Wave Glider™ Mobile Operations Kit

Operator's Guide

(Installation Instructions for LRI Part 130-00485)

Version 1.20

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REVISION HISTORY

Rev	Changes	Author(s)
1.00	Initial Release	FJ, EB, RO, EMP, EP
1.10	Add section 10.4. Minor formatting changes	FJ

TRADEMARKS

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Figures and Tables

1. Introduction

The Liquid Robotics Inc. (LRI) Wave Glider Vehicle is a platform for long-duration deployment of ocean surface sensor systems. The Wave Glider Management System (WGMS) software provides browser and programmatic interfaces to allow users and applications to send commands to, and receive data from the Wave Glider and its payloads.

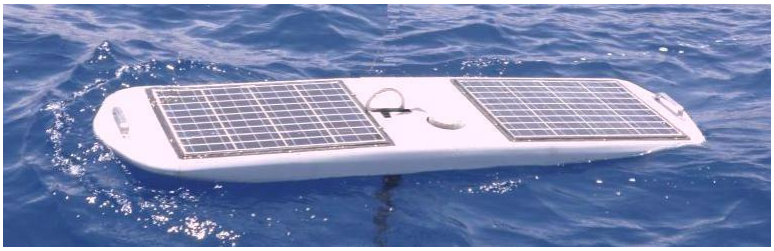


Figure 1-1: Wave Glider Surface Float

1.1 The Mobile Operations Kit

The Mobile Operations Kit is a "turnkey" package that includes pre-configured Wave Glider components, along with all the accessories required to assemble, launch, operate and recover a Wave Glider using a small boat. The Vehicle is delivered in two large hard-sided packing cases. A smaller hard-sided Accessories case contains tools and hardware used for assembly, launch and recovery. It also includes electronics and software for operating the Wave Glider. Float payloads are sent in separate boxes.

Figure 1-2: Mobile Operations Kit Containers

The contents of the Mobile Operations Kit are described in detail in Chapter 2.

1.2 Intended Audience

This Operator's Guide assumes that the reader has a general familiarity with the Wave Glider Vehicle, including the assembly, launch, operation and recovery procedures. It also assumes an overall understanding of the configuration and use of the WGMS Graphical User Interface.

As such, this document is not designed as a detailed comprehensive explanation of all the features of, and operational procedures for the Wave Glider. Rather, it is intended to provide an overview and outline of all aspects of operation and use specific to the Mobile Operations Kit.

For additional information, refer to the documents cited in section 1.3, below.

1.3 Reference Documents

There are four primary documents used for the working with the Wave Glider:

1.3.1 User Manual

The Wave Glider *User Manual*, LRI part number 030-00025, focuses on operational issues, such as provisioning, launch, retrieval and mission planning. The *User Manual* should be studied by all personnel who will be working with the Wave Glider.

1.3.2 Interface Control Description

The *Interface Control Description* (ICD), LRI part number 030-00026, describes in detail the mechanical, electrical, electronic and software configuration of the Wave Glider components. The ICD is a primary source document for payload developers.

1.3.3 System Administration Manual

The LRI *System Administration* Manual, LRI part number 030-00481, describes how to install and configure WGMS for a variety of deployment scenarios, including Mobile to Mobile.

1.3.4 Payload Electronics Guide

The LRI *Payload Electronics Guide*, LRI part number 030-00759, describes the details of the payload electronics, and the interfaces to the main Wave Glider Command and Control system.

1.4 System Overview

1.4.1 The Wave Glider Vehicle

Mechanically, the Wave Glider is composed of two main parts, connected by a flexible umbilical. Figure 1-3 shows the basic components and their names.

The Float rides on the surface of the water. The Glider remains well below the surface. A flexible Umbilical connects the two parts.

The Glider provides propulsion by harnessing power from wave action. An electrically-controlled rudder on the Glider provides steering.

The middle section of the Float contains the Command and Control (C&C) drybox. The C&C contains the central computer processor, batteries, power control, and antennas for Iridium satellite and XBee communications. In general, the C&C drybox contains no customer-modifiable components.

Fore and aft payload dryboxes in the Float can contain electronics and other devices specific to the Vehicle's mission. The C&C provides power and communications interfaces to the fore and aft payload boxes (underneath the solar panels) and to the Glider. Connectors on the top of the C&C drybox provide additional interfaces to any externally-mounted payloads.

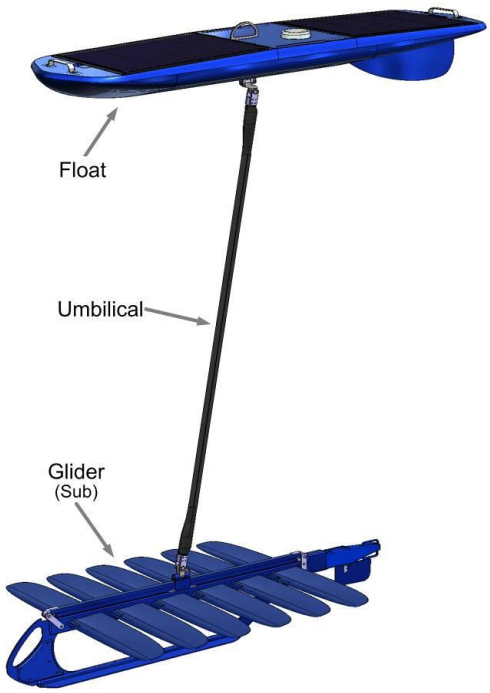


Figure 1-3: Wave Glider Main Components

Figure 1-4 below shows the names for various external parts of the Float and Glider. These are the key parts that will be referenced during assembly, handling, launch and recovery of the Vehicle.

Figure 1-4: Float and Glider Primary External Parts

1.4.2 Wave Glider Communications

Figure 1-5 shows the general configuration of the payload and communications on the Wave Glider.

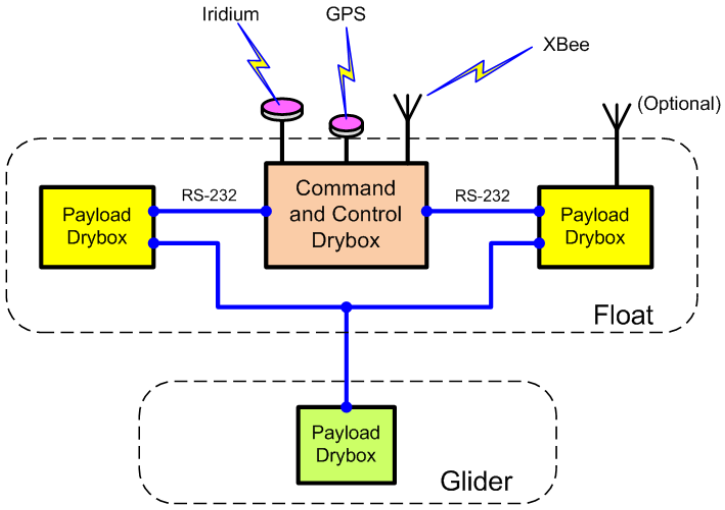


Figure 1-5: Wave Glider Communications

The C&C communicates directly with the external world via either Iridium Communications, Inc. satellite Short Burst Data (SBD) or via XBee (IEEE 802.15.4). The C&C also receives GPS signals, which are used for location and navigation.

Note also that communication between the C&C and the Float payloads is via RS-232. A custom payload mounted to the Glider can communicate with either of the Float payloads, but cannot communicate directly with the C&C.

Payload components receive power from and communicate through the corresponding connectors on the lid of the C&C Dry Box.

1.4.3 Wave Glider Management System

WGMS is the administrative control system for operating all Wave Gliders. It coordinates communication between users and Wave Gliders and provides a number of administrative services, such as logging telemetry and alarm monitoring. Users communicate with the Vehicle via Microsoft Internet Explorer. The Mobile Operations Kit is designed to use a WGMS configuration known as "Mobile to Mobile" (M2M).

The basic operational issue addressed by the Mobile to Mobile configuration is that it supports operation of a Wave Glider without requiring any access to the Internet. In the hosted LRI system, the Internet is used for retrieving mapping information from Google Maps and for transporting messages between the Iridium Communications ground station and WGMS. In M2M, messages are sent via an Iridium modem installed in a "Deck Box", which is supplied with the Mobile Operations Kit. The kit also contains a ruggedized laptop computer with WGMS pre-installed. The Deck Box connects to the laptop. The map displays are provided by a third-party application (Coastal Explorer) that runs on the laptop.

These operational capabilities are provided via configuration options – the LRI-provided software is identical to that used on LRI's hosted service, and the software that executes on the Wave Glider is essentially unaware that it is being operated in a mobile-to-mobile configuration. Thus, it is possible to use the M2M version of WGMS as a mini-host, allowing browsers on other computers to view and control the paired Wave Glider.

1.4.4 Mobile to Mobile Communications

The standard Wave Glider can communicate through the Iridium satellite network as well as an XBee local area wireless protocol. The copy of WGMS installed on the laptop is preconfigured to support both communications paths using the hardware in the Deck Box. Due to the underlying technologies involved, the Deck Box modems, the laptop and the Wave Glider are a matched set. It is possible to reconfigure the components of a set, but that typically would not be a field operation.

Iridium communications for the Mobile to Mobile version depend on an Iridium technology called ISU-ISU, as illustrated in Figure 1-6.

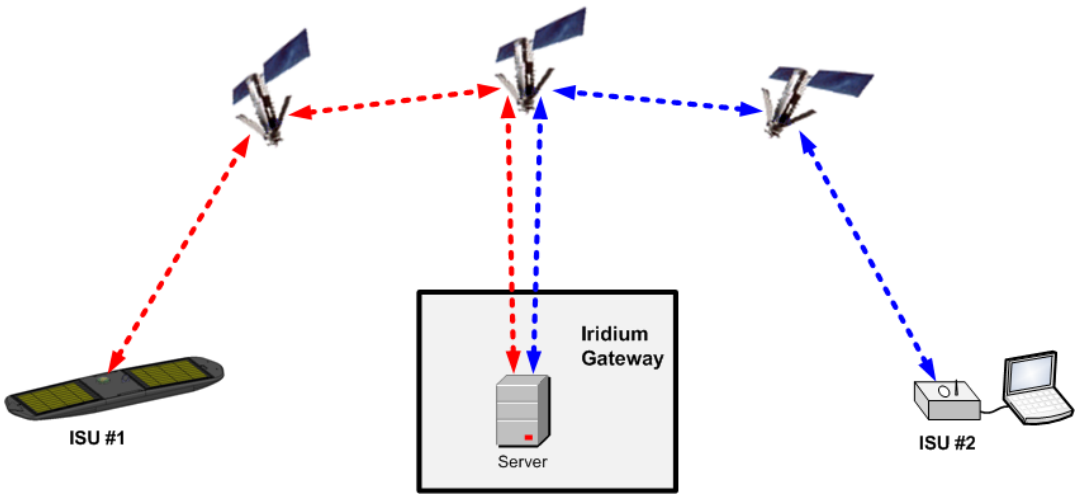


Figure 1-6: ISU-ISU Communications Paths

In the figure, the Iridium modem in the Wave Glider is ISU #1 and the Iridium modem in the Deck Box is ISU #2. Communications go through two hops, with the message being held temporarily at the Iridium Gateway between hops. Messages are delivered to the paired ISU modem, where the pairing

information is held at the Iridium Gateway server. Thus, changing a modem in a pair requires that the pairing information held at the Iridium Gateway server be updated.

Similarly, the XBee communications interface depends on pairing information. XBee is a short-range radio technology. The XBee modem inside the Deck Box acts as a network controller and can talk to any Wave Glider in range. To avoid the problem of having multiple controllers try to talk to multiple Wave Gliders, each XBee modem is configured with a unique "PAN ID". The paired Wave Glider is similarly configured to communicate just with a controller that uses that PAN ID. As with the Iridium option, you can change the PAN ID. See the LRI *System Administration* manual for more information.

Depending on range, both communications options are available for use in the Mobile Operations Kit.

The Deck Box also contains a GPS receiver. Location information from the GPS is used by Coastal Explorer to plot the current location of the laptop, which obviously could be different than the location of the Wave Glider.

1.5 Phases of Operations

1.5.1 Operational Workflow

The diagram below shows the general flow of operations when using the Mobile Operations Kit. Items in Green boxes are described in this document. Items in Gray are described in other LRI documents.

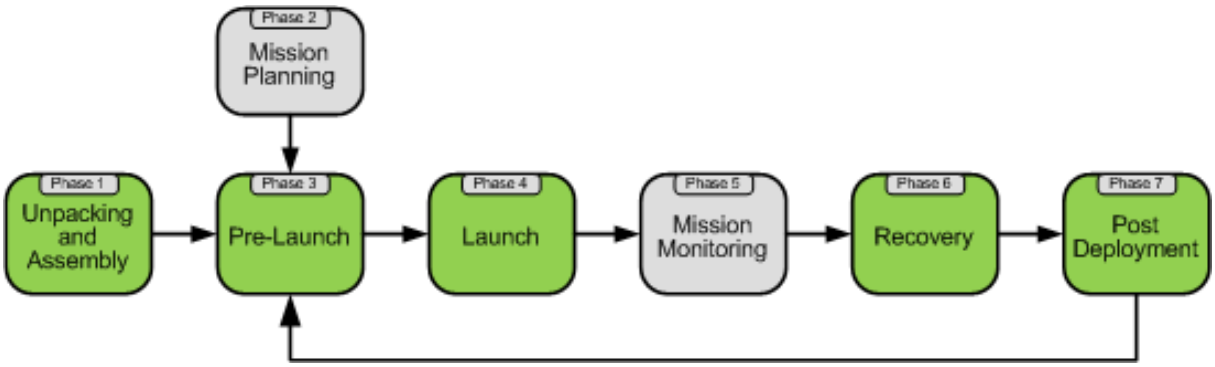


Figure 1-7: Operation Phases

Each of the above phases is described briefly below.

1.5.2 Phase1: Unpacking and Assembly

The Mobile Operations Kit is configured to minimize unpacking and assembly operations. However, for shipping purposes, some assembly is still required. The contents of the kit are described in chapter 2. A general description of the unpacking and assembly is covered in chapter 3. This phase is complete when the vehicle is assembled and the topside support equipment has been setup.

1.5.3 Phase 2: Mission Planning

Mission planning is described in detail in the Wave Glider *User Manual*.

1.5.4 Phase 3: Pre-Launch

Pre-Launch preparation is critical, both for enabling a safe and successful launch, as well as insuring that the Wave Glider will operate reliably on long-duration missions. Pre-launch preparations are described in chapter 5.

1.5.5 Phase 4: Launch

Vehicle launch is second only to Vehicle recovery in that experienced personnel, using the correct equipment, conscientiously follow a prescribed set of procedures. Launch procedures are described in chapter 6.

1.5.6 Phase 5: Mission Monitoring and Operation

Mission monitoring is described in detail in the Wave Glider *User Manual*.

1.5.7 Phase 6: Recovery

Vehicle recovery is the most demanding of the Wave Glider operation procedures. Recovery procedures are described in chapter 8.

1.5.8 Phase 7: Post-Deployment

1.6 Additional Topics

Some additional topics relevant to Wave operation are also described in this document. These are described briefly below.

1.6.1 Emergency Location

The Wave Glider has a continuously-broadcasting emergency-location beacon. The Mobile Operations Kit contains a radio-direction-finding (RDF) receiver and antenna that can be used to home-in on the beacon. Use of the Emergency RDF receiver is described in Chapter 9.

1.6.2 Maintenance

Basic procedures maintaining the Wave Glider are described in chapter 10.

1.6.3 Troubleshooting

Basic troubleshooting procedures and specific scenarios are described in chapter 11.

1.6.4 Checklists

Checklists are given in Appendices at the end of this document.

2. Remote Operations Kit Contents

The contents of the three main shipping cases are described below, in the general order that they should be opened. Depending upon your specific Wave Glider application, there may be some variations from the contents described below.

2.1 Support Equipment Case

2.1.1 Contents

This container should be opened first, as it contains the hand tools and parts necessary to perform the assembly of the Wave Glider. It also contains support equipment for Vehicle operations.

Figure 2-1: Support Equipment Case

#	Qty	Item
1	1	Panasonic Toughbook®-30
2	1	"Communications Deck Box"
3	1	Radio Direction-Finder Receiver
4	1	Direction-Finder Antenna
5	1	Launch/Recovery Rigging Gear
6	1	Tool Kit
7	1	Small Parts Box

We recommend that you check to verify that all the contents are present and undamaged. Then, remove the tool kit (ref 2.1.2.1) and the parts box (2.1.2.2), as only these are required for Vehicle assembly. The use of the other contents will be described in subsequent chapters.

2.1.2 Assembly Tools and Supplies

The assembly tools are provided in the black zip-up bag at the right side of the container. On the far left is a plastic box containing various small items required for assembly, as well as some spare parts.

2.1.2.1 Tool Kit

The Tool Kit contains the following:

Figure 2-2: Tool Kit Contents

#	Qty	Item
1	1	Rubber Mallet
2	1	Cutting Pliers
3	1	4mm Allen-Head T-Handle Wrench
4	1	6mm Allen-Head T-Handle Wrench
5	1	Large Flat-Head Screwdriver
6	1	Small Flat-Head Screwdriver
7	1	#2 Phillips-Head Screwdriver
8	1	12mm Combination Wrench
9	1	8mm Combination Wrench
10	1	Vise-Grip Pliers
11	1	Canvas tool bag

2.1.2.2 Parts Box

The Parts Box contains 20 different items.

