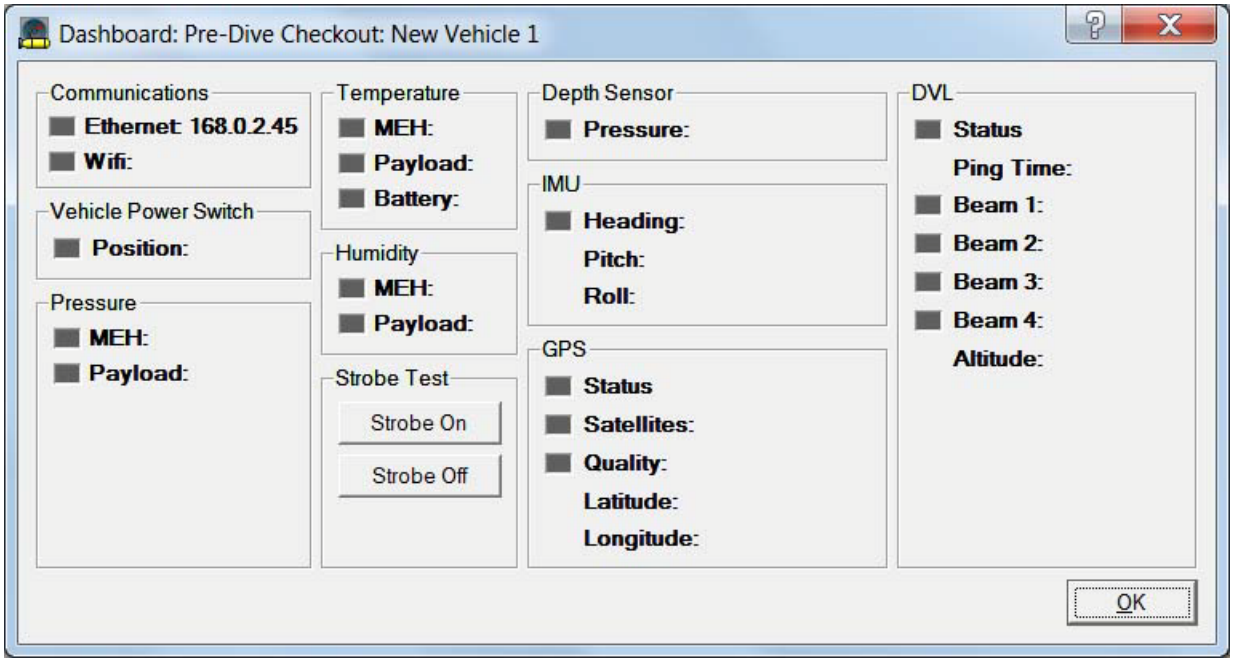


Figure 146: Pre-Dive Checkout Window

*>> For more information about the **Pre-Dive Checkout** window and performing pre-dive checkouts, see Chapter 17: "Dashboard: Pre-Dive Checkout"*

Maintenance Window

Select **Devices > Maintenance Menu...** from the menu bar. Not used on this vehicle.

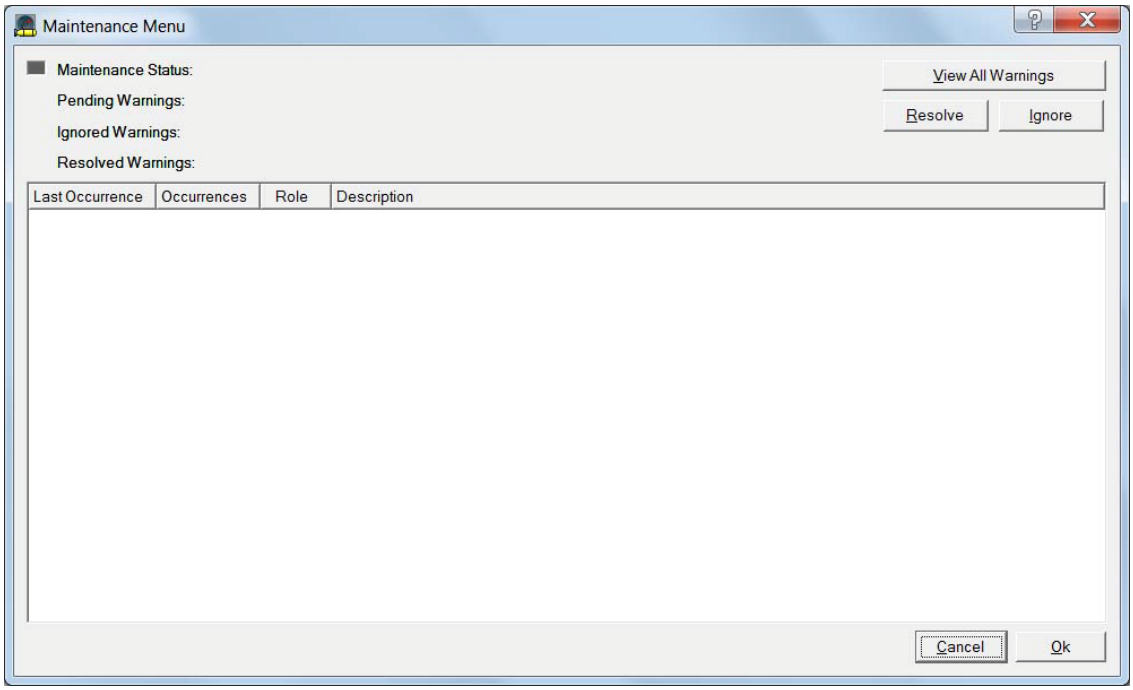


Figure 147: Maintenance Menu Window

Menu Bar

The Dashboard menu bar contains a series of menus that allow you to activate, control, and test AUV devices, access status windows, and work with charts in the chart view.

Details of the menu bar options are provided in the table below. Details of the functions they perform are described in detail elsewhere in this manual.

Table 16-1:

Menu	Menu Contents
File	• **Shutdown Vehicle**–Shuts down the AUV. • **Service Mode** – Not in production vehicle • **Service Mode IP Config**– Not in production vehicle • **Exit**–Exits the Dashboard application.
Edit	• **Switch Vehicle or Operator**- Ends the Dashboard session and starts a new one with the selection of a new vehicle and operator. • **Night Mode Toggle**-Changes the display to red-on-black night mode. • **Preferences**–Accesses the application preferences window. Note: Bluefin recommends using the default font settings. In any event, do not set the font size > 12pt. Using a font size over 12 pts will result in poor visibility on the screen. • **USBL Configuration**- Not used by this vehicle
Dive	• **Upload and Begin Dive**–Initiates a dive. Prompts the user to select a mission file. • **Begin Dive**–Begin a dive. Prompts the user to select a mission file. • **Upload Dive**–Upload a new dive. Prompts the user to select a mission file. • **Restart last dive**–Commands the AUV to restart the most recent dive. • **Emergency Behavior**–Opens the Emergency Behavior window and prompts the user for a pre-loaded emergency mission name. • **Calibration Dive**–Run the gNav calibration mission. This must be run once per harbor and must be the first dive in a new harbor. • **Wrapup**–Commands the AUV to commence the wrapup mission. • **Stop**–Stops the current dive.
Chart	• **Select Chart**–Accesses a dialog window that allows you to choose a chart to display in the chart view. • **Edit Chart Properties**–Accesses the Pick Projection dialog that allows you to specify projection properties for an imported chart, and to give it a nickname to use in Dashboard. • **Configure Tracking**–Accesses the Asset Tracking Configuration dialog which allows you to setup the Dashboard tracking utility. • **Import Annotations**–Import Planner mission files to display in the chart view. • **Export Annotations**–Export annotations to a folder on the Operator Laptop. • **Clear Annotations**–Clears exported and placed annotations from the chart.
Devices	• **Device Status**–Opens the Device Status window. • **Power and Ground Faults**–Opens Power and Ground Faults window. • **Batteries**–Opens the Battery Status window. • **Tailcone**–Opens the Tailcone Test window. • **Pre-dive Checkout**–Opens the Pre-Dive Checkout window. • **Maintenance Menu**–Opens the maintenance window.

Table 16-1:

Menu	Menu Contents
Help	• **About**–Opens the Dashboard application information window.

Tool Bar

The Dashboard tool bar contains tools for working in the chart section (see “Working in the Chart Section” on page 214) and for accessing the various Dashboard device windows.

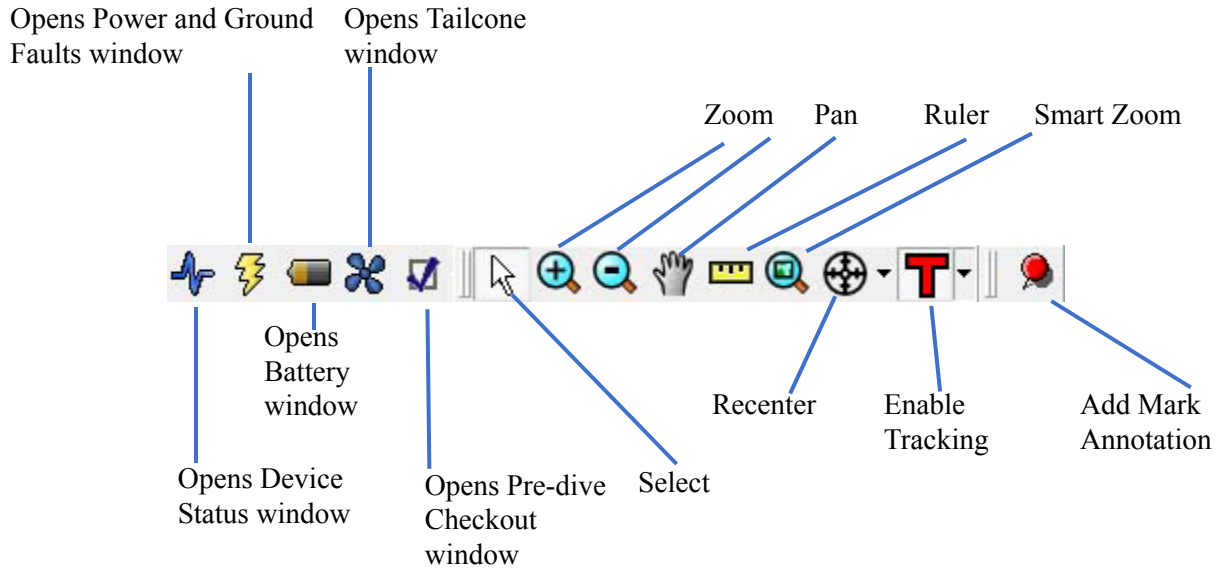


Figure 148: Dashboard Tool Bar

The sections of the tool bar are tear-off menus. To move a section of the tool bar around the screen, click on the two vertical bars at the left edge of the section and drag it to the new location. To return the section to the tool bar, click on the section window title and drag it back to the tool bar. The tear-off menus can be hidden or displayed individually by right-clicking in the menu bar or tool bar and selecting the section name in the pop-up menu. Selecting Line up in the pop-up menu moves all of the tear-off menu sections displayed in the tool bar to the left.