Figure 2-3: Parts Box Contents

#	Qty	Item
1	1	Wing spring cover plate
2	1	Subconn locking sleeve
3	2	80/20 anchor studs
4	4	Rubber bands
5	1	Loctite 243
6	1	8-pin dummy male subconn
7	10	M5 hex nuts
8	10	Fiberglass washers
9	10	M5x12mm pan head screws
10	12	M5 split washers

#	Qty	Item
11	12	M5 flat washers
12	2	Nylon washers
13	2	Cotter key
14	2	M5x100mm titanium standoffs
15	2	M5x16mm socket cap screws
16	2	M6x35mm socket cap screws
17	1	M5x40mm titanium screws
18	4	M5x18mm titanium screws
19	4	M5x25mm titanium screws
20	10	M4x12mm pan head screws

2.1.3 Communications Equipment

The communications Equipment consists of a Toughbook ruggedized laptop, a Communications Deck Box, and the cables used to supply power and connect the components.

2.1.3.1 Panasonic Toughbook-30

The Toughbook laptop is preconfigured with a complete copy of WGMS that is configured for use with the Deck Box and with the software and hardware in the Float. Changing the Toughbook software is possible but is beyond the scope of this document.

Figure 2-4: Toughbook, Showing Side and Back USB Ports

As shown in the figure above, the Toughbook has two USB ports on the back, and one on the side. Any of these can be used to connect to the Comm Deck Box.

2.1.3.2 Communications Deck Box

The Communications Deck Box ("Comm Deck Box") contains an Iridium 9522B transceiver, an XBee modem and a GPS receiver, along with the appropriate antennas for each.

Figure 2-5: Comm Deck Box, Closed and Opened

The Comm Deck Box connects to the Toughbook with a USB cable. The GPS and XBee modems can be powered by the USB. However, the Iridium receiver requires an external power supply.

2.1.3.3 USB, Power and Coax Cables

Four cables should be packed together in a drybag.

Figure 2-6: USB, Power and Coax Cables

1) A USB cable connects the Toughbook to the Comm Deck Box.
2) A wall-plug power converter and cable provides power to the Comm Deck Box.
3) A 12V mobile power plug that can be substituted for the wall-plug converter.
4) A coax cable that is used for the Emergency RDF equipment. Its use is described in chapter 9.

2.1.4 Launch and Recovery Gear

2.1.4.1 Launch/Recovery Bag

The Gray and Yellow Launch/Recovery Bag contains the items used for Wave Glider handling and for shipboard launch and recovery operations. These operations, and the use of the bag's contents, are described in later sections.

2.1.4.2 Launch/Recovery Bag Contents

The bag contents are shown in the figure below.

Figure 2-7: Launch/Recovery Bag Contents

The contents and their uses are:

Tag Line Ropes: (Contents: 2). These can be tied to the handles on the Float for stabilizing the Vehicle assembly when it is being lifted on shore, or when loading/unloading from the launch/recovery vessel.

Float Recovery Line + Carabiner: (Rope with the large carabiner). The carabiner is latched onto the Lift Eye on the Float during recovery.

Glider Recovery Line + Carabiner: (Carabiner wrapped with black rope). This carabiner is latched to the front handle on the Glider for lifting it out of the water.

Quick Release Launch Strap: Used to hold the Float+Glider assembly together prior to launch. Pulling the quick release cord causes the bundled assembly to separate to launch the Vehicle.

Release Cord Extension: (Gray) Allows lengthening the quick release cord.

Endless Ratchet Straps: (Contents: 2). Used to tie the Float+Glider assembly together for moving to and from the support vessel.

Tie-down Ratchet Straps: (Contents: 2). Hook-end ratchet straps used to secure the Float+Glider assembly to the deck of the support vessel during transport.

Lift Sling Assembly: (Green) A load-rated lift sling with carabiner. Used for shore-based lifting of the Float or the bundled Float+Glider assembly.

2.1.5 Emergency Radio Direction-Finding Equipment

The Emergency RDF equipment consists of a receiver, an antenna, and a coax cable. Use of the RDF is described in chapter 9.

2.1.5.1 Radio Beacon Receiver

The Radio Beacon Receiver is packed in a padded carrying case. We recommend always using the receiver in the case.

Figure 2-8: Receiver in Carrying Case

2.1.5.2 Folding Antenna

The antenna (packed in the lid) unfolds for use.

Figure 2-9: Folded RDF Antenna in Lid

2.1.5.3 Coax Cable

A coax cable is included with other cables (ref 2.1.3.3) in a small drybag. The coax is used to connect the Receiver to the antenna.

2.2 Glider Case Components

2.2.1 Contents

The Glider case contains:

Figure 2-10: Opened Glider Case

#	Qty	Item
1	1	Glider Frame
2	1	Umbilical (attached to Glider)
3	6	Pairs of Wings
4	2	Glider Assembly Blocks
5	4	Support Stand Parts
6	1	Glider-Float Saddle
7	8	Caster Wheels for Case

Refer to section 3.1 for general instructions on Glider assembly.

2.2.2 Glider Frame + Umbilical

The Glider frame has the Umbilical attached. Both are packed in the top of the case, and are wrapped in plastic sheet. The figure below shows the position of the Glider in the case, without the plastic.

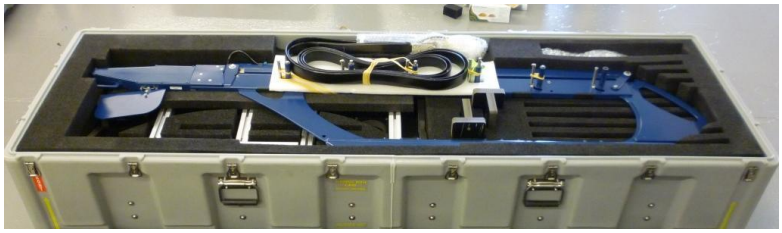


Figure 2-11: Position of Glider in Case

2.2.3 Wing Sets (6)

The 12 Glider wings are packed in pairs and inserted in slots at the front of the case. They will need to be installed on the Glider frame.

2.2.4 Glider Assembly Blocks (2)

The T-shaped Glider assembly blocks are used for packed near the center of the box, underneath the Glider frame. These are used to support the Glider frame for wing installation

2.2.5 Vehicle Support Stand Parts (4)

The support stand is used for assembly and transport of the Vehicle assembly. The stand will need to be assembled from the four parts included in the case.

2.2.6 Glider-Float Saddle

The Glider-Float saddle is used as a spacer for the Glider + Float assembly.

2.2.7 Caster Wheels

Both the Glider and Float cases are designed for caster wheels to be mounted on the bottom of the cases, as shown in Figure 2-12.

Figure 2-12: Case Bottom with Wheels Mounted

Eight wheels are supplied with each case: 6 standard casters and 2 locking casters.

The cases are shipped without the wheels attached. The eight wheels are inserted in pockets in the foam packing. In the Glider case, they are wrapped in plastic and inserted into a wide slot at the front of the case.

No tools are required for installation. Press the retainer stud and slide into place.

2.3 Float Case Components

The Float case contains:

#	Qty	Item
1	1	Float (with C&C)
2	1	Tail Fin
3	4	Tail Fin Attach Hardware
4	1	Collapsible Boat Hook
5	1	AIS Whip Antenna
6	8	Wheels for Case

Figure 2-13: Opened Float Case

Refer to section 3.2 for information on unpacking the Float container.

2.3.1 The Float

The Float has a handle at both the fore and aft ends. When lifting the Float out of the case, use the handles.

2.3.2 Tail Fin

The Tail Fin is in a plastic bag underneath the Float.

Figure 2-14: Tail Fin in Shipping Bag

It will need to be attached to the Float (ref. section 3.2.2).

2.3.3 Fin Attach Hardware

The attach hardware is (loosely) mounted in the attachment flange holes on the Float. Spare screws, nuts and washers are included in the Parts Box (ref. 2.1.2.2).

2.3.4 AIS Whip Antenna

The AIS antenna is located in mounts in the inside lid of the Float container.

Figure 2-15: AIS Antenna Shipped in Float Case Lid

The antenna is removed by slipping off the black plastic cap and sliding the antenna out. The cap is then replaced on the antenna tip.

2.3.5 Collapsible Boat Hook

The boat hook is strapped to the inside lid of the Float container.

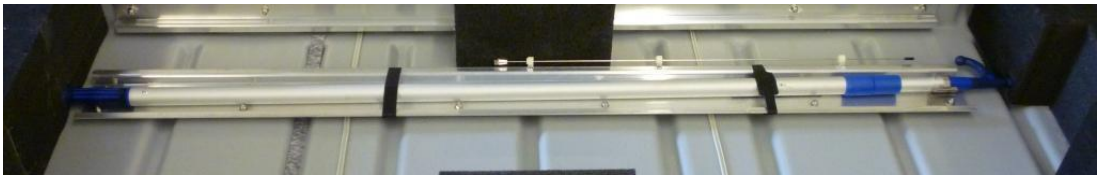


Figure 2-16: Boat Hook in Float Case Lid

In collapsed form, the hook is less than 2 meters long. However, it can be expanded to over 4.5 meters.

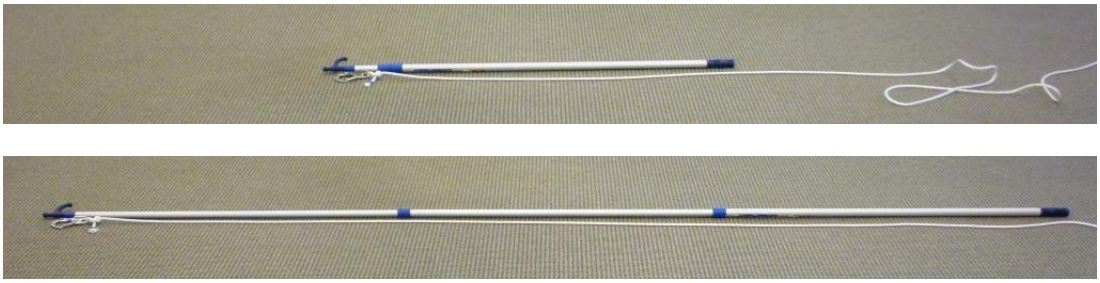


Figure 2-17: Boat Hook, Collapsed and Extended

The extension is done by twisting the pole between two sections to unlock, telescoping out the inner section, then twisting in the opposite direction to lock.

The boat hook has a conventional hook at the end. It also has a fitting for the special capture carabiner attached to the Float recovery rope.

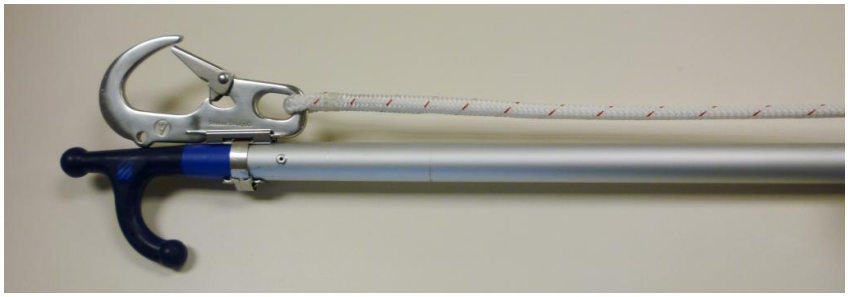


Figure 2-18: Boat Hook with Capture Carabiner

Note that the carabiner is held in place by tension on the rope. This allows the boat hook to be removed once the Float has been captured. The complete procedure is described in chapter 8.

2.3.6 Caster Wheels (8)

As with the Glider case, eight wheels are inserted into pockets in the foam packing of the Float case. The wheels can be clipped into the bottom of the case. No tools are required.

3. Phase 1: Unpacking and Assembly

3.1 Unpacking and Assembling the Glider

The order of unpacking and assembly is important. As described in section 3.2.7, when assembly is complete the entire Wave Glider will be strapped to its support frame, ready for deployment.

3.1.1 Unpacking the Glider Container

Since the Glider container contains several components, they should be removed and used in a specific order.

Figure 3-1: Glider Container Contents

First, remove the T-shaped Glider frame mounting blocks and place them on at table or other flat surface, about 1 meter apart. Then, remove the Glider frame and mount it on the blocks.

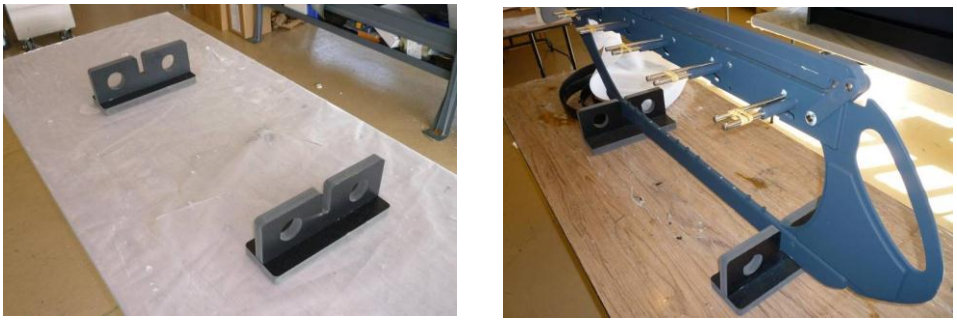


Figure 3-2: Glider Frame on Mounting Blocks

3.1.2 Adding Wings

Recall that all the wings are identical, except for two wings that have a larger notch at the base. The large-notch wings are specially marked. Their location on the Glider is marked also.

Figure 3-3: Labels for Notched Wings

Add the wings one set at a time. First one side, then the other.

Remember: Hold the aft shaft so that it doesn't push through when sliding on the wing.

Use a small amount of Loctite on each wing screw.

Figure 3-4: Installing and Securing Wing

Add the wing on the opposite side. Then check for free and full movement up and down, as shown in Figure 3-5 below.

Figure 3-5: Checking Wing Movement

Add the remaining five wing sets. Be sure to mount the larger-notch wings at the correct location.

3.1.3 Assembling the Vehicle Support Stand

The next step is to assemble the Vehicle Stand. There are 4 parts to the stand, as shown in Figure 3-6.

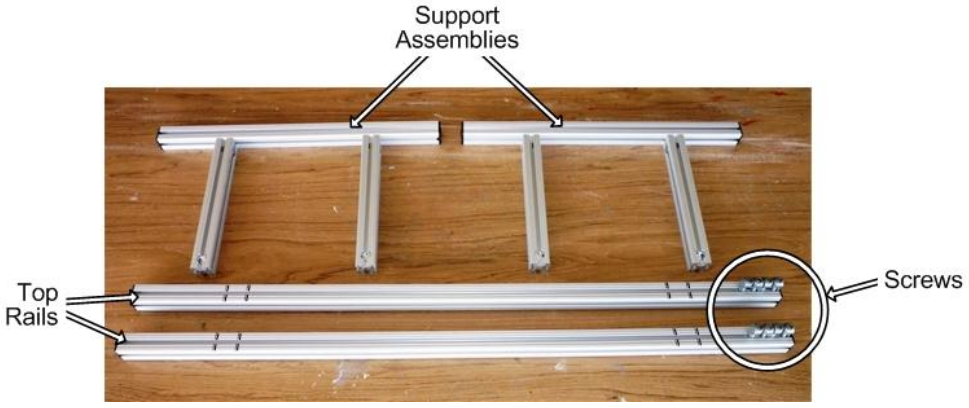


Figure 3-6: Support Stand Parts

The screws for assembly are located on the top rails. The black lines indicate the positions of the support assemblies on the top rail. Recall that the stand is assembled upside-down.

When assembled, the stand should look like:

Figure 3-7: Assembled Support Stand on Cart

We recommend that the stand be mounted on a movable cart, as shown above in Figure 3-7.

3.1.4 Mounting Glider on Stand

This must be done by a minimum of two people, one each at the front and back of the Glider. We recommend that a third person be used to hold the Umbilical.

Move the Glider to the stand. The Glider should be positioned such that all the wings are supported by the side rails, as shown on the left in the figure below.

Then, place the Float-Glider Saddle on the top of the Glider. Make sure that the stubs on the bottom of the saddle fit in the gaps between the wings.

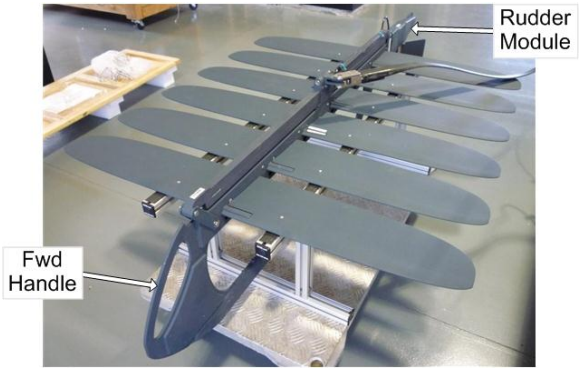
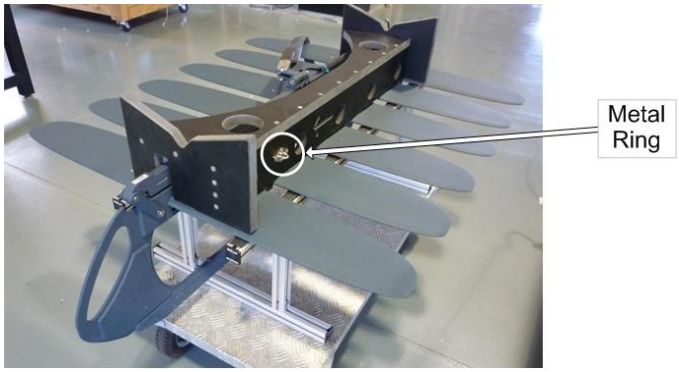


Figure 3-8: Glider on Stand.



Saddle on Glider.

Note that Saddle is mounted so that the metal ring is on the forward-left side.

3.2 Unpacking and Assembling the Float

3.2.1 Unpacking the Float Container

The Float container contains basically the Float and its Tail Fin. However, the lid of the container also contains the boat hook and the AIS antenna.

Figure 3-9: Float in Container

Moving the Float requires at least two people: Lift the Float by the front and back handles, and place it on the top of the Saddle above the Glider. Be careful not to damage the fin-mounting flange in back.

When properly positioned, the nose of the Float should be about even with the nose of the Glider.