>> For details on the device windows, see “Dashboard Device Windows” on page 219.

Status Indicators

All status and control windows in Dashboard use a system of status indicators so that the operator can quickly identify possible errors in devices or systems. The table below describes the status indicator values.

Status Indicator	Color	Value
	Blue	The device or system is connected and turned on.
	Grey	The device or system is offline or switched off.
	Red	The device or system is not within operational parameters/not working properly.
	Yellow	The device or system is initializing, or: The device is approaching the limits of its operational parameters.
	Green	The device or system is within operational parameters.

A status indicator can be either a blue and grey indicator or a red, yellow, and green indicator. The status indicators are sometimes accompanied by written status information. Some out of date status information fades to grey. Holding the cursor over status information may open a tooltip that lets you know when the information was last updated.

NOTE: *Some status indicators cannot display the last update time.*

17

DASHBOARD: PRE-DIVE CHECKOUT

This chapter describes how to use Dashboard to test and monitor the AUV before starting a dive. Depending on the operational requirements, some of these checks may be performed with the AUV on the deck of the support ship, while others may be performed with the AUV in the water and tethered at the surface. A pre-dive checkout involves checking and recording the status of the various devices on the AUV. Some devices must be tested manually by the operator using auxiliary topside equipment. For more information about Pre-Dive checks, refer to the vehicle User Manual.

Dashboard is designed to facilitate an easy pre-dive checkout procedure. The Pre-Dive Checkout window (Figure 149) provides most of the information needed to complete the Bluefin AUV Operator Pre-Dive Checkout tasks.

To access the Pre-Dive Checkout window, click the pre-dive checkout button (check-mark) on the tool bar, or select **Devices > Pre-Dive Checkout** from the menu bar.

The Pre-Dive Checkout window consists of a number of areas corresponding to components and subsystems that are checked out prior to commencing a dive. These areas fall into the following broad categories:

- Communications
- Environmental Status Group
- Emergency Systems
- Navigation Systems
- Wet Sensors

The pre-dive checkout areas are described in detail in this chapter.

>> Please refer to the Operations Checklists for more information on performing system checkouts.

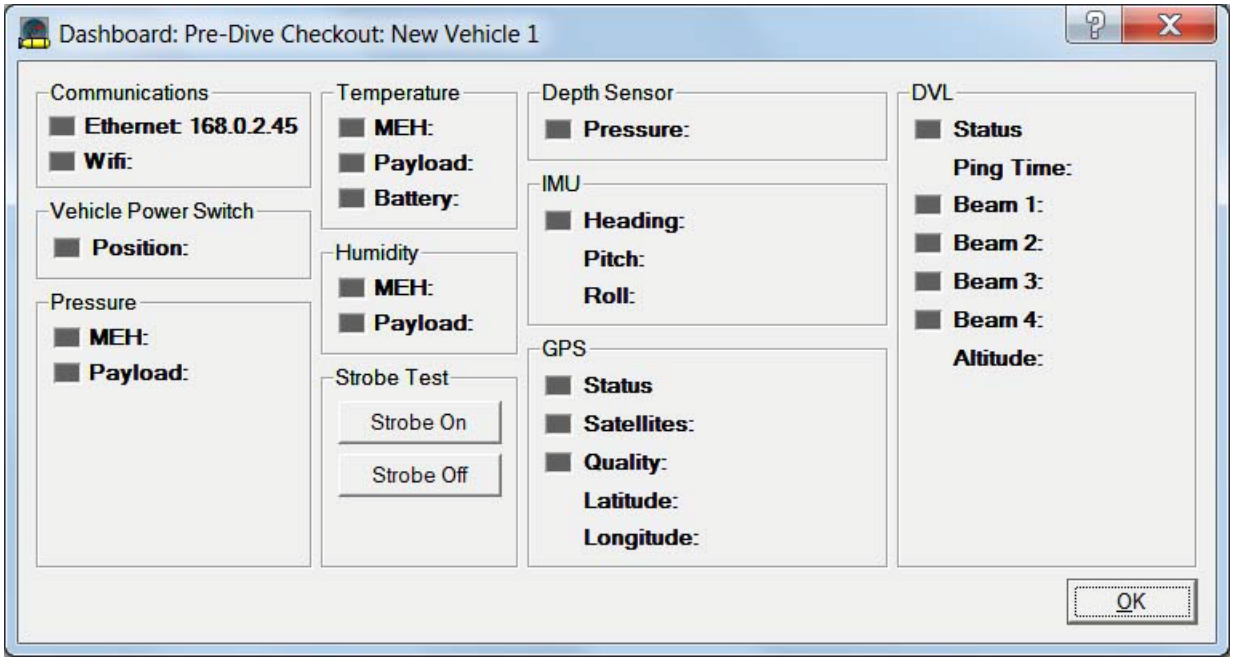


Figure 149: Pre-Dive Checkout Window

Communications

Communications Area

The communications area displays information about the AUV's communications systems

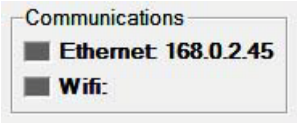


Figure 150: Pre-Dive Window: Communications Area

The IP address of the communications link always displays. If there is a connection between the communications device the status indicator will be **blue**. If there are no communications, the status indicator will be **grey**.