Figure 3-10: Float Mounted Above Glider

3.2.2 Adding the Tail Fin

The four sets of mounting hardware are located at the attach points. Remove them to install the Tail Fin. (Spare hardware is in the Small Parts Box.) Attach the Fin as shown.

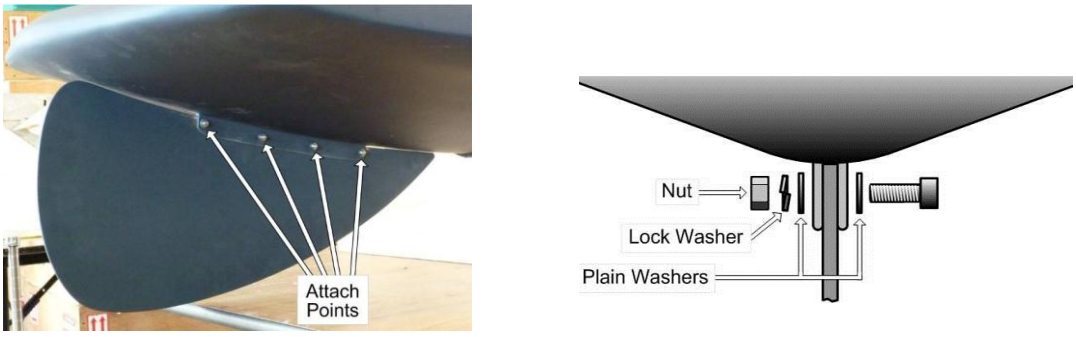


Figure 3-11: Tail Fin Mounting

3.2.3 Removing Turtledeck and C&C Covers

In order to install attach the Umbilical to the Float, you will need to remove the Turtledeck cover. You will also need to remove the cable covers on the top of the C&C drybox.

Figure 3-12: Removing Turtledeck and C&C Cable Covers

3.2.4 Connecting Umbilical to the Float

Note: The Umbilical connection is critical to the operation of the Wave Glider. Incorrect assembly can result in poor performance or possible loss of the Vehicle.

This procedure requires a minimum of two people. We recommend having a third person.

First, lay out the Umbilical and untwist as necessary. Then fold back to the Float.

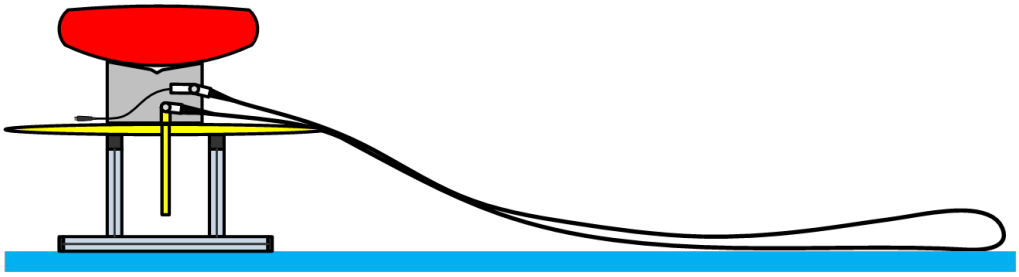


Figure 3-13: Untwisting the Umbilical

With one person in front and one in back, rotate the Float on the Saddle at least 60°, as shown in Figure 3-14 below.

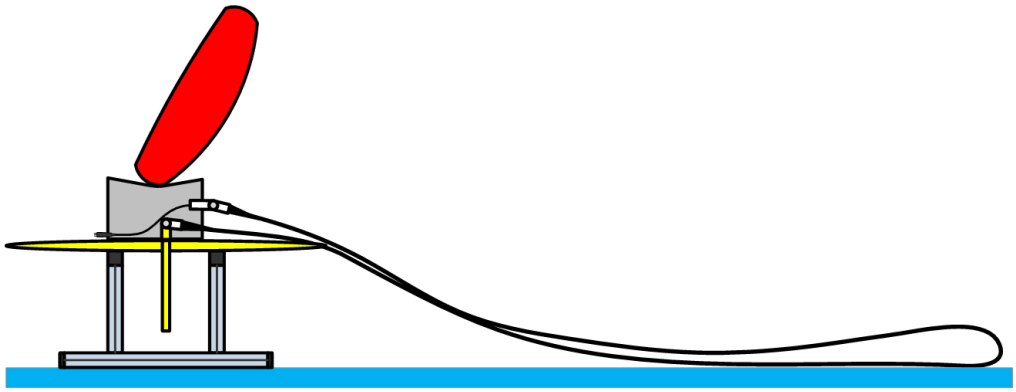


Figure 3-14: Rotating Float for Umbilical Insertion

Feed the electrical cable up through the hole in the bottom of the Float, and pull through on the top side. It is easiest if one person feeds on the bottom, and another pulls on the top.

Figure 3-15: Feeding Through Umbilical Electrical Cable

Insert the Umbilical fitting, with the black plastic part aft. Have someone on the upper deck of the Float pull through the electrical cable. Lock the fitting in place with the rubber mallet.

Figure 3-16: Inserting the Umbilical Fitting

Pull on the fitting to check that it is locked in place. Then, rotate the Float back onto the Saddle.

On the top side, check that the disk on the release fitting is flush with the plastic base.

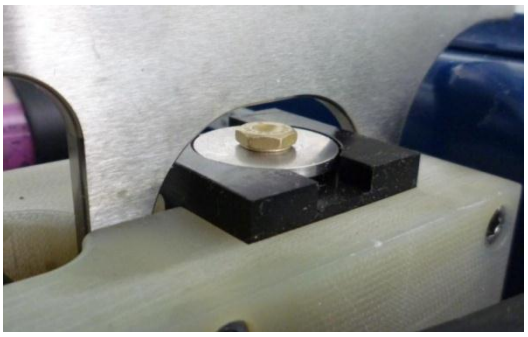


Figure 3-17: Flush Line Terminator Disk

Connect the Umbilical electrical cable to the appropriate connector on the C&C drybox.

Re-install the cable covers on the C&C box top.

Finally, re-install the Turtledeck cover.

3.2.5 Stowing the Umbilical

The Umbilical must be folded such that it will not tangle during launch.

First, get one large rubber band from the Parts Box. Next, stretch the Umbilical out and start folding back, as shown.

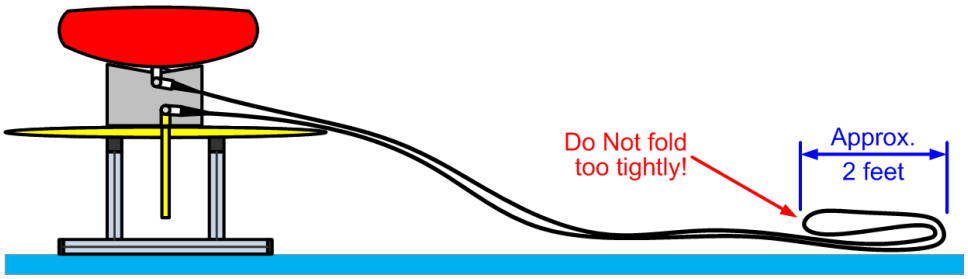


Figure 3-18: Folding the Umbilical

Continue loosely rolling up the Umbilical, and secure in the center of the wrap with the one doubled-over rubber band.

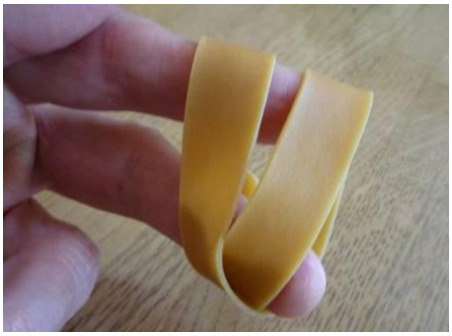


Figure 3-19: Securing the Umbilical

Do not wrap the rubber band around the Umbilical more than twice.

3.2.6 Installing the AIS Whip Antenna

If your Vehicle was shipped with the AIS receiver option, the AIS antenna whip will need to be installed.

The AIS antenna is mounted on the inside lid of the Float container.

Figure 3-20: AIS Antenna Shipped in Float Case Lid

To remove, slip off the black plastic cap and slide the antenna out. Be sure to replace the cap.

Attaching the antenna requires the use of the 12 mm combination wrench.

Note: Use the boxed (enclosed) end of the wrench. Do not use the open end.

Apply a small amount of Loctite to the threads at the top of the antenna base.

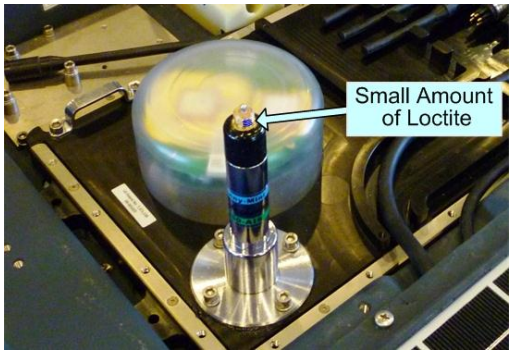


Figure 3-21: Applying Loctite to Antenna Base

With one hand holding the antenna, use the other hand to screw the antenna onto the base. If it doesn't screw on easily, the antenna is not aligned with the base. Re-align the antenna and try again.

Do not try to force the antenna on, or you will damage the threads.

When the antenna has been hand-screwed on, tighten it with the box end of the combo wrench.

Bring the box end of the wrench down from the top of the antenna whip.

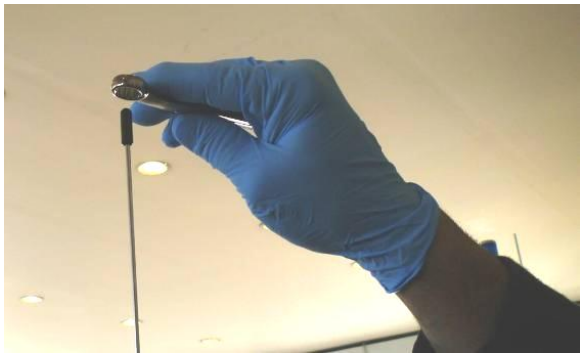


Figure 3-22: Slipping Wrench Box End on Antenna

Tighten the base until snug – Be careful not to over-tighten

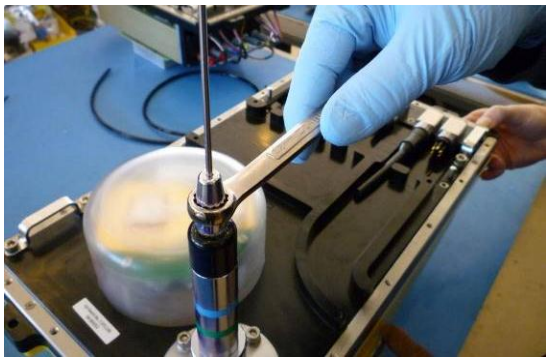


Figure 3-23: Snugging the Antenna to the Base

3.2.7 Strapping the Float and Glider Together

The Float, Glider, Saddle and Support Stand are strapped together for transport and launch. A successful launch depends on this being done as specified below.

Three straps are used:

- The center strap with the release carabiner only wraps around the Float and Glider, not the support stand.
- The front and rear straps with the cinch buckles wrap around the support stand also. This allows the support stand to be picked up with the assembly.

Figure 3-24: Assembly Straps and Release Carabiner

The front and rear straps are also used to secure the assembly to the deck during water transport.

This is described in more detail in chapter 5.

3.3 Configuring the Software

3.3.1 Overview

The software on the Toughbook is pre-configured to support its paired Wave Glider in Mobile to Mobile mode. When you start the laptop, most of the software automatically starts along with the Windows operating system. This section describes the additional startup steps that are required.

In addition, Mobile to Mobile WGMS operates without an Internet connection, necessitating some differences in the UI between the hosted version and Mobile to Mobile. This section assumes the reader is familiar with the hosted version and consequently just highlights the differences.

3.3.2 Setting up Communications

3.3.2.1 Connect the Deck Box

A USB cable and an external power adapter should be included in a drybag in the Equipment container.

Figure 3-25: USB Cable and Power Adapter

These cables connect to the ports on the side of the Deck Box.

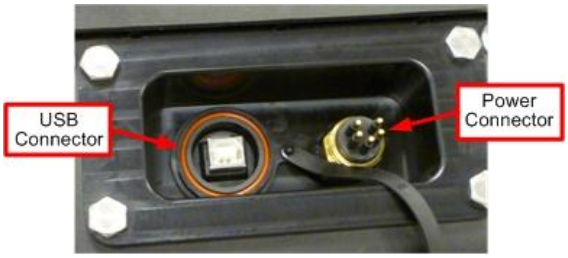


Figure 3-26: Deck Box USB and Power Connectors

The Toughbook connects to the Comm Deck Box using the supplied USB cable. There are three USB connectors on the Toughbook, one on the right side and two on the back. Any one of them can be used. A diagram of the connections is shown in Figure 3-27.

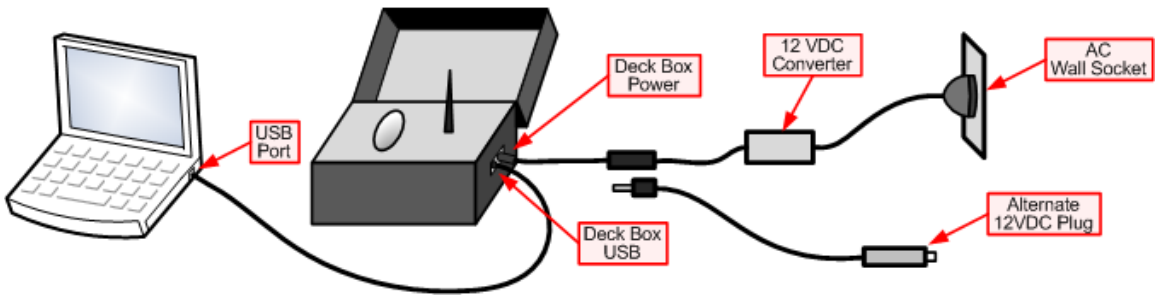


Figure 3-27: Connecting the Toughbook and Comm Deck Box

The Iridium modem in the Comm Deck Box is powered using the supplied external power adapter. The kit is configured with an adapter for a standard 3-prong wall plug. A compatible 12-volt auto adapter is included in the kit and can be used instead of the power adapter.

Note that the USB bus powers both the XBee modem and the GPS in the Deck Box, so they can be used even if external power is not available.

3.3.2.2 Software Start-Up

Once the Deck Box and the Toughbook are connected:

1) Check the USB connection between the Deck Box and the Toughbook.
2) Turn on the laptop. This also starts the main WGMS services (runs in the background).
3) Log in to Windows as Administrator. The default password will be **M2Mlog!n**. (Once logged in, you can change the password).

   Note: If the system asks you to reload the USB drivers, cancel the request.

3.3.2.3 Start the XBee Relay

If you are not close enough for XBee communications, you will not be able to perform the steps below. Skip down to section 3.3.2.4 "Start the Alternate Iridium Relay".

1) Click on the XBee Relay icon (or use Windows Start menu) to bring up the WGMS XBee Relay dialog.

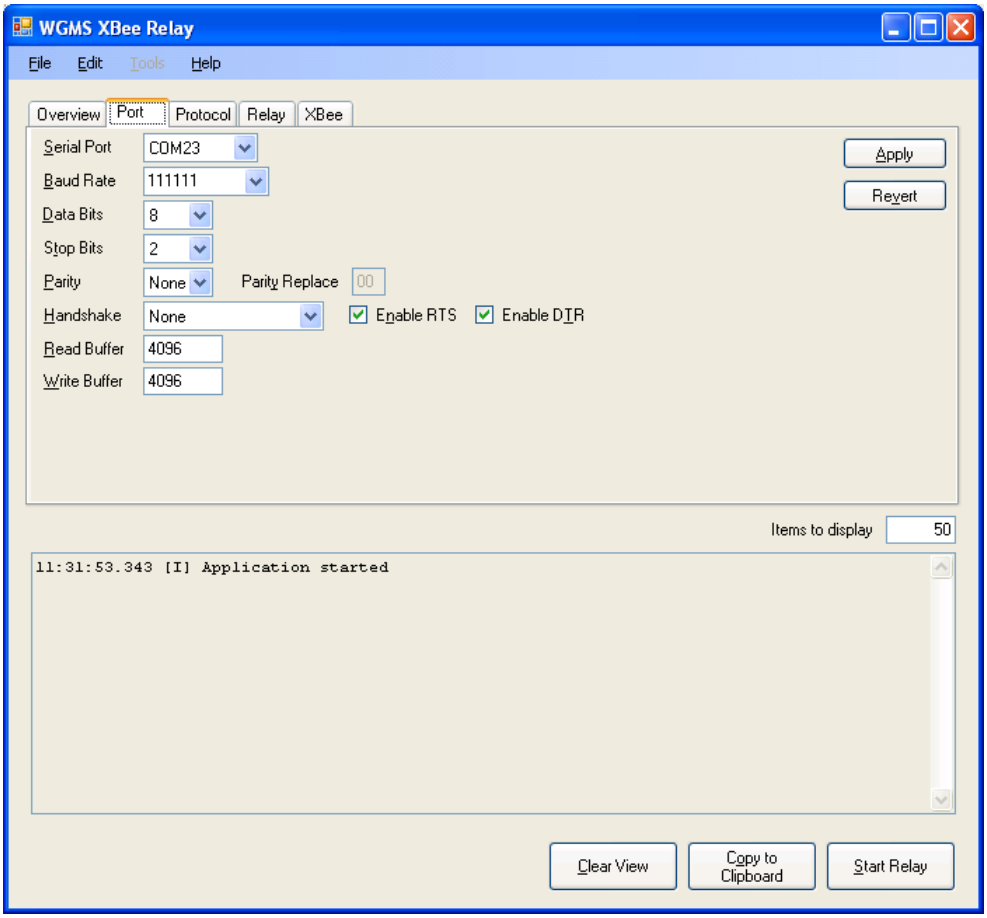


Figure 3-28: XBee Relay Dialog – Port Tab

2) Click the **Start Relay** button at the bottom-right.