>> For more information about connecting to the AUV, see "Connecting to the AUV" on page 194.

Environmental Status Group

There are a number of environmentally sealed components that are checked out by Dashboard. The status of these components is displayed in the environmental status group areas. The status of all environmentally sealed components must be OK (green indicator) before a dive is executed.


Caution

•If any environmental indicator is red, do not begin a dive. Exposure of environmentally sensitive components to seawater could cause serious damage. Refer to the User Guide for more information, or contact Bluefin Robotics for assistance.

This section describes the pre-dive areas for environmentally sealed components.

Humidity Area

This area provides leak indicators for the environmentally sealed components. These include the MEH and Payload. All of the status indicators in this area must be green before performing a dive. A red status indicator means that component is leaking.

Caution

•If there is a leak in any of the devices, the AUV must be removed from the water as soon as possible. A red status indicator next to a component means that the component is leaking.

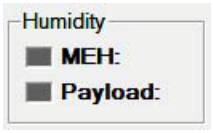


Figure 151: Pre-Dive Window: Humidity Area

Temperature Area

This area displays the status and the temperature of environmentally sealed electrical components. This includes the MEH, the payload, and the battery.

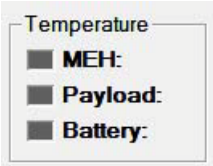


Figure 152: Pre-Dive Window: Temperature Area

When a component's temperature is too high for normal operation, the indicator light turns yellow. When a component's temperature is critical, the indicator light turns red.

Internal Pressure Area

This area contains status information about the internal pressure of onboard pressure vessels. (e.g. MEH.) The value of pressure in psi (absolute) is also displayed.

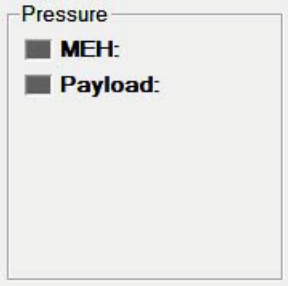


Figure 153: Pre-Dive Window: Pressure Area

When a component's pressure is too high or low for normal operation, the indicator light turns yellow. When a component's pressure is critical, the indicator light turns red.

Emergency Systems

Strobe Test

The Strobe Test area allows operators to test the strobe during the pre-dive checkout. Click **Strobe On** to turn the strobe on or **Strobe Off** to turn the strobe off.

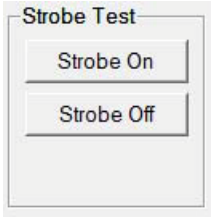


Figure 154: Pre-Dive Window: Strobe Test

Navigation Systems

The navigation systems areas provide status information from the AUV system's navigation devices.

GPS Area

This area provides status information for, and input from, the primary GPS system. The GPS system is on the vehicle and cannot see satellites while inside a building.

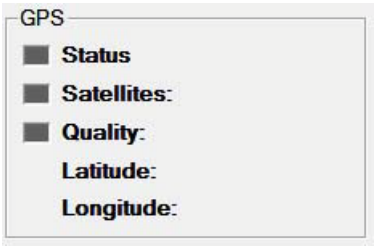


Figure 155: Pre-Dive Window: GPS Area

The following information is displayed:

- Status–GPS system status.
- Satellites–The number of satellites currently used by the GPS to compute its location.

NOTE: *The AUV should be moved outdoors to perform this test, as GPS reception is poor indoors and will not provide an accurate reading.*

- Quality–The Figure of Merit (FOM) of the GPS position fix. The value must be between 1 and 3 in order to operate a mission (9 is the worst value).
- Latitude/Longitude–The coordinates of the AUV's current location. This value should be compared, if possible, against known coordinates, e.g. from a handheld GPS device located next to the AUV. The Latitude and Longitude display can be set to DD, DM, or DMS in Dashboard Preferences.

IMU

The IMU Area contains IMU status information. The IMU must have these conditions met to align itself:

- GPS input available
- Direct, blue sky view of GPS satellites
- If aligning on ship, ship moving slower than 10 knots.
- Depth input

If these conditions are met, the IMU will automatically align itself.

Figure 156: Pre-Dive window: IMU Area

DVL Area

The DVL area provides status information about and displays the output from the Doppler Velocity Log.

NOTE: *This area only contains information if the vehicle has a DVL.*

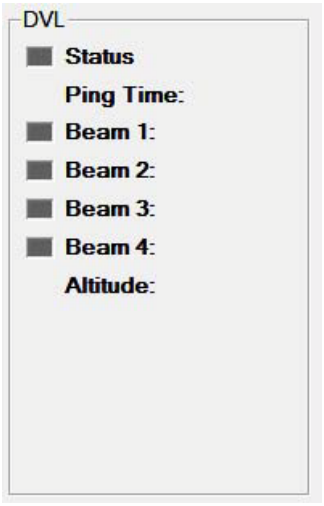


Figure 157: Pre-Dive Window: DVL Area

This area provides:

- Functional status of the DVL
- Ping Time (in seconds)
- Measurements from beams 1–4
- Altitude as measured by the DVL if within 180 m of the sea floor

NOTE: *All the DVL beams should be reporting the same value if the terrain is flat. The values reported when the vehicle is out of the water may be meaningless.*

Wet Sensors

The wet sensors areas display the status of the AUV wet sensors and their outputs. These are described in what follows.