Note: At this point, several messages will appear in the lower box. This is normal.

3) Click on the **Overview** tab.

4) Wait several minutes for the Unique ID (an 8-digit hex number) to appear in the "Connected Devices" box at the left.

Note: The Unique ID will be requested from the Vehicle, then transmitted back. Thus it can take up to 10 minutes to receive the Unique ID value.

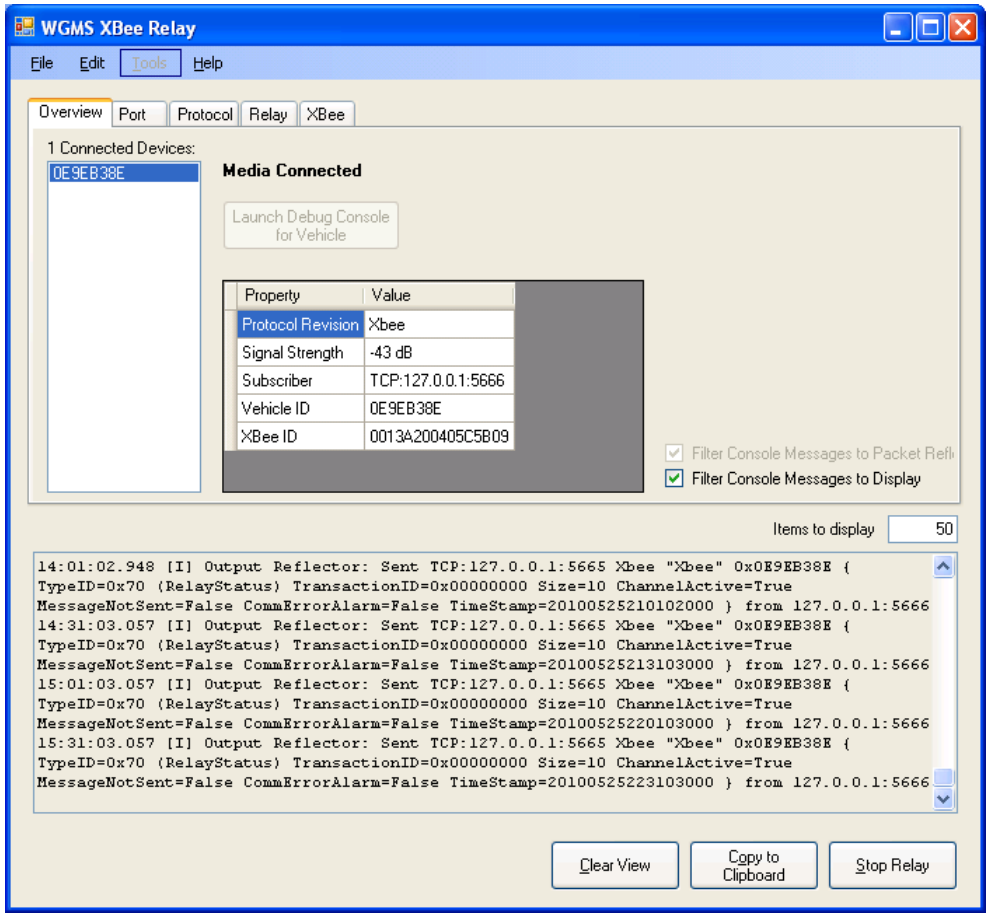


Figure 3-29: XBee Relay Dialog -- Overview Tab

Note: If the Unique ID does not appear after 15 minutes, go to the Troubleshooting chapter 11.

Leave this XBee Relay running and proceed to start up the Alternate Iridium Relay (see next section).

3.3.2.4 Start the Alternate Iridium Relay

Starting the Alternate Iridium Relay is similar to starting the XBee Relay, with some additional steps.

1) Click on the WGMS icon (or use Windows **Start** menu) to bring up the WGMS Iridium Relay dialog.

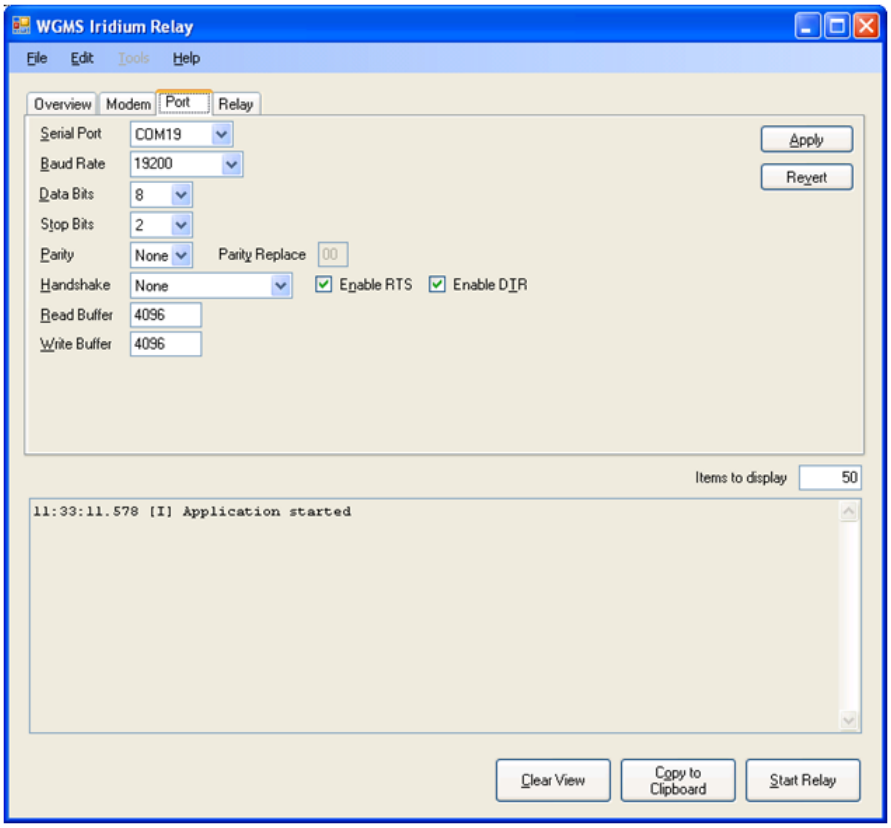


Figure 3-30: WGMS Iridium Relay Dialog – Port Tab

2) Click the **Start Relay** button at the bottom-right.

   Note: The Vehicle ID number for your system should be on the label on your Toughbook.

After clicking **Start Relay**, you should get a prompt: "Use existing vehicle ID xxxxxxxx?" (where the xxxxxxxx represents the Vehicle ID number).

3a) Select **Yes** if the Unique ID matches the label on your laptop.

3b) Select **No** if the Unique ID number does not match the label. When you select "No", the Relay should then query the Vehicle for its Unique ID. The Relay may ask if the Unique ID query should be made immediately. For this request, respond with **Yes**.

4) Select the **Overview** tab.

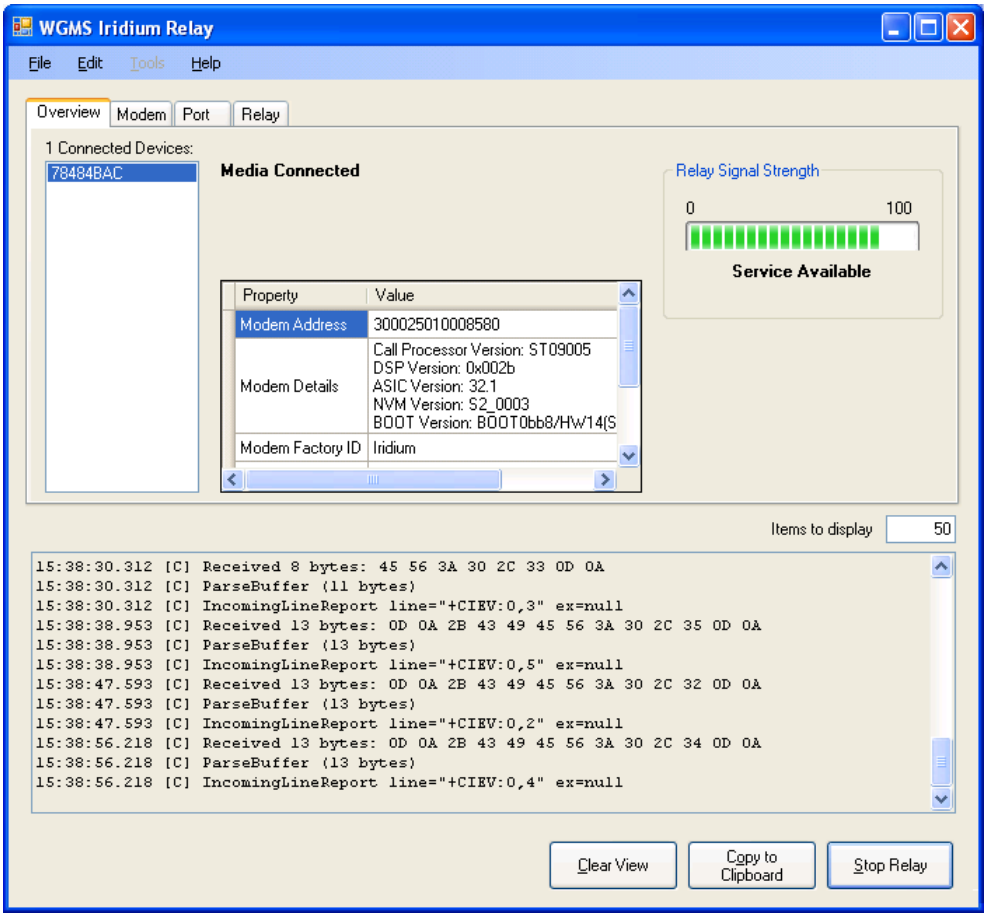


Figure 3-31: WGMS Iridium Relay Dialog -- Port Tab

5) Wait for the Unique ID to appear in the list of Connected Devices at the left. This will take about ten minutes.

   Note: If the Unique ID does not appear after 15 minutes, go to the Troubleshooting chapter 11.

Leave the Alternate Iridium Relay running and proceed to set up the Coastal Explorer (next section).

3.3.3 Start WGMS and Coastal Explorer

To access Coastal Explorer:

1) Start Internet Explorer.
2) Enter **http://localhost** in the upper-left box. You should receive a request for a username and a password.
3) Login using the username **login@liquidr.com** and the password **pass0124**

Note: Once logged in, you can change the username and/or password for security or customization reasons.

4) Telemetry should begin to arrive from the Vehicle via Iridium.

5) From the Windows **Start** menu, start Coastal Explorer.
You will see a marker indicating the location of the Deck Box.

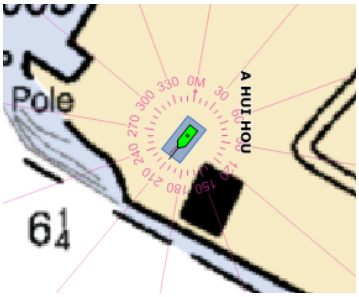


Figure 3-32: Coastal Explorer Deck Box Marker

You will see a triangle representing the location of the Vehicle.

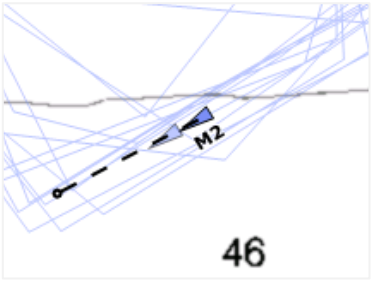


Figure 3-33: Coastal Explorer Vehicle Marker

Note: If the Deck Box and Vehicle are close to each other, you may have to zoom in on the map in order to see the Vehicle.

3.3.4 Test the Wave Glider Using WGMS

Exercise the relays to verify that the Wave Glider is communicating with WGMS.

3.3.4.1 Requesting a Vehicle Status

Using the WGMS Dashboard, request a Vehicle status as follows:

1) Click More Commands…
2) Add a "Command Reason"
3) For "Command Type", select **Retrieve Status**
4) Select the appropriate "Com Channel", either **XBee** or **Alternate Iridium**.
5) Click the **Send** button.
6) Confirm that the command is ACKed by the Wave Glider. This may take a few minutes if you are using the Alternate Iridium Com channel.

3.3.4.2 Test Communications and Control

Using the Dashboard, change the rudder angle to physically check that the rudder is free to move:

1) Click More Commands…
2) Add an entry in the "Command Reason" box, such as 'Comm Test'.
3) For "Command Type", select **Set Rudder Position**
4) Set the "Course" value to **45**
4) Select the appropriate "Com Channel", either **XBee** or **Alternate Iridium**.
5) Watch the rudder and click the **Send** button.
6) Verify that the rudder moves.
7) Confirm that the command is ACKed by the Wave Glider. This may take a few minutes if using the Alternate Iridium Com channel.

Other tests can be found in the Wave Glider *User Manual*.

4. Phase 2: Mission Planning

4.1 Planning Considerations

A successful mission depends upon careful planning and preparation. Although a Wave Glider's mission can be changed "on the fly", a poorly-planned mission can result in wasted time, premature retrieval, or even Vehicle loss.

The following factors need to be considered when planning a mission:

- Mission Requirements
- Type of Course
- Vehicle Configuration
- Restricted Areas
- Communications
- Sea Conditions
- Season and Weather
- Currents and Tides
- Waypoint Spacing and Currents

For more information on mission (and course) planning, see chapter 5 of the Wave Glider *User Manual*.

We highly recommend that complete mission planning be done prior to starting the mission, including adding Waypoints to both WGMS and Coastal Explorer. Waypoints can always be added or changed during the mission if necessary.

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5. Phase 3: Pre-Launch

5.1 Introduction

Careful pre-launch preparation is essential to insuring a successful launch. The pre-launch checklist contains tasks that ensure full vehicle functionality, records settings and status, and final assembly checks.

5.1.1 Basic Procedure

The primary steps for pre-launch are:

1) Final assembly
2) Strapping together the Float+Glider launch assembly
3) Reviewing the mission configuration
4) Checking the Vehicle functionality

Each of these steps is described in more detail below.

5.2 Pre-launch Checklist

We strongly recommend the use of a checklist for the pre-launch preparations.

An example pre-launch checklist is shown in Appendix A. The example checklist may require modifications for your specific application. The minimum recommended checklist items are shown below.

Mission Planning Checks
Waypoints Created
Waypoints to Coastal Explorer
Op Polygon created and Active
Status Checks
Battery Watt-hours
Final Assembly
Wet mates connected
Connector covers installed
Activate RDF beacon
Turtledeck secure
Rudder moves freely
Vehicle strapped for launch

Vehicle Functionality
Set default comms to IridiumAlt
WGMS telemetry current
Payload powered on
Fixed heading test (spin)
Set course test (spin)
Clear alarms

5.3 Requirements

5.3.1 Time Required

Time required will depend upon the number of people performing the checks, and their experience. Allocate 1 hour for one or two people with minimum experience.

5.3.2 Personnel Required

All pre-launch procedures can be performed by one person who understands all the Wave Glider systems and software. Some pre-launch steps are more conveniently done with two people.

5.3.3 Tools and Equipment

- Wave Glider tool kit
- Quick release launch strap
- Endless ratchet straps (2)
- Operator laptop connected to Deck Box

5.4 Pre-Launch Procedures

5.4.1 Mission Planning Checks

5.4.1.1 Waypoints Created

Refer to section 4.6 of the Wave Glider *User Manual* for instructions on adding waypoints in WGMS. Ensure the intended mission waypoints have been entered. If Google Maps is enabled in WGMS move the chart to the area and check the waypoint positions

5.4.1.2 Waypoints Exported to Coastal Explorer

Check the intended mission area in Coastal Explorer to ensure the waypoints have been exported from WGMS. If the waypoints do not show up on the nautical chart refer to the export procedure in Appendix C.

5.4.1.3 Op Polygon Created and Active

Refer to section 4.5 of the Wave Glider *User Manual* for instructions on adding an Operational Polygon. Review the waypoints in the table of coordinates for the polygon for accuracy. It is important to place a checkmark in the "Generate Alarms" checkbox in the Operational Polygon definition window.

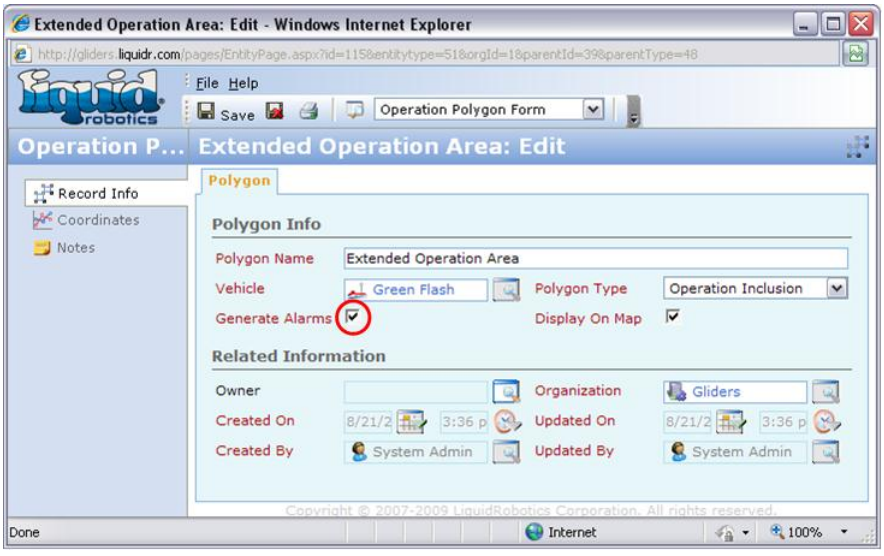

Figure 5-1: Setting an Operational Polygon Active

5.4.2 Status Checks

5.4.2.1 Battery Watt-hours

This check ensures there is enough battery power for the planned mission. Section 2.6.1 of the Wave Glider *User Manual* describes where to find the battery reserves in watt-hour in the WGMS telemetry list. Note the watt hours on the checklist. Refer to Appendix B Solar Flux of the *User Manual* to determine a minimum value for launch.

5.4.3 Final Assembly

5.4.3.1 Wet-mate Connectors Seated

Check the wet-mate cables are connected to the corresponding C&C connector. Typically during assembly payload connectors are often removed. Ensure there are no C&C connectors without a cable or dummy plug inserted fully.

5.4.3.2 Connector Covers Installed

Install the connector covers removed during the assembly procedures detailed in section 3.2.3 of this manual.

5.4.3.3 Turtledeck Secure

Apply Loctite to the turtledeck screws and tighten them to **30** in/lbs.

5.4.3.4 Rudder Moves Freely

Spin the rudder by hand in both directions to ensure it does not bind on the rudder module.

5.4.3.5 Vehicle Strapped for Launch

Proper strapping of the components is a critical factor for handling, transport and launching of the Wave Glider.

As shown in the diagram below, the two fore and aft ratchet straps are wrapped around the Float, Glider and the stand (with the Saddle separating the Float and Glider). However, the center release strap is wrapped around the Float/Saddle/Glider only, and not around the stand.

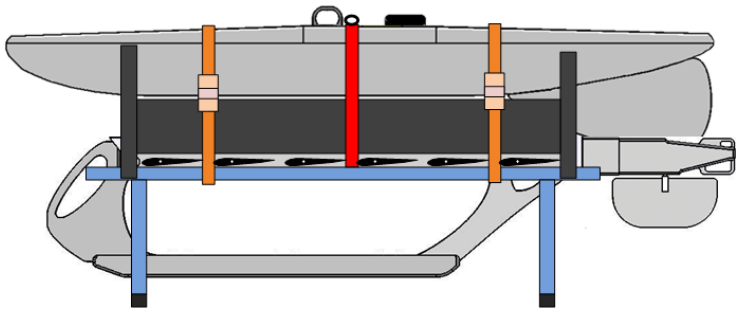

Figure 5-2: Strap Positions for Handling

- During on-shore handling, and On/Off loading of the assembly, using all three straps provides an extra measure of safety.
- On deck, the fore and aft straps are used to hold the Vehicle in place.
- During launch, only the center strap is used. This allows quick release of the assembly when the Vehicle is in the water.

5.4.3.6 Activate RDF Beacon

The Emergency Beacon has a long operating life, but generally should not be activated until near launch.

Activating the Beacon requires removal of the turtledeck.

The Emergency Beacon is enabled by removing the small magnet under the yellow tape. Remove the tape and the magnet and save in a location away from the bundled Vehicle.

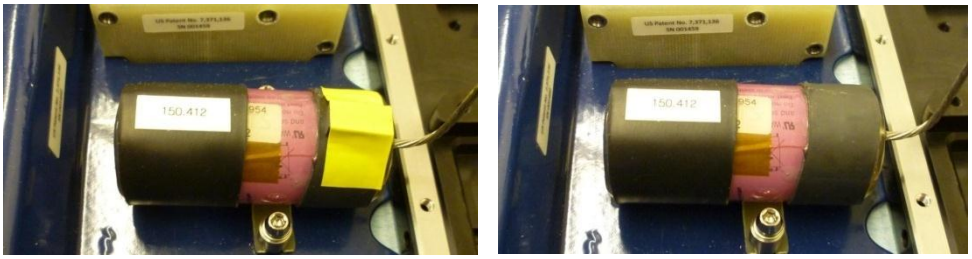

Figure 5-3: Emergency Beacon With and Without Magnet

Record the frequency number on the beacon.

We recommend that you used the RDF receiver (ref. chapter 9) to verify that the Emergency Beacon is broadcasting.

5.4.4 Vehicle Functionality

5.4.4.1 Set Default Comm Channel to IridiumAlt

To set the Wave Glider communications channel to ensure telemetry is received via Iridium follow these steps:

1) Click the "More Commands …" link in the WGMS dashboard.
2) Choose "Set Default Com Channel" in the "Command Type" dropdown list.
3) Choose "IridiumAlt Communications" in the "Com Channel" dropdown list.
4) Enter a comment in the "Command Reason" text box.
5) Click the "Send" button.

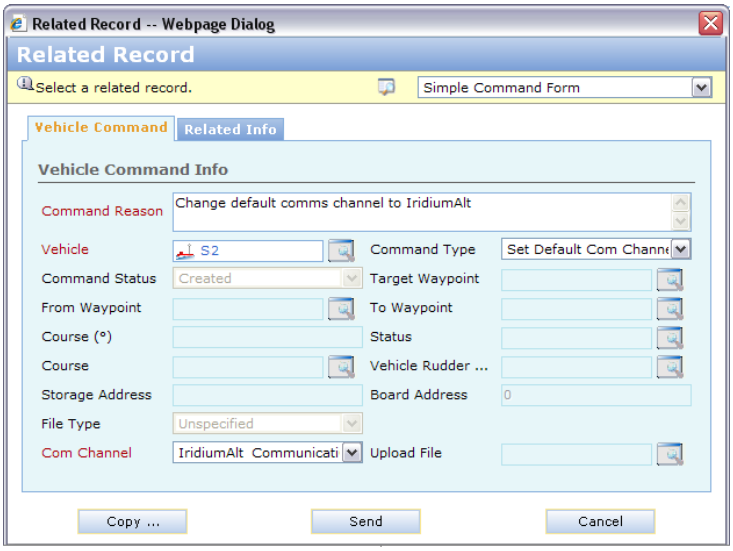

Figure 5-4: Setting IridiumAlt Default Comm Channel

5.4.4.2 Fixed Heading Test (Spin)

Command a specific heading for the Wave Glider. Rotate the bundled assembly and observe the position of the rudder on the Glider.

1) Point the Vehicle in the commanded direction. The rudder should be straight. If it slowly wiggles a small amount, that is acceptable.
2) Point the Vehicle 45° to the left of the commanded position. The back of the rudder should move to the right.
3) Point the Vehicle 45° to the right and verify that the rudder moves to the left.
4) Continue moving the Vehicle clockwise in 45° increments and verify that at each position, the rudder moves to the appropriate position.

If it is not possible to spin the vehicle, command the same heading that the sub is pointed. Ensure that the rudder centers.

5.4.4.3 Set Course Test (Spin)

Command the Vehicle to follow the defined course. The rudder should move in the direction that would put the Vehicle on course to that waypoint. Rotate the Vehicle and verify that the rudder responds correctly.

5.4.4.4 Clear Alarms

Clear any active alarms and note any abnormalities. An "Out of Bounds" alarm is the only alarm that should be active before launch.

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6. Phase 4: Launch

6.1 Introduction

Once the Pre-launch checklist has been completed, the Wave Glider is ready to be launched. This phase describes a procedure to place the Vehicle in the water from a small boat. These types of operations are often easier to perform on a small boat due to the ease of communication between boat crew and the Wave Glider operations team. Small boat operations also offer better visibility and ease of access to the Vehicle while it is in the water. Large vessel operations are not covered in this document. Please contact Liquid Robotics customer support for guidance on launching a Wave Glider from a larger platform.

Every Wave Glider support vessel is different. These procedures should be seen a set of guidelines that may need to be adapted to the features of your vessel.

6.2 Requirements

6.2.1 Time Required

Approximately 15 minutes.

6.2.2 Manpower Required

Roles:

Support Vessel Coxswain – Responsible for the safe operation of the vessel. Coordinates with the Deck Supervisor during launch.

Deck Supervisor – Responsible for coordinating the launch evolution. Ensures the readiness of both the support vessel crew and the Wave Glider operations team.

Hoist Operator – Operates the crane or hoisting equipment under the guidance of the Deck Supervisor.

Line Handler 1 – Responsible for steadying the Wave Glider as it is hoisted into the water. In addition, a line handler may operate the launch quick-release mechanism.

Line Handler 2 (optional) – According to the size of the support vessel and the prevailing sea state, a second line handler may be required to ensure a safe launching.

Depending on the size of the vessel these roles may be shared. For example the Hoist Operator and the Deck Supervisor role may be performed by the same member of the launch team.

6.2.3 Tools and Equipment

- Completed Wave Glider pre-launch checklist
- Float+Glider bundle strapped for hoisting
- Wave Glider support vessel of adequate size
- 110VAC power
- Hoisting equipment capable of lifting 1000 lbs (450 kg)
- Launch and recovery rigging gear bag

- Wave Glider topside operator station, including:
  > WGMS
  > Iridium relay
  > XBee relay
  > Communications deck box

6.3 Safety Considerations

This section is not meant to replace or supersede your own established policies and procedures. Consult with the coxswain or master of your Wave Glider support vessel before attempting to launch. LRI suggests using these guidelines to supplement your existing safety protocols:

- Safety toe shoes should be worn at all times.
- Hardhats are to be worn at all times during hoisting or crane operation.
- Hoists, cranes and other lifting equipment should only be operated by qualified personnel.
- Coast Guard approved PFD Type III work vests will be worn at all times while working on deck.
- Be alert for any signs of equipment malfunction.
- Only trained and authorized personnel should perform Wave Glider maintenance and operation.

6.4 Small Boat Launch

6.4.1 Procedure Outline

Launching a Wave Glider from a small boat has three main steps:

1) Launch preparation
2) Lifting the bundled Float+Glider into the water
3) Releasing the Vehicle

6.4.2 Launch Preparation

6.4.2.1 Moving the system onto the boat

Once the quick release launch strap and is installed the Vehicle should be moved onto the Wave Glider support vessel. The Wave Glider lifting eye is the preferred crane attachment point for this procedure.

Figure 6-1: Using Lift Eye for Crane Attachment

In addition to the launch strap, we recommend that the two other endless ratchet straps be installed before lifting.

Figure 6-2: Additional Ratchet Straps

Note that the ratchets are positioned on the sides where they do not press against the Float hull or the solar panels. Do not position the ratchets on the solar panels.

6.4.2.2 Tag Line Setup

To prevent the vehicle from swinging uncontrollably as it is hoisted into the water a minimum of one tag line should be utilized. Sea state conditions may warrant the use of two tag lines. The primary tag line should be looped around the half handle and halved. The line handler should have to hold onto both standing ends of the line to steady the Wave Glider. This allows the line to be removed by slipping one end through the handle once the vehicle is the water. Do not tie or otherwise affix the tag line to the aft handle.

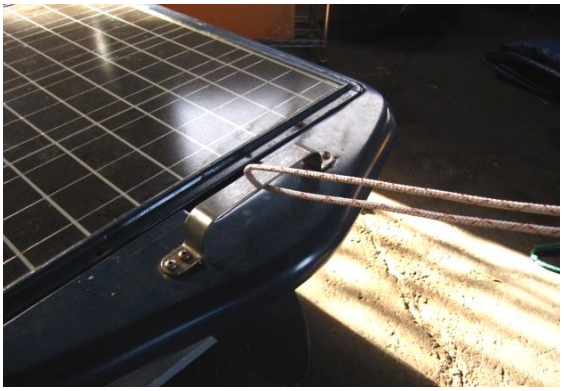

Figure 6-3: Tag Line Attached to Handle

6.4.3 Release Methodologies

6.4.3.1 Lifting Using the Launch Strap

The Wave Glider launch strap provided is not a load rated mechanism. However, it may attach directly to the boat's hoist line for lifting. By connecting the crane or hoist lift hook directly on the launch strap the launch process is simplified. One the quick release mechanism is triggered, the vehicle is immediately free to move away from the boat.

Figure 6-4: Lifting Using Release Strap

6.4.3.2 Lifting Using the Wave Glider Lift Eye

In situations where lifting from the launch strap is not advised, it is possible to employ a second quick release. This method requires additional personnel and adds the hazard of another line to tend to during launch. A second quick release is not included with the Mobile Operations Kit.

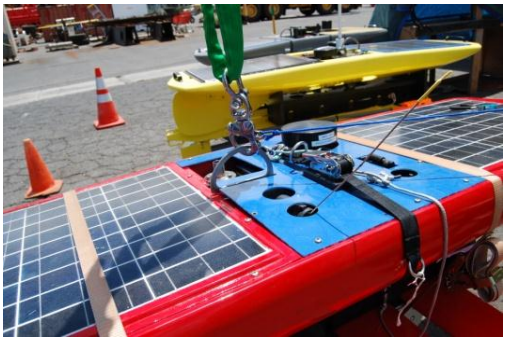

Figure 6-5: Lifting Using the Lift Eye

6.4.4 Launch Script

1) Line handler attaches taglines to vehicle handle(s).
2) Deck Supervisor provides launch point to coxswain.
3) Deck Supervisor gives OK signal indicating readiness to coxswain.
4) Once support craft is in position for launch Coxswain gives OK signal.
5) Deck supervisor/crane operator hoists bundled Wave Glider up and over the side.
6) Line handler maintains control of vehicle using the tag line and ensures the Float is pointing away from the boat.
7) Once lowered into the water the Deckhand pulls quick release(s) and recovers the saddle.
8) Line handler pulls tag line free as the vehicle moves away from the boat.
9) A comment is entered into WGMS describing the launch.
10) Vehicle is put on mission in WGMS.

7. Phase 5: Mission Monitoring and Operation

7.1 Basic Mission Tasks

The basic tasks for monitoring a mission are outlined below.

7.1.1 Operation Considerations

- Operator Role
- Coordinating With Shipboard Ops
- Pre-Launch Vehicle Checking

7.1.2 Typical Mission Operations

- Starting a Mission
- Monitoring the Launch Procedure
- Monitoring Telemetry Data
- Responses to Alarms
- Sending Commands

7.1.3 Changing a Mission

- Updating Course Waypoints
- Manual Navigation
- Recovering From Manual Navigation

7.1.4 Completing a Mission

- Coordinating With Recovery Crew
- Post-Mission Actions

For full information on mission monitoring and operation, see chapter 6 of the Wave Glider *User Manual*.

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8. Phase 6: Recovery

8.1 Introduction

Once the mission has been completed, the Wave Glider is ready to be recovered.

During the small boat recovery the Glider and the Float must be recovered separately. For recovery, a swimmer is required to enter the water.

8.1.1 Recovery Vessel Considerations

This phase describes a procedure to remove the Vehicle in the water from a small boat. These types of operations are often easier to perform on a small boat due to the ease of communication between boat crew and the Wave Glider operations team. Small boat operations also offer better visibility and ease of access to the Vehicle while it is in the water.

Large vessel operations are not covered in this document. Please contact Liquid Robotics customer support for guidance on recovering a Wave Glider from a larger platform.

Every Wave Glider support vessel is different. These procedures should be seen a set of guidelines that may need to be adapted to the features of your vessel.

8.1.2 Basic Procedure

Launching involves several steps:

1) Recovery Preparation
2) Deckhand captures Float
3) Swimmer captures Glider
4) Recover Glider
5) Recover Float
6) Secure on deck

Each of these steps is described in more detail below.

8.2 Requirements

8.2.1 Time Required

Approximately 30 minutes

8.2.2 Personnel Required

Support Vessel Coxswain – Responsible for the safe operation of the vessel. Coordinates with the Deck Supervisor during recovery.

Deck Supervisor – Responsible for coordinating the recovery evolution. Ensures the readiness of both the support vessel crew and the Wave Glider operations team.

Hoist Operator – Operates the crane or hoisting equipment under the guidance of the Deck Supervisor.

Swimmer – Responsible clipping the Glider recovery line into the Glider.

Line Handler 1 – Responsible for attaching the Float recovery line to the Float and fending it off.

Line Handler 2 (optional) – According to the size of the support vessel and the prevailing sea state, a second line handler may be required to recover the Glider.

8.2.3 Tools and Equipment

- Boat Hook with attached carabiner
- Glider recovery line
- Float recovery line
- Glider stand
- Float saddle

8.3 Safety Considerations

This section is not meant to replace or supersede your own established policies and procedures. Consult with the coxswain or master of your Wave Glider support vessel before attempting to recover. LRI suggests using these guidelines to supplement your existing safety protocols:

- Safety toe shoes should be worn at all times.
- Hardhats are to be worn at all times during hoisting or crane operation.
- Hoists, cranes and other lifting equipment should only be operated by qualified personnel.
- Coast Guard approved PFD Type III work vests will be worn at all times while working on deck.
- Be alert for any signs of equipment malfunction.
- Only trained and authorized personnel should perform Wave Glider maintenance and operation
- Follow all existing safety regulations and procedures regarding swimmer or diver operations.

8.4 Small Boat Recovery

8.4.1 Procedure Outline

The procedure to recovery Wave Glider to a small boat contains the following steps:

1) Swimmer hooks Glider recovery line to nose of Glider and re-boards vessel.
2) Glider is hoisted on board and set in stand.
3) Float is hoisted on board and set on saddle.

8.4.2 Recovery script

1) Swimmer/diver attaches Glider recovery line to the Glider

The Glider recovery line has a carabiner attached on one end. A small buoy or boat fender is attached to the standing end of the line. This buoy allows the recovery line to be retrieved after swimmer attaches the carabiner to the nose of the Glider. Once attached the swimmer returns to the support vessel. The Wave Glider continues to navigate with the Glider recovery line attached.

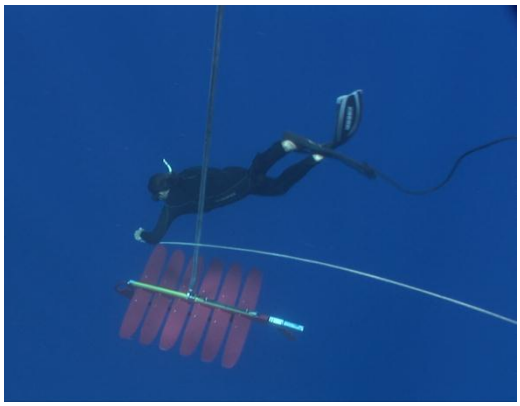

Figure 8-1: Swimmer Diving To Attach Glider Recovery Line

Figure 8-2: Recovery Line Attached To Glider Nose

2) Glider recovery line retrieved with boat hook and Glider motion is disabled

Use the supplied boat hook to the retrieve the buoy on the end of the Glider recovery line. The Glider recovery line is connected to the boat's hoist and the Glider is lifted vertically to disable the forward motion of the Vehicle.