Depth Sensor

The depth sensor area displays the status of the depth sensor and the absolute pressure reading in psi. This is used for navigation.

Figure 158: Pre-Dive Window: Pressure

18

DASHBOARD: STARTING, MONITORING, AND STOPPING DIVES

This chapter describes how to start, monitor, and terminate dives. Dives are selected, started, and monitored using Dashboard. Monitoring and controlling (if necessary) of dives is done primarily in the Dive Monitor.

Dives generally only need to be started and monitored. When a mission is completed, the associated wrapup mission is automatically initiated and the dive is concluded. If it is necessary to terminate the dive early, this can be done in Dashboard.

Selecting a Mission File

Mission files are created using the Planner application which is a part of the Operator Tool Suite. Mission files created in Planner are saved to a local directory on the Operator Computer and then uploaded to the AUV using Dashboard. Mission files created in Planner are saved in the .bm2 format.

NOTE: *Pre-dive sonar storage space on the Operator Laptop should be 500 MB at a minimum.*

Uploading and Starting a Dive

When all electrical, mechanical and operational pre-dive checks have been completed, and the AUV is in the water, the mission file can be uploaded to the AUV via WiFi, and the dive started. A dive is started from the Dive menu in the main window. Status information about the dive is displayed in the Dive Status area.

NOTE: *In order to start a dive, the AUV must be in the water and powered on.*

To start a dive using Dashboard to upload the mission files from the Operator Laptop:

1. Select **Dive > Upload and Begin dive** from the menu bar
2. The **Select a mission to start** window (Figure 159) opens.

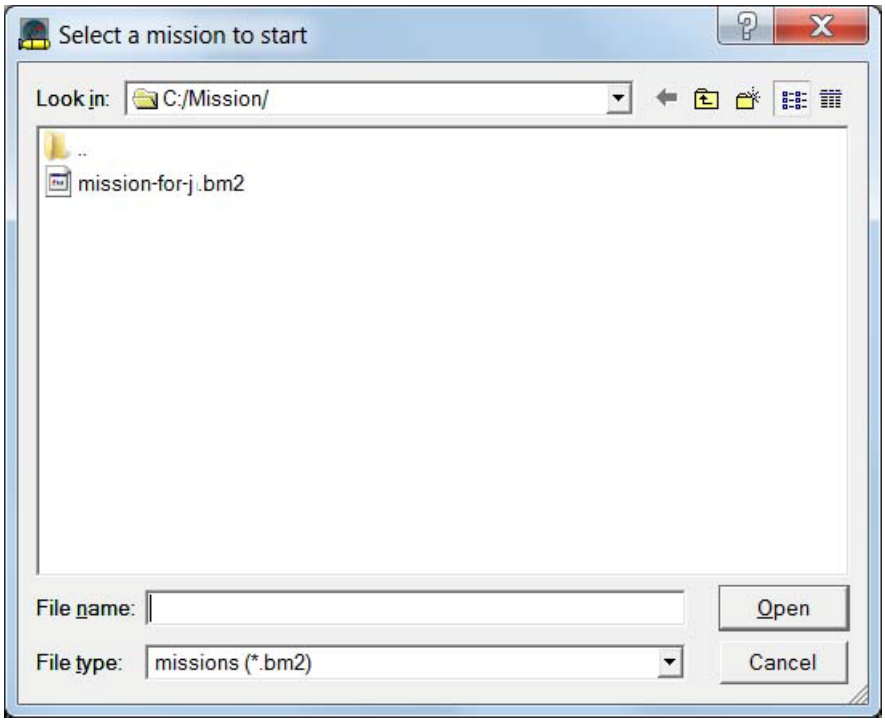


Figure 159: Select a New Mission from the Window

3. Locate the mission directory and the applicable main mission file (.bm2 format).
4. Click **Open**.
5. A confirmation dialog opens. Check the displayed mission information and Click **OK** to open the mission file.
6. Dashboard begins uploading the mission file to the AUV. When the mission file upload is complete, the AUV starts the dive.

To start a pre-loaded dive:

1. Select **Dive > Begin dive** from the menu bar.

2. The **Choose Pre-Loaded Mission** window opens.

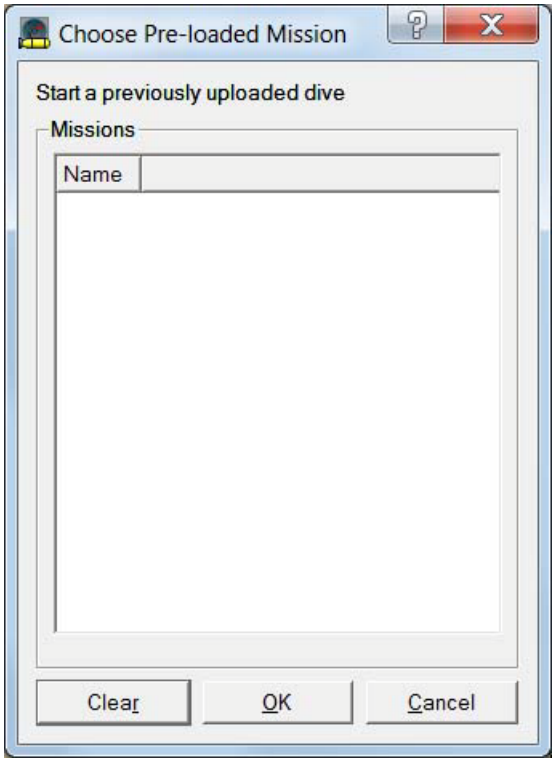


Figure 160: Choose Pre-Loaded Mission Window

3. Click on a mission name to select a mission.
4. Click OK to begin the mission or Cancel to return to the main screen. Click Clear to delete all pre-loaded missions.

Monitoring a Dive

The dive can be monitored from the Dive Monitor and, if necessary, the component windows.The Dive Monitor displays status indicators and information fields to update the user on the progress and status of the dive. It also provides controls that the operator can use, if necessary, to control the dive when it is in progress.

>> For a detailed description of the Dive Monitor, see "The Dive Monitor" on page 203.

Most status indicators and information fields, with the exception of *Elapsed Dive Time* are only updated when Dashboard is in communication with the AUV over WiFi.

Stopping/Restarting a Dive

Dashboard contains a number of controls that can be used to terminate or modify a dive in case of changing conditions or vehicle emergencies. These can only be used if the vehicle is on the surface and within WiFi range.

The following AUV controls are available:

- Stop Dive
- Wrapup Dive
- Emergency Behavior

Stopping a Dive

The Stop Dive command is used to stop the current dive without proceeding to the wrapup mission. The AUV remains active, but it transitions to an idle state (not executing a mission and the propeller does not move). If the vehicle is not communicating with Dashboard this command cannot be used.

To stop the dive:

1. Click the **Stop Dive** button in the Dive Monitor, or select **Dive > Stop** from the menu bar. The Stop Dive dialog box opens requesting confirmation of the command.
2. Click **Yes** to confirm the stop dive command. The vehicle stops the current mission and awaits further operator instruction or recovery.

Initiating a Wrapup

The Wrapup Dive command is used to stop the current activity of the vehicle, and proceed directly to the wrapup mission.

Wrapup behavior can be configured in Planner. Know what the programmed wrapup behavior is before issuing the wrapup command.


Caution

•Wrapup behavior can be configured in Planner and may put the vehicle in danger.

To wrapup a dive:

1. Click the **Wrapup dive** button in the Dive Monitor, or select **Dive > Wrapup** from the menu bar. The Wrap up Dive dialog box opens requesting confirmation of the command.
2. Click **Yes** to confirm the wrapup dive command. The vehicle proceeds to the wrapup mission.

A

EXTERNAL INTERFACE

This appendix contains information on the external connectors to the pressure vessel and the payload interface.

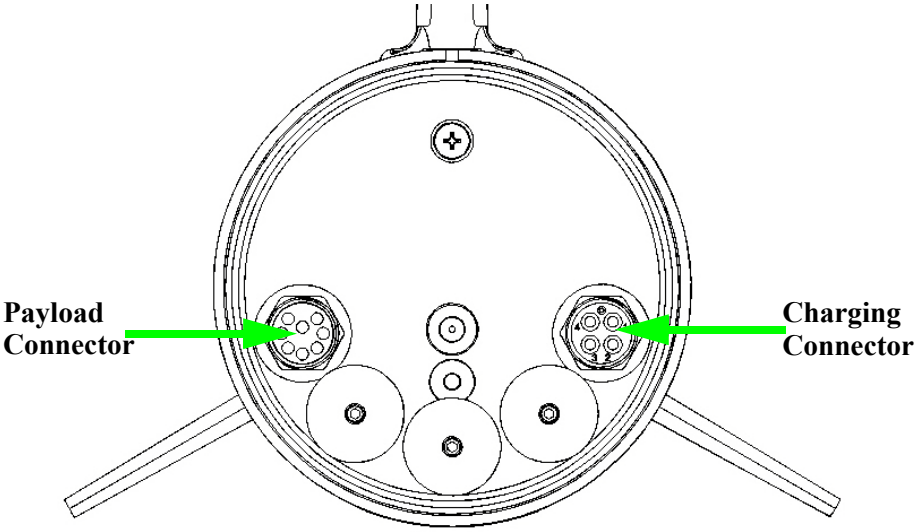


Figure 161: Pressure Vessel Endcap

Caution

- During underwater operation, the external connectors must be mated to a cable or plug with the locking sleeve tightened down.
- Always cover connectors with a dust plug or dummy cap when not in use.

Both connectors must be mated to a cable or plug with the locking sleeve tightened down during in-water operations. The payload connector must be connected to the payload or have a dummy plug installed. The shore power connector must have the shorting plug installed.

Before storing the vehicle:

1. Remove the shorting plug.
2. Install dummy plugs on both connectors.

Payload Integration

For payload integration support, contact General Dynamics Mission Systems at Bluefin_Support@gd-ms.com. A copy of the Bluefin SandShark™ Payload Interface Control Document (000-020-764) is included on the Technical Publications CD.

B

TOPSIDE EQUIPMENT

This appendix contains information on the topside equipment used to operate and maintain the Bluefin SandShark™ AUV.

Cases

The two pelican cases are used for ground shipping with the battery inside the vehicle.

Figure 162: Pelican Cases: AUV and Support Equipment

WiFi Router

The ASUS RT-N66R wireless router provided with the system has omnidirectional antennas and a range of 50-90 meters.

Figure 163: Wireless Router

Charging Brick(000-021-458)

The charging brick is a PowerStream Technology PST-G100-24L7 with a connector to connect to the vehicle.