Figure 8-3: Glider Hoisted Vertically to Disable Forward Motion

3) Float recovery line is attached to the Float lift eye with boat hook

Once the Vehicle forward motion has been disabled, the Float is free to move. To prevent damage to the vehicle, the Float recovery line is attached to the Float lift eye. An available deckhand should fend the Float off with the boat hook and maintain control with the boat hook while the Glider is being recovered.

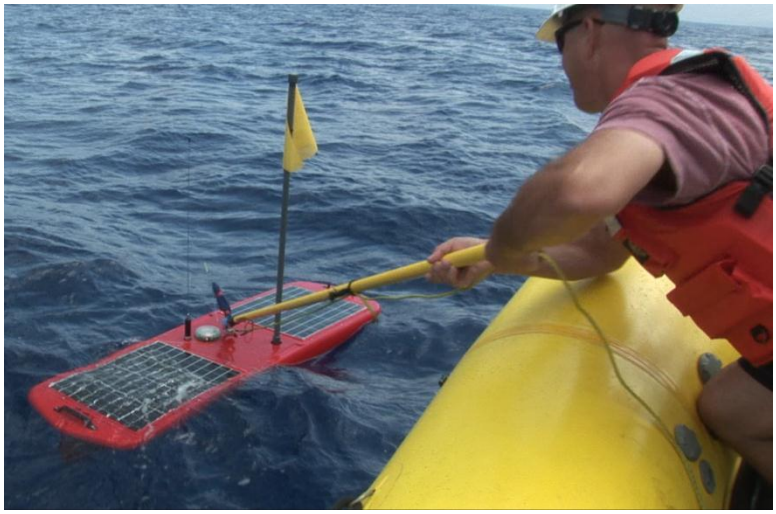

Figure 8-4: Deckhand Attaching Float Recovery Line

4) Glider hoisted on board and set on stand

Figure 8-5: Glider Hoisted On Board

5) Saddle is placed on Glider

6) Float is hoisted on board and set on Saddle

Figure 8-6: Float Being Set Down on Saddle

7) Vehicle secured to the deck for transit

8) Power shorting plug is removed

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9. Using the Emergency Locator Beacon

9.1 Overview

9.1.1 Beacon and Receiver

The Wave Glider Float contains a beacon that is continuously broadcasting a simple beeping signal on a specific radio frequency. The beacon uses its own battery, which allows location of a Vehicle even if all other electronics have failed.

Figure 9-1: Emergency Radio Beacon

Vehicle direction finding uses a radio receiver connected to an antenna with a coax cable. The receiver and antenna are shown in Figure 9-2 below.

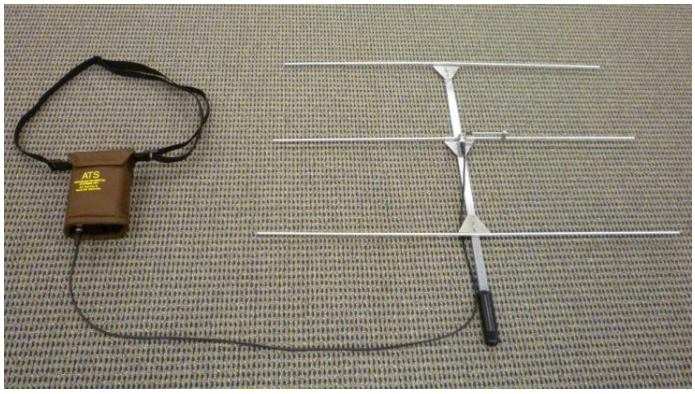

Figure 9-2: Beacon Receiver and Antenna

The receiver uses four batteries, which are provided in the Mobile Operations Kit. Refer to section 9.2.1 for information on how to install the batteries.

9.1.2 Basic Operation Principle

The Radio Beacon receiver can be tuned to the beacon frequency. The antenna is directionally sensitive, so reception is much stronger when the antenna is pointed towards the beacon.

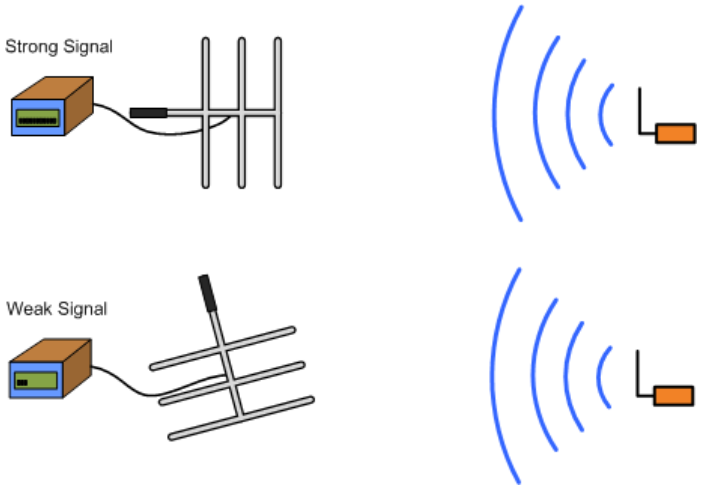

Figure 9-3: Signal Strength vs. Antenna Direction

By adjusting the sensitivity ("RF Gain") and by moving the antenna in different directions, the location of the radio beacon (and thus the Wave Glider) can be determined.

9.2 Initial Preparation

9.2.1 Adding Batteries to Beacon Receiver

The Beacon Receiver requires four AA batteries, which are supplied, but not installed. Installation is straightforward, but some points should be noted.

Two batteries are inserted in each of two compartments on the bottom of the Beacon Receiver.

Remove a cover by rotating it ¼ turn counterclockwise (use a large coin in the slot) until the slot lines up with the "O" marking. Then carefully lift off the cover.

Figure 9-4: Battery Covers on Bottom of Receiver

Figure 9-5: Removing a Battery Cover

Note: Be careful to not lose the small battery covers; they are necessary to retain the batteries.

Insert the two batteries with the negative (flat end) first. If inserted correctly, the button end of the battery should be sticking out.

Figure 9-7: Battery Compartment Cover Removed

Figure 9-6: Batteries Inserted in Compartment

Put the cover on the exposed battery, push down (hard) and rotate ¼ turn clockwise to lock.

Repeat the procedure for the other battery compartment.

Note that the covers must be turned until the slots line up with "1" markings. If the covers are not locked, the batteries will eventually fall out.

Figure 9-8: Battery Cover Positions

9.2.2 Preparing the Emergency RDF

The DF antenna unfolds by pulling out the six dipole elements. Loosen the each wing nut and rotate a pair of elements together, then tighten the wing nut. When all elements are extended, the antenna should appear as shown on the right in Figure 9-9.

Figure 9-9: Unfolding the Radio Beacon Antenna

The Radio Beacon receiver connects to the antenna using a coax cable from the back of the receiver box to the connector in the middle of the antenna.

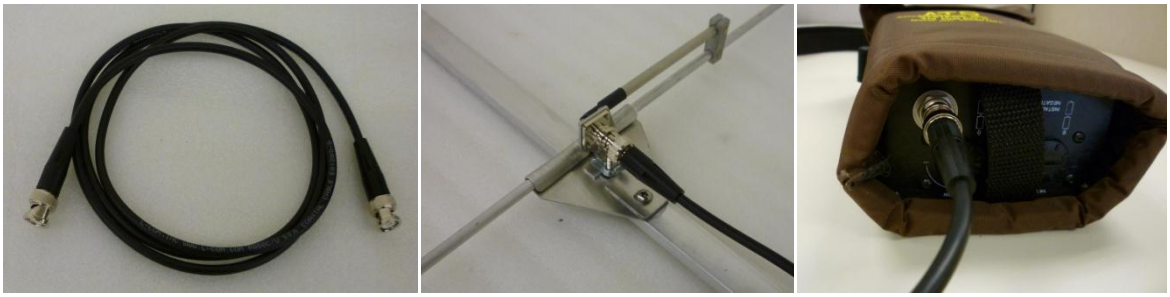

Figure 9-10: Emergency RDF Coax Connection Points

9.3 Using the Receiver

The basics of Radio Beacon Receiver operation are described below. For additional information, consult the R410 User Manual, packed in the black Support Equipment Case.

9.3.1 Receiver Front Panel

The basic features of the front (top) panel are shown in Figure 9-11 below. The figure shown is of the "Main" screen. There are other menu screens, as will be described below.

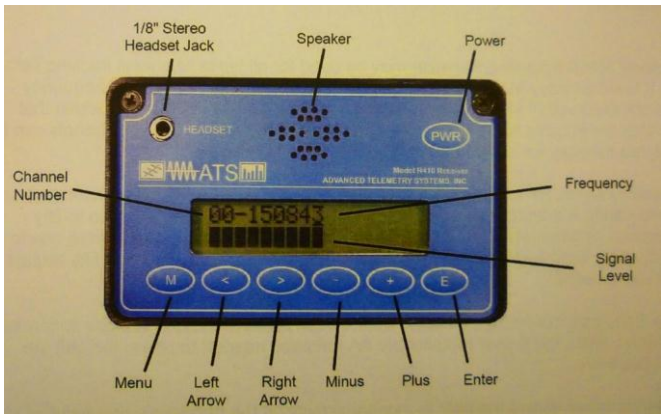

Figure 9-11: Receiver Front Panel Features

The bottom keys have the following functions:

Power: Push for 1 second to turn ON. Push for 3 seconds to turn OFF. When ON, pressing for 1 second will turn the backlight ON or OFF.

Menu: Pressing sequences through different displays to allow setting different values.

Left/Right Arrows: Moves the cursor to the left or right for setting the frequency value.

Minus/Plus: When Frequency is displayed, decrements/increments the number above the cursor. When RF Gain or Audio Level is displayed, lowers or raises the value.

Enter: Used for advanced functionality. Refer to the R410 User Manual.

Note that there is a plug-in for a stereo headset jack in addition to the speaker. A headset (not included in the kit) can be helpful if using the receiver in a noisy environment, or when searching for a faint signal.

9.3.2 Battery Condition Indicator

The four non-rechargeable batteries should provide about 18 hours of operation, depending upon usage. A flashing "LOW BAT" will show in the upper-right of the display when there is about 1 hour of life remaining. Refer to section 9.2.1 for information on replacing the batteries.

9.3.3 Using the Menu Button

Pushing the Menu ("M") button will continually sequence through the screens in the following order:

Main → RF Gain → Audio Level → Channel Scan → Setup Menu → **Main → RF Gain → . . .**

Only the first three screens need be used for direction finding. These are described below.

9.3.4 Main Screen (Frequency)

This shows the Channel Number, Frequency value and Signal Level. In the figure below, there is no beacon within range, so there is no Signal Level shown.

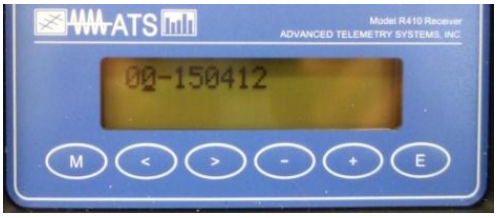

Figure 9-12: Receiver Frequency Screen

Leave the Channel Number set at **00**. The frequency value to the right is shown in kilohertz (e.g., 150412 → 150.412MHz). The frequency should already be set for your Vehicle. You can check the value against the number on the Emergency Beacon label.

9.3.5 Main Screen (Signal Level)

If a beacon at the set frequency is within range, bars indicating the Signal Level will show below the frequency, as seen in Figure 9-13.

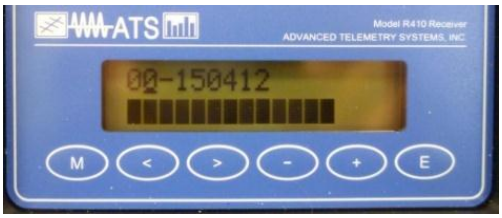

Figure 9-13: Receiver Signal Level

The Signal Level indicates the strength of the received signal. This is the primary gauge used for direction finding.

Generally, you want to adjust the RF Gain (see below) so that at strongest reception, the Signal Level bars go most of the way across the screen. If all 16 bars are showing, decrease the RF Gain value. This will provide maximum sensitivity without saturation.

Pressing the "M" (Menu) button will switch to the RF Gain screen.

9.3.6 RF Gain Screen

The RF Gain is adjusted according the strength of the signal (ref. "Signal Level", above). To increase or decrease the gain, press the "+" or "–" button.

Figure 9-14: Receiver RF Gain

Pressing the "M" button will switch to the Audio Level screen.

9.3.7 Audio Level Screen

Adjust the Audio Level so that the speaker or headset output is not uncomfortable when the received signal is strongest.

Figure 9-15: Receiver Audio Level

Use the "+" and "–" buttons to change the Audio Level

When you've check/changed the Audio level, use the "M" button until you are back to the Main (frequency) screen and check/change the Signal Level.

9.4 Frequency Scanning

The R410 allows scanning of multiple frequencies. However, this is not required for direction finding of a single beacon. For more information on this feature, consult the R410 User Manual.

9.5 Direction Finding

Using the Receiver for direction finding is straightforward, but involves an element of trial-and-error. Typically, a person's ability will improve with actual experience.

9.5.1 Basic Usage

The Emergency Beacon on the Wave Glider emits continuous "pings" about 1 second apart. These can be heard on the speaker (or headset) when the Beacon is within range. When the antenna is pointing toward the beacon, the pings will be louder and the Signal Level on the display will show more bars. The volume and signal level will diminish as the antenna is pointed away.

Hold the antenna horizontal, away from your body, and scan around slowly (several seconds for a complete circle).

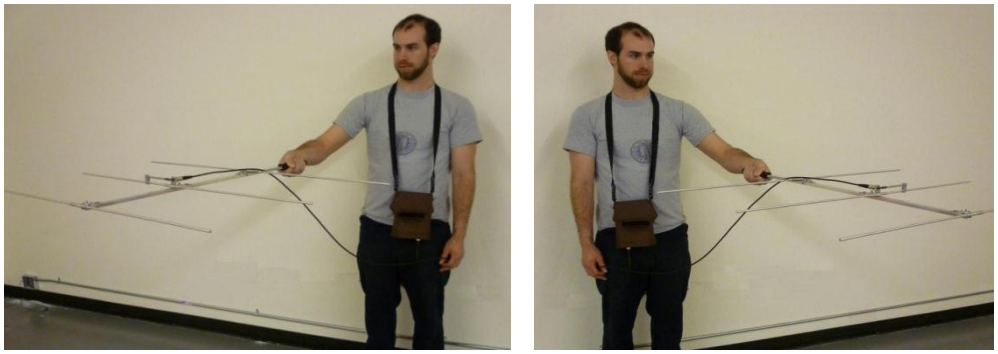

Figure 9-16: Scanning with Antenna

The signal will be strongest at two positions: 1) Antenna pointing toward beacon, and 2) Antenna pointing 180° away from the beacon. See section 9.5.2 below for how to deal with this.

For the initial search, set the RF Gain to maximum to acquire the signal. Then, adjust the gain down so that the Signal Level indicator is below the maximum when the signal is strongest. As you get closer to the Vehicle, you continually reduce the RF Gain to keep the Signal Level indicator below maximum. You probably will need to adjust the Audio Level also.

To maximize sensitivity and minimize signal distortion, you should be outside any enclosed metal structure. You should also be as far as possible from external metal structures, such as bulkheads, masts, railings and cables.

9.5.2 Searching for a Lost Wave Glider

The basic problem with direction finding is that the signal is equally as strong whether the antenna is pointing towards or away from beacon. A signal may seem slightly stronger in one direction, but other factors (such as the ship's structure) can influence signal strength.

If you are sure of the general relative position of the Wave Glider, this will not be a problem.

If you are on the water and receiving a signal, but do not know the location of the Wave Glider, The most effective approach is to use triangulation. This is done by moving at a right angle to the signal and seeing how the direction changes. This is diagrammed in Figure 9-17.

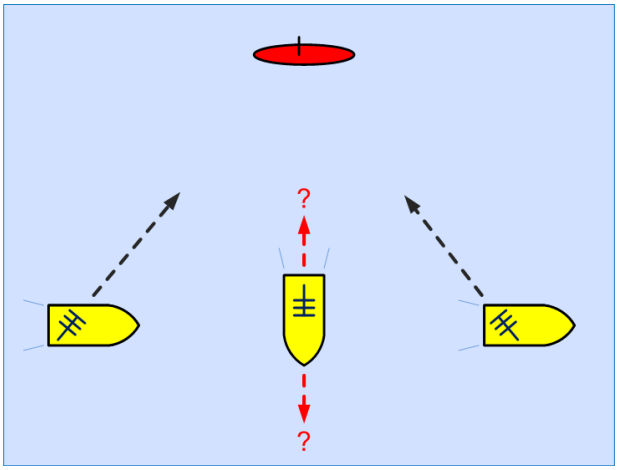

Figure 9-17: Triangulating for Location

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10. Maintenance

10.1 WGMS and Communication Procedures

10.1.1 Changing the Iridium Modems

Configuring a different Iridium modem for either the M2M Deck Box or the Wave Glider C&C Dry Box requires changes to the provisioning information at the Iridium data center as well as corresponding changes in the Vehicle information in the laptop copy of WGMS.

The Iridium modem in the Deck Box, the Iridium modem on the Wave Glider and the Wave Glider provisioning information in the laptop WGMS are pre-configured as a matched set at the LRI factory. First, the LRI Iridium service provider is notified that the two modems are to be configured for ISU-ISU operation, with the one destined for the Deck Box additionally configured for Ring Indicator/Alert. Then the IMEI of the Wave Glider's Iridium modem is entered in the WGMS vehicle information form. The IMEI of the Deck Box's Iridium modem is not recorded.