Figure 164: Charging Brick

Figure 165: Connector

Shore Cable

Caution

•Always turn off the vehicle before connecting the shore cable.

The shore cable connects the vehicle and the operator laptop and is used for faster transfer of data and large files. The vehicle end connects to the 8-pin payload connector on the tail section endcap. The laptop end connects to the laptop's ethernet port.

Figure 166: Shore Cable

Laptop

The Operator Laptop (OL) is a GETAC V110 Rugged laptop.

Figure 167: Operator Laptop

Cradle

The portable vehicle cradle has 2 end plates (000-018-446) and 2 support beams (000-018-448) held together with 4 thumbscrews (000-020-593).

To assemble the cradle:

1. Push a thumbscrew through a tapped hole in one end plate.
2. Align with the tapped hole in a support beam and tighten until it engages.
3. Repeat with a second thumbscrew and support beam on the same end plate.
4. Align the tapped holes in the second end plate with the holes in the free ends of the support beams. Check that both end plates have the feet on the same side.
5. Insert the 2 thumbscrews and tighten until they engage.
6. Tighten all 4 thumbscrews in a star pattern until the beam ends are flush with the end plates.

Figure 168: Portable Vehicle Cradle

NOTE: *The vehicle should be secured to the cradle with a Titan Strap before picking up and carrying the cradle and vehicle together.*

On/Off Magnets

The hall latch magnetic ON/OFF switch in the aft upper corner of the antenna is operated by neodymium magnets.

To turn on the vehicle, pass the neodymium magnet over the magnetic switch. If the blue LED does not turn on, pass the neodymium magnet over the switch again.

The hall switch responds to magnetic flux densities of 15mT or more. Magnets are provided with the topside equipment. Avoid placing the magnet near the vehicle's tail section as this can affect the on-board compass.

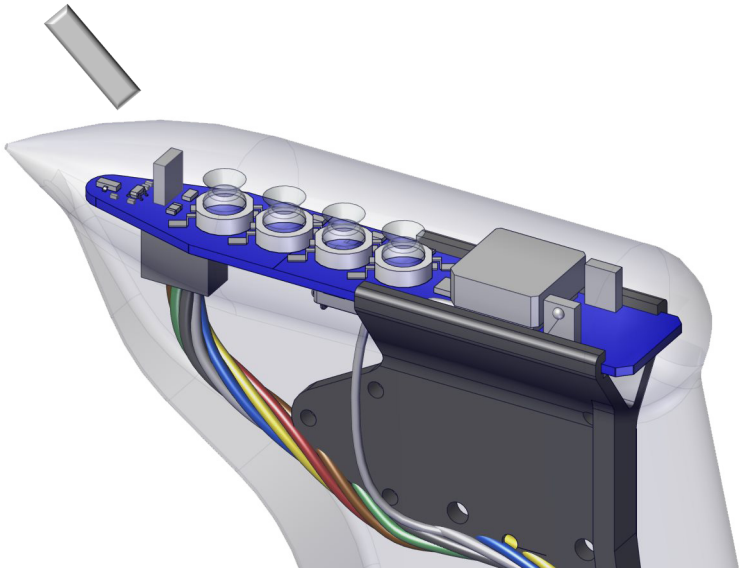


Figure 169: Turning on the Vehicle

Figure 170: Magnets

Pressure Vessel Jacking Key

The pressure vessel jacking key is used to separate metal pressure vessel sections. Insert the key into the cutouts and turn to push them apart.

Figure 171: Pressure Vessel Jacking Key

Shorting Plug

The shorting plug is inserted in the shore power connect to enable the vehicle battery. The shorting plug must be inserted before turning on the vehicle.

Figure 172: Shorting Plug

Tool Kit List

Table 9 lists the contents of the Tool Kit.

NOTE: *All hex screws involved in routine maintenance are 3-32.*

Table 9: Tool Kit List

Supplier	Supplier PN	Description	QTY
McMaster-Carr	7127A37	SCREWDRIVER, PHILIPS BLADE*	1
McMaster-Carr	5709A52	HEX SET, BALL END, IMPERIAL*	1
McMaster-Carr		Needlenose Pliers*	1
McMaster-Carr	57805A42	Retaining Ring Pliers*	1
		Flashlight*	1
GD-MS	000-018-053-01	WEDGE, JACKING KEY, TAIL SECTION	1

*Not provided by General Dynamics Mission Systems.

Spares List

Table 10 lists the contents of the Spares Kit.

Table 10: Spares Kit List

Supplier	Supplier PN	Description	QTY
Arnold Industries	SCS3PL04024	SCREW, SKT HD CAP, .112-40 UNC-2A X .75L, 316SS	50
Arnold Industries	SCS3PL04016	SCREW, SKT HD CAP, .112-40 UNC-2A X .50L, 316SS	50
Arnold Industries	SCS3PL04012	SCREW, SKT HD CAP, .112-40 UNC-2A X .38L, 316SS	50
Arnold Industries	LMS3PL04	WASHER, SPLIT LOCK, .112 NOM (#4), 316SS	100
GD-MS	000-016-436-01	SACRIFICIAL ANODE, ZINC ALLOY, .500 DIA X .188 T, #4 NOM	2
GD-MS	000-016-747	Ballast Weights	20
GD-MS		Foam	1/2 lb
GD-MS	000-021-460-02	Ortman Keys	18
GD-MS	000-021-844-05	Ortman Keys	18
		Rare Earth Magnets (Vehicle power switching magnets)	2
GD-MS	000-021-424	Rudder/Elevator Fins	3
SubConn, Inc.	MCDC8M	SubConn MCDC8M Dummy Plug	1
GD-MS	000-021-189	Shorting Plug	
SubConn, Inc.	MCDLSF	SubConn MCDLSF Locking Sleeve	2
GD-MS	000-016-435	Propeller	1
GD-MS	000-016-412	Duct	1
GD-MS	000-016-373	Retaining Ring	6
GD-MS	000-016-389	Woodruff Key	1