Note that the pairing of the two Iridium modems is based on their IMEI numbers, not the SIM card, if present. Swapping SIM cards between modems does not change the pairing at the Iridium Gateway. To change that pairing, you must contact your Iridium service provider.

When provisioning the modem pair, instruct your vendor that modem 1 (the one in the Wave Glider) will communicate with modem 2 (the one in the deck box) via SBD, ISU to ISU. Modem 2 must be configured with Ring Indicator / Alert enabled.

The PINs on the Iridium modems must be disabled. See the Iridium documentation for the AT commands to disable the PINs on the particular model of Iridium modem you are using.

To change the IMEI of the Wave Glider's Iridium modem, log in to WGMS and click on the vehicle icon next to the vehicle name on the dashboard. This will pop up a form showing the components of the vehicle. Search for the Iridium Modem entry under the C and C Dry Box entry. Click on that entry, popping up another form titled Part Info.

The new IMEI should be entered in the Serial Number field and the change saved. Again, note that this IMEI is for the modem installed in the Wave Glider.

Turn everything on and confirm that the new modems are talking by sending commands and checking telemetry.

Contact LRI Support for detailed assistance.

10.1.2 WGMS UI Configuration Settings for M2M

The WGMS Browser UI for use in the M2M setting is very similar to that used in other settings. In order to set up the Browser for M2M functionality, do the following from the Dashboard:

1) Click the Show System Menus link. This will bring up the buttons in the lower-left.
2) Click the **Settings** button.
3) Double-click on "Gliders". This should bring up the dialog box shown in Figure 10-1 below.

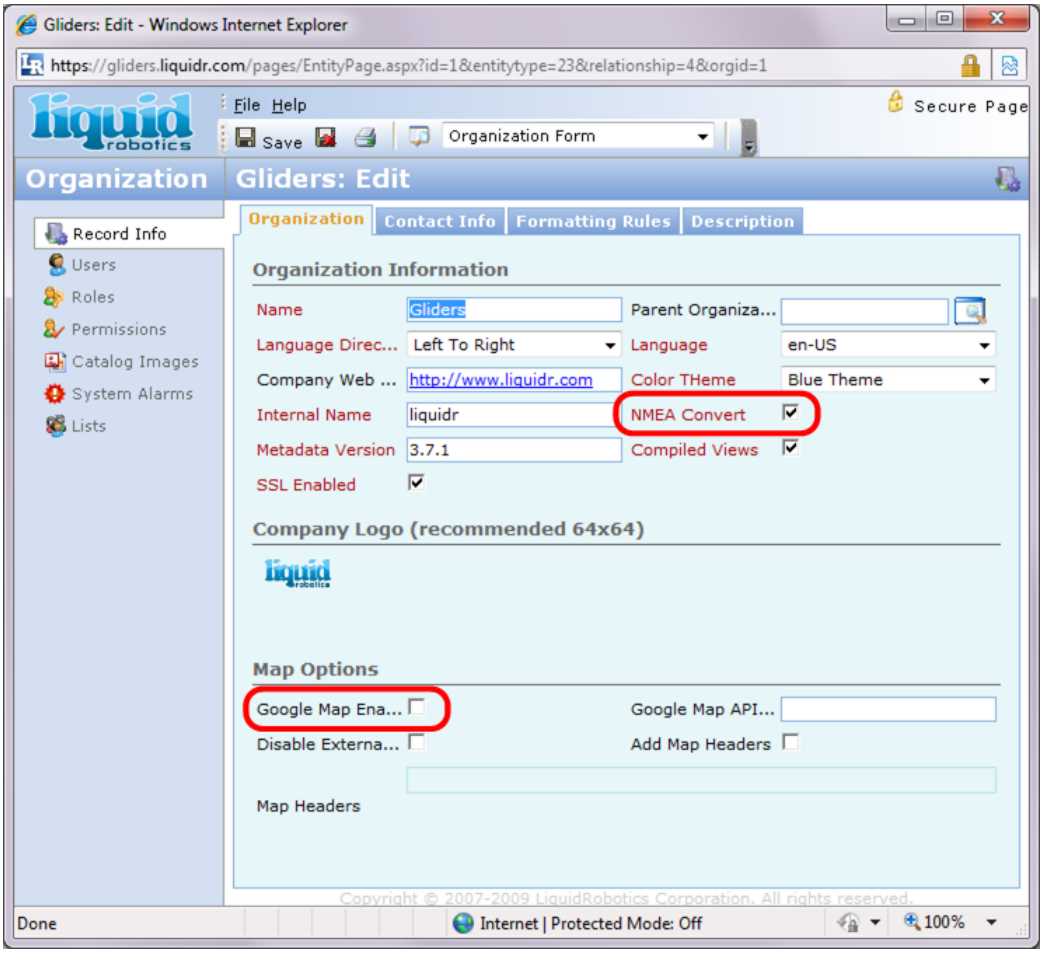

Figure 10-1: Browser Configuration Settings for M2M

4) Make sure that the "NMEA Convert" box is checked. This instructs WGMS to send Vehicle location data to Coastal Explorer.
5) Make sure that the "Google Map Enabled" box is not checked. This will prevent WGMS from attempting to load Google Maps.

10.2 Coastal Explorer Configuration

Check the Coastal Explorer documentation for details on configuration and adding waypoints. Then do the following:

1) Left click on the Coastal Explorer icon at the upper left, and choose **Options**.
2) Under "AIS", set the vessel track length to **1000** days.
3) Set the "AIS Lost Target" to **30** minutes

4) Scroll down from the "AIS Track Length" to the Safety section, and set the option for "Hide Lost Targets After" to **30** minutes.
5) Right click on the AIS contact, choose "Properties", and change the track color in the properties pane to the right of the screen. Set the "AIS Track Color" to **Blue**
6) Right click the Vessel, choose "Properties", and change the track color in the properties pane to the right of the screen. Set the "Vessel Track" to **Red**.

10.3 Vehicle Maintenance Procedures

10.3.1 Removing the Umbilical

In order to remove the Umbilical, it is necessary to release the Line Terminator disk, located below the Lift Eye.

If the Float is resting on the saddle, the procedure can be done by one person. However, it is best done by two people.

First, remove the turtledeck cover.

Hold onto the attach fitting at the bottom of the Float to prevent it from falling out. While holding onto the fitting, lift up the metal disk by using a large flat head screwdriver. The attach fitting can then be pulled out.

Figure 10-2 shows the lifting of the metal disk. Note that the disk moves up only a few millimeters.

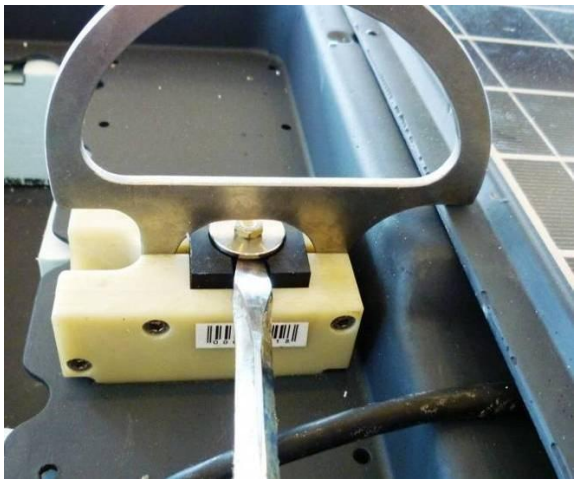

Figure 10-2: Lifting the Disk to Remove Umbilical Attach

10.3.2 Battery Charging

Liquid Robotics Inc. offers an external charger specifically designed for the Wave Glider. This allows charging or "topping-off" of the batteries before or after a mission.

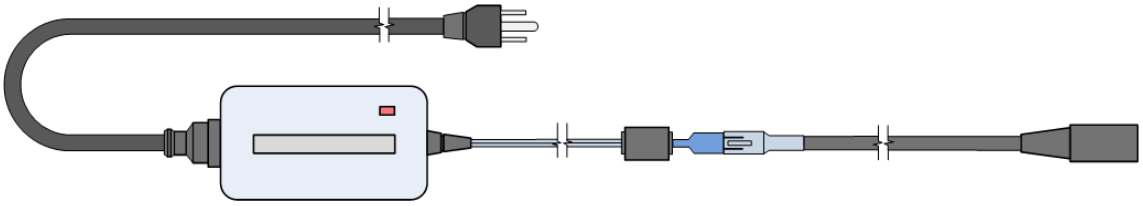

Figure 10-3: LRI-Supplied Charger

The charger can be connected to either of the C&C solar panel connectors. The time required to fully charge the batteries will depend upon the initial state of the batteries. When a single charger is used, allow 24 hours for heavily depleted batteries. There is no problem leaving the charger plugged in for periods up to 48 hours.

For faster charging, a separate charger can be connected to each of the two solar panel connectors.

10.3.3 Obtaining Replacement Parts

The hardware used in the Wave Glider has been carefully designed and selected for conservative strength margins and minimum galvanic corrosion in a salt-water environment. LRI recommends against using "off the shelf" hardware (screws, bolts, etc) on a Wave Glider.

Contact LRI if you have any questions.

10.4 Disassembling and Repacking the Wave Glider

Disassembly and repacking are essentially the reverse of the unpacking and assembly (ref. Chapter 3). The general steps are outlined below, with additional notes and cautions.

10.4.1 Float Disassembly

10.4.1.1 Umbilical Removal

- If the Umbilical has not yet been removed, refer to the procedure described in 10.3.1.
- Coil up the Umbilical as described in section 3.2.5.

Note: Proper coiling and storage of the Umbilical will be essential to the repacking of the Glider.

10.4.1.2 Remove AIS Antenna

- Using the 12 mm box end wrench, unscrew the antenna (ref. Figure 3-22).

  Note: Do not use the open end of the wrench.

- Place the antenna in the holders in the lid of the Float case (ref. Figure 3-20).

10.4.1.3 Tail Fin Removal

- Remove the four sets of screws, washers and nuts.
- Remove the fin and pack in the plastic bubble-bag (or suitable protective wrap).
- Put the hardware back in the flange (or put in a separate plastic bag).

10.4.1.4 Deactivate Emergency Beacon

Note: Deactivation should have been done following Vehicle recovery.

- Remove the turtledeck.
- Add back the magnet on the beacon (ref. 5.4.3.6).
- Replace turtledeck.

10.4.2 Float Repacking

- Remove the wheels from the case bottom (if necessary). Place two wheels in each of the four storage areas at the corners of the foam.
- Place the Tail Fin (in its plastic bubble-bag) in the center of the case bottom.
- Place the Float in the case.

  Note: Verify that the front of the Float is toward the end where the case is marked "Front".

- Strap the boat hook next to the AIS antenna in the lid (ref. Figure 2-16).
- Note the markings on the case bottom and lid, and place the lid on the case.

  Note: It is very important that the case lid be oriented correctly with respect to the case bottom. If the lid is put on "backwards", you can damage the radome and AIS antenna base.

- Close all of the latches on the case. Re-check that they are all closed.

  Note: The lid distorts when it is being latched. You may have to experiment with different latching sequences in order to get all of the latches closed.

10.4.3 Glider Disassembly and Repacking

Unlike the Float case, the Glider case has several "pockets" for placing items, and the sequence of placement is important. Thus, disassembly and repacking are done as a combined procedure.

10.4.3.1 Glider Wing Removal

- Mount the Glider on the two Glider assembly blocks (ref. Figure 3-2)
- Unscrew and remove each wing pair in sequence (ref. 3.1.2).

  Note: Be careful when removing each wing that you do not pull through the aft metal rods for each wing pair.

- Pack each wing pair in the plastics bags. Put one wing in each pocket of the plastic bag.

  Note: Make sure that the wings are in separate pockets in the plastic bag, so they will not rub against each other.

- Place each packed wing pair in a slot in the foam.

10.4.3.2 Packing Wheels

- Remove the wheels from the case bottom (if necessary). Place two wheels in each of the four storage pockets at the corners of the foam.

10.4.3.3 Stowing the Saddle and Stand

- Place the Saddle in its pocket in the bottom foam.
- Disassemble the stand and place in the slots in the foam.

10.4.3.4 Umbilical Folding

- If not already done, fold the Umbilical and secure with the rubber band (ref. 3.2.5).

  Note: The Umbilical must be folded fairly tightly in order to allow it to fit within the recess in the case top foam.

10.4.3.5 Placing the Glider Frame

- Put the Glider frame into the shaped recess in the case bottom foam.

  Note: It is important that the Umbilical be positioned carefully (ref. Figure 2-11).

- Stow the Glider assembly blocks in the shaped slots in the foam.

10.4.3.6 Closing the Case

- Note the markings on the case bottom and lid, and place the lid on the case.

  Note: The case top must be oriented correctly. If not, the recess in the top foam will not align with the folded Umbilical.

- Close all of the latches on the case. Re-check that they are all closed.

  Note: You may have to try different latching sequences to get all of the latches closed.

10.4.4 Re-Packing the Support Equipment Case

- Refer to Figure 2-1 for the packing positions in the Equipment case.

  Note: It is necessary to get most of the air out of the launch/recovery bag in order for it to fit in the case.

11. Troubleshooting

11.1 Communications Problems

11.1.1 Doesn't talk on XBee

Check that the Comm Deck Box is connected via USB to the Toughbook.

Use the Digi tool to verify that the port is still communicating (ref. section 10.1).

Check the Deck Box PAN ID on the sticker on the laptop. In the WGMS XBee relay, on the XBee tab, the PAN ID should match. If it doesn't, stop the relay, change the PAN ID, Apply the change, and Start the Relay.

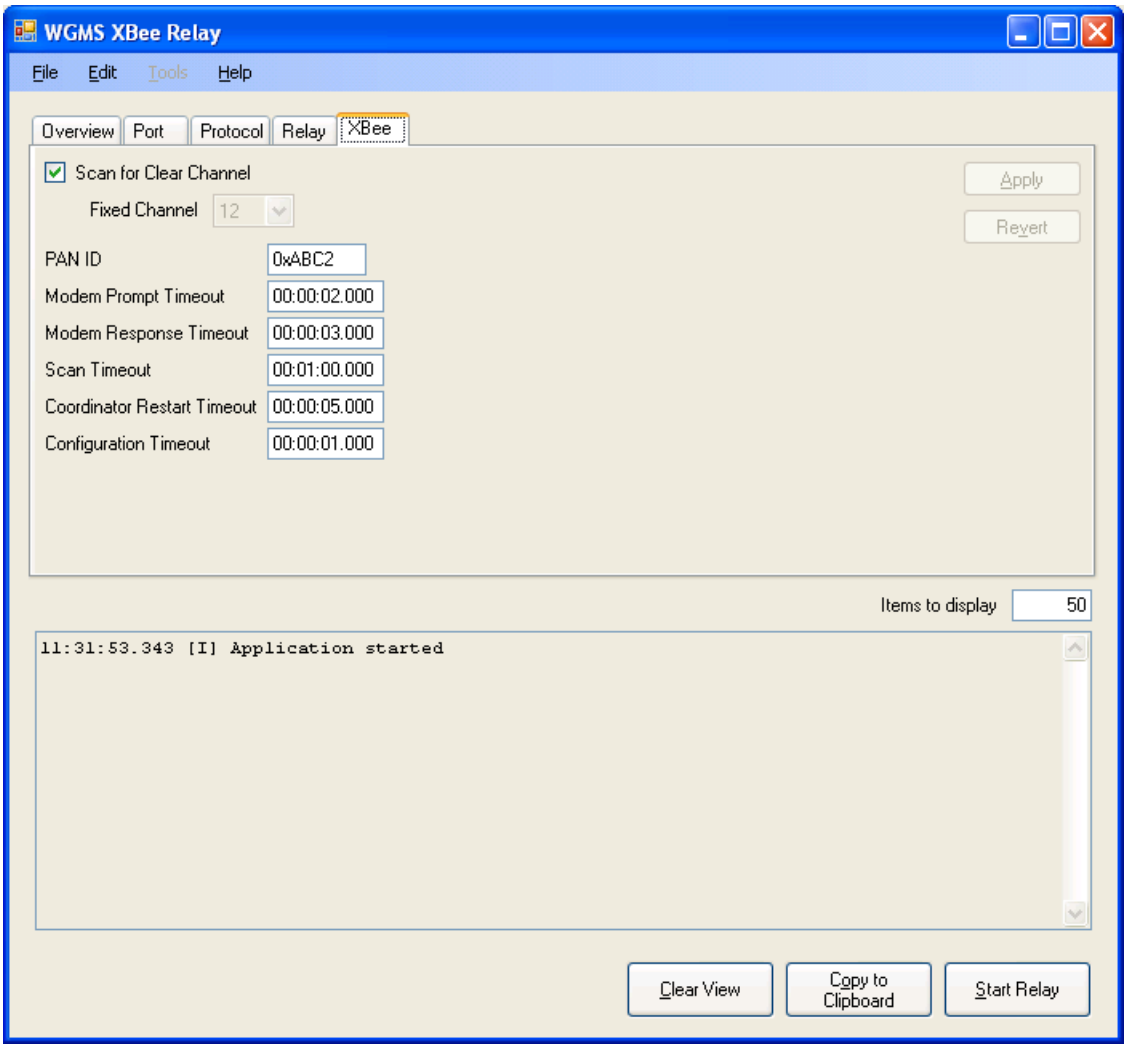

Figure 11-1: XBee Relay PAN ID Dialog

Stop both the WGMS XBee Relay and the WGMS Iridium Relay. Unplug the Deck Box from both the Toughbook and the power supply. Plug both back in. Restart both relays.

11.1.2 Doesn't talk on Iridium

- Check that the connectors on the Deck Box and computer are connected.
- Check that the light on the Deck Box power supply is on (to ensure that the Deck Box is powered).
- Check that the Toughbook, Deck Box, and Vehicle are the correct matching set. Each should be labeled with matching numbers.
- Use the Digi tool to verify that the port is still communicating (ref. section 10.1).
- Stop both the WGMS XBee Relay and the WGMS Iridium Relay. Unplug the Deck Box from both the Toughbook and the power supply. Plug both back in. Restart both relays.