Table 10: Spares Kit List (Continued)

Supplier	Supplier PN	Description	QTY
GD-MS	21-0801-03	Vent Screw	3

Table 11 lists the o-rings in the spares kit. All O-Rings must be BUNA-N nitrile.

Table 11: O-Rings in Spares Kit

Part No.	Description	QTY
000-019-117	O-RING, 2-044, 3.739 ID, 3.879 OD, .070 WD, BUNA-N	100
000-002-706	O-RING, 4.489ID X 4.629OD, .070WD, 2-047	100

Consumables List

Table 12 lists the consumable supplies and vendor information.

Table 12: List of Consumables

Part Number	Description	CANNOT SHIP VIA AIR?
000-001-461	LUBRICANT, AQUASHIELD, 8OZ TUBE	
000-001-245	ELECTRICAL INSULATING COMPOUND,DOW CORNING 4	
000-007-004	TAPE, ELECTRICAL 3/4" WD X 66'L, BLACK, SCOTCH BRAND	
	Gorilla Tape	
000-006-280	LUBRICANT, SILICONE, 3M, 13-1/4 OZ, AEROSOL SPRAY CAN	CANNOT SHIP VIA AIR
000-004-752	TIE WRAP, 11", BLACK, HEAVY DUTY, PACKAGE 50	
000-004-754	TIE WRAP, 4", BLACK,LIGHT DUTY, PACKAGE 100	
000-004-757	TIE WRAP, 5.5 ", BLACK, MED DUT, PACKAGE 100	
000-006-281	DUSTER, ELECTRICAL CLEANING, 8 OZ AEROSOL SPRAY CAN	CANNOT SHIP VIA AIR
	Isopropyl alcohol, 99.9%	
	Kimwipes, 4”x4”	

C

TRIM INSTRUCTIONS

This appendix contains the trim and ballast instructions.

Payload Section

Wet payload sections should contain internal mounting points with a zip-tie hole. Use zip-ties to attach foam and ballast weights. Generally, foam should be in the top half of the section and ballast weights in the bottom half. For dense, heavy payloads, foam may need to fill all free space in the section.

Dry payload sections should contain external mounting points similar to the tail section mounting points. See “Tail Section” on page 262.

Trim options (inside the hull):

- Add or remove ballast to points on the sides of the bottom hull to correct roll.
- Add ballast to the center bottom of the hull and foam to the center top of the hull to increase CB-CG separation and stabilize the vehicle’s flight.
- Remove ballast from all points to reduce weight.
- Add foam to the top half of the hull to increase buoyancy.
- Add foam or ballast as far forward as possible to correct pitch.

Tail Section

The tail sections has 3 ballast mounting points on the endcap. Each point can hold 2 ballast disks. The ballast is attached to the endcap with a washer and screw.

No foam can be added to the tail section.

Trim options:

- Add or remove ballast from the port and starboard points to correct roll.
- Add ballast to the center point to increase CB-CG separation and stabilize the vehicle's flight.
- Remove ballast from all points to reduce weight.

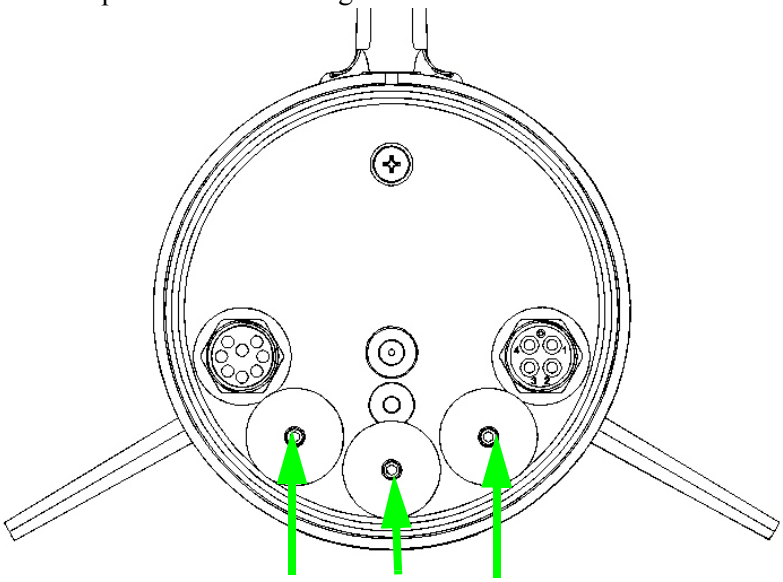


Figure 173: Ballast Mounting Points

Table 13: Ballast Disks and Hardware

Part Number	Description
000-016-747	BALLAST WEIGHT, BRASS, 1.000 DIA, 25G
	WASHER, SPLIT LOCK, .112 NOM (#4), 316SS
SCS3PL04024	SCREW, SKT HD CAP, .112-40 UNC-2A X .75L, 316SS

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