11.1.3 No DF Signal

- Check that the RF Gain is set high (ref. 9.3.6)
- Check that the Volume is set high (ref. 9.3.7)

11.2 Operational Problems

11.2.1 Float or Sub Leak Alarm

A water leak was detected in the C&C Drybox or the Rudder Module.

- Check for a Float-Sub comm error alarm. If there is, immediately initiate Vehicle retrieval.
- If no other alarms, monitor. If the alarm continues for more than one hour, initiate Vehicle retrieval.

11.2.2 Float Battery Low

C&C battery capacity level is below the specified "Low Battery Power" value. This condition will trigger a longer telemetry interval in order to conserve power.

- Turn off power to the payloads and check if the alarm stops.
- Turn off lights, center the rudder and check if the alarm stops.
- If no solution, prepare for Vehicle retrieval.

11.2.3 Umbilical Fault

This alarm indicates either a broken conductor or possibly a damaged (or broken) Umbilical.

- Check the course on the telemetry to verify that the Umbilical has not broken.
- Check telemetry for an abnormal slowdown in Vehicle speed.
- Command the Vehicle to make a 90° turn and use telemetry to verify a correct response.
- If poor directional control or other alarm, prepare for Vehicle retrieval.

11.2.4 Float Pressure Low

The pressure in the C&C Drybox is below the "Float Pressure Threshold" value.

- Check the Float pressure value from telemetry.
- If the pressure value is within the OK range, re-boot and see if the alarm goes off again.
- If the pressure value is too low, monitor for a Float leak alarm.
- If low pressure or a Float leak alarm, initiate Vehicle retrieval.

11.3 Software Problems

11.3.1 Resetting the COM Port Values

11.3.1.1 Determining COM Port Assignments

On start-up, or anytime the Deck Box loses power, the Windows operating system may change the COM (serial communications) port assignments. Reconfigure them using the following procedures.

Using the Windows Start menu, start the **Digi X-CTU** tool.

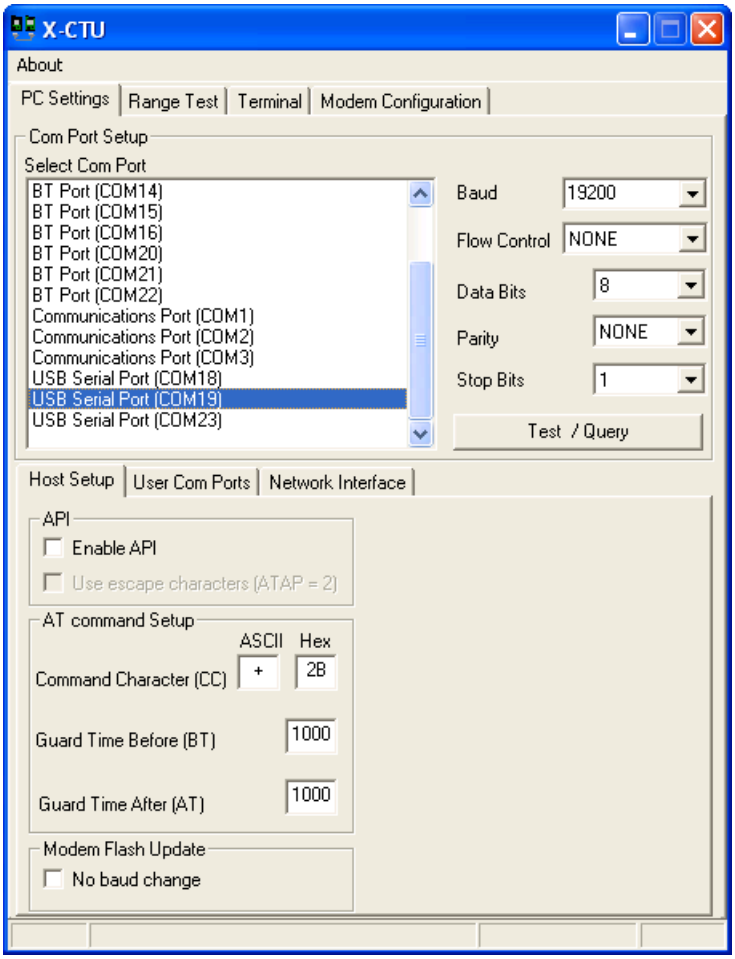

Figure 11-2: X-CTU Dialog for Setting Ports

To find the XBee Relay COM port:

1) In the "Select Com Port" box, find and select the correct port for the XBee Relay.
   > The port may be labeled as "Digi PKG-U Serial Port Adapter"
   > or, the port may be labeled "USB Serial Port" (as shown in Figure 11-2)
2) When a port has been selected, type in the baud rate value of **111111**

3) Click the **Test/Query** button on the right. If you have selected the correct port, you should see a dialog similar to:

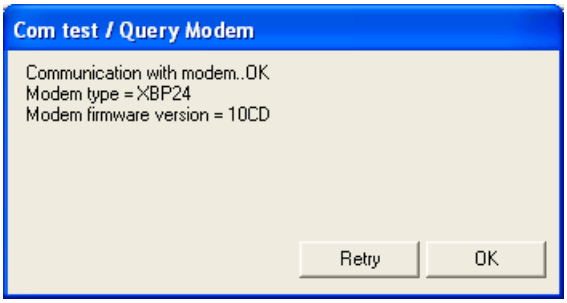

Figure 11-3: Com test / Query Modem

4) If you get a "Failed" message, select another port and try the Test/Query again. Repeat as necessary until you find the correct port.
5) When you have found the correct XBee Relay port, record the port number (COMxx).

To find the Alternate Iridium Relay port:

1) Use the **PC Settings** tab in the X-CTU tool.
2) In the "Select Com Port" box, select the port for the Iridium Modem.
   > This will be one of the ports labeled "USB Serial Port"
2) Set the baud rate to **19200**
3) Click on the **Terminal** tab.
4) Check the lights in the upper left. If CTS and DSR are both Green, this is the correct port.

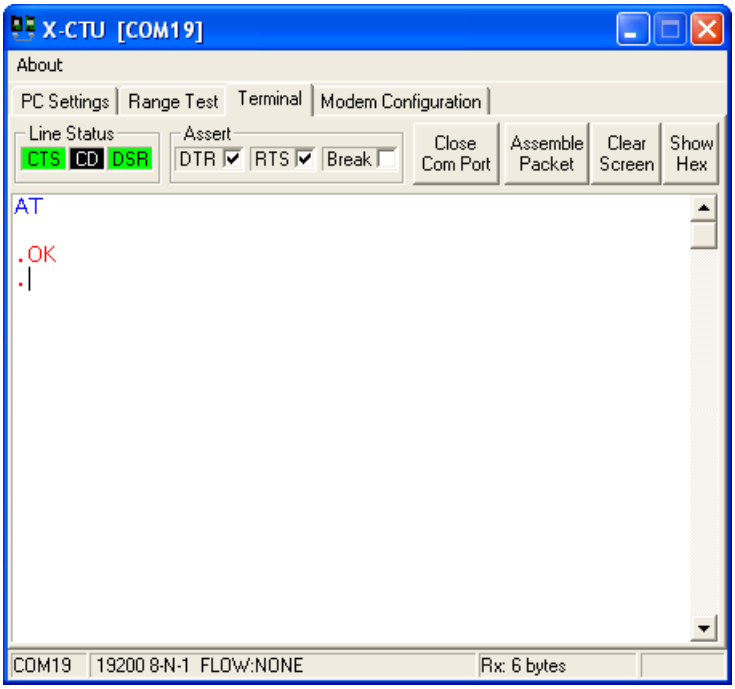

Figure 11-4: X-CTU Dialog – Terminal Tab

5) Type **AT** <enter> to check the port.
6) If you get a response (for example, as shown in Figure 11-4), the port is verified.

7) If you do not get a response, go back to the **PC Settings** tab and select another port to try.
8) When you have found the correct Iridium modem COM port, record the port number.

11.3.1.2 Setting the XBee Com Port Values

If you are not close enough for XBee communications, you will not be able to perform the steps below.

Set the XBee Relay values and start it as follows:

1) Click on the XBee Relay icon (or use Windows Start menu) to bring up the WGMS XBee Relay dialog.

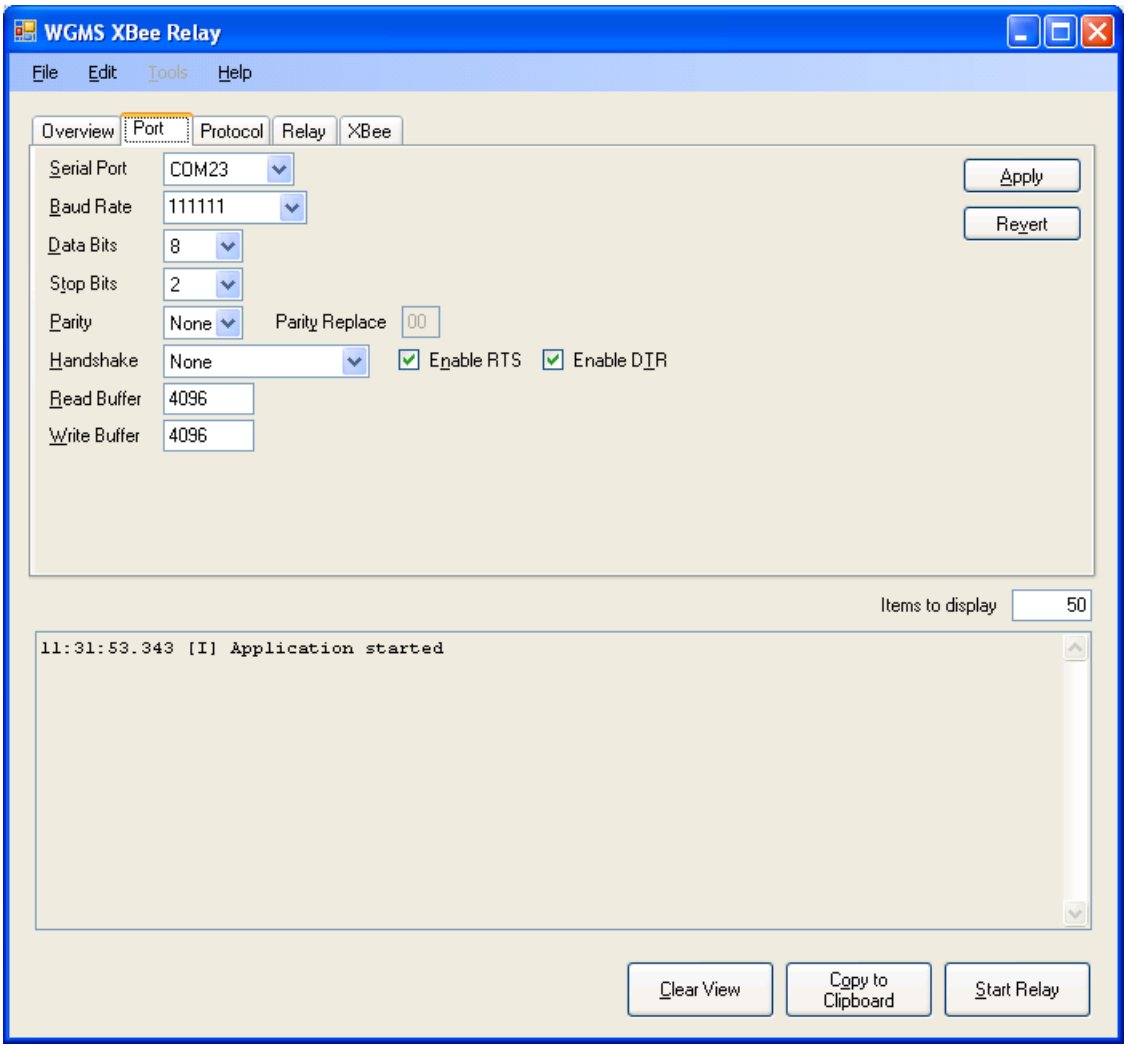

Figure 11-5: XBee Relay Dialog -- Port Tab

2) Click to select the **Port** tab.
3) Select the XBee "Serial Port" number (that you recorded earlier).
4) Click the **Apply** button at the upper-right.

11.3.1.3 Setting the Alternate Iridium Relay Port Values

Setting the Alternate Iridium Relay is similar to the XBee Relay.

1) Click on the WGMS icon (or use Windows Start menu) to bring up the WGMS Iridium Relay dialog.

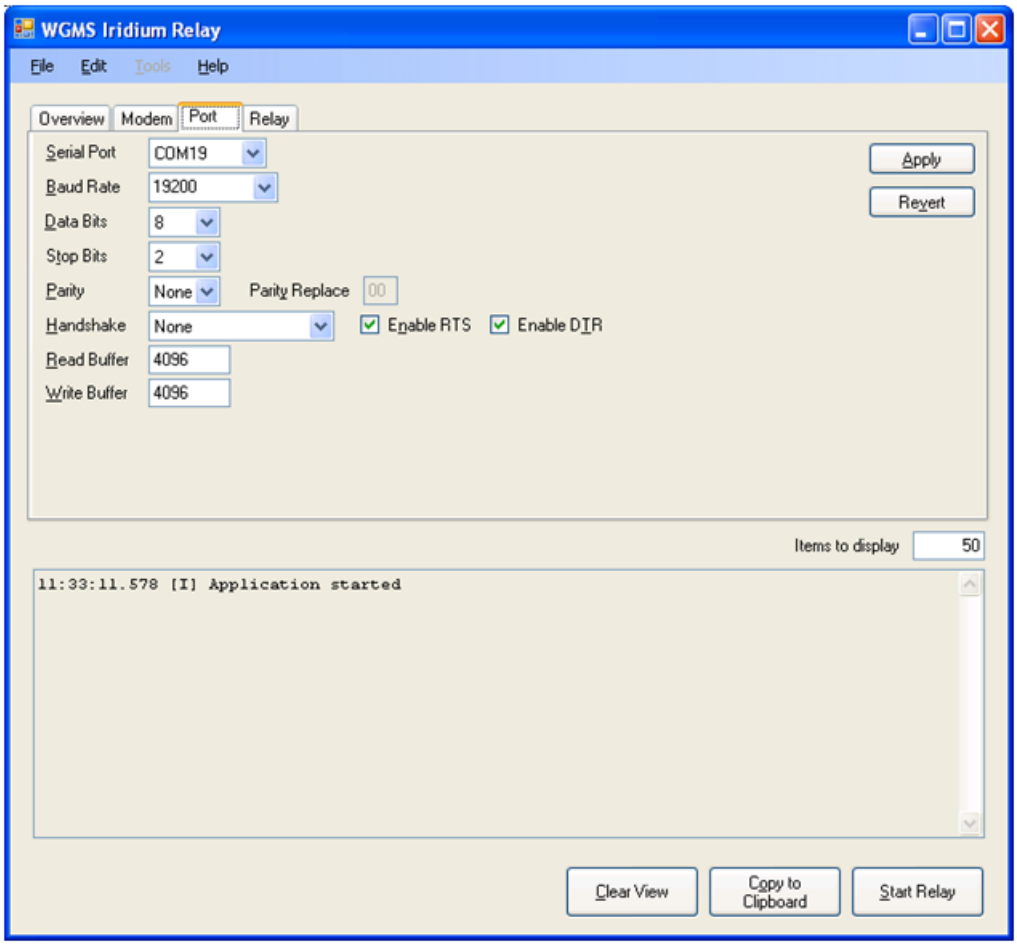

Figure 11-6: WGMS Iridium Relay Dialog – Port Tab

2) Click to select the **Port** tab.
3) Select the Alternate Iridium "Serial Port" number (that you recorded earlier).
4) Click the **Apply** button at the upper-right.

11.4 Contacting Liquid Robotics

If you cannot determine or correct the cause of a problem, please contact LRI.

To expedite resolving the problem, make a brief list beforehand with the following information.

- Time/date when problem occurred.
- Location of Vehicle when problem occurred.
- Initial indication of problem.
- Any other indications or unusual readings.
- Attempts at corrective actions and their results.

For time-critical problems, call LRI at:

(888) 574-4574 (toll free in the US)

or

+1 (650) 240-4603

For non-critical problems, please send the above information via email to:

support@liquidr.com

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Appendix A: Example Pre-launch Checklist

Wave Glider Pre-Launch Checklist			
Date/Time:		Glider Name:	
Technician Name:		Ship/Op Area:	
Mission Planning Checks			
Item/Procedure	Readings	Specifications	Initials
1.1 Waypoints created			
1.2 Waypoints to Coastal Explore			
1.3 Op polygon created/active			
Status Checks			
Power:			
2.1 Battery Wh		> 200 Wh (HI ops)	
Final Assembly Checks			
3.1 Wet-mates connected			
3.2 Connector covers installed			
3.3 Activate RDF		Note frequency	
3.4 Solar panels secure		30 in/lbs	
3.5 Turtledeck secure		30 in/lbs	
3.6 Rudder moves freely		Spins 360	
Functionality Checks			
4.1 Set/check default comms		Set to IridiumAlt	
4.2 WGMS telemetry current		Update every 5 mins	
4.3 Payload powered on		If applicable	
4.4 Fixed heading spin test		Heading	
4.5 Set course spin test		Waypoint number	
4.6 Clear alarms			

Note: Once Vehicle is launched the following tasks must be completed

1. Clear alarms
2. Put vehicle on mission
3. Create *LAUNCHED* comment into Hyperion.

Technician Signature: _____

Reviewer Signature: _____

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Appendix B: M2M Using the Internet

B.1 M2M Internet Features

The discussion in this document assumes that the system is not connected to the Internet. If an Internet connection is available, several additional features are available.

1) The Mobile-to-Mobile system can be added to a local network using an Ethernet cable or by turning on the Toughbook wireless communications (at the front right of the laptop).

2) When the Toughbook is communicating with the Wave Glider and on the network, system alarms will be sent out via the local SMTP server to accounts listed on the vehicle and system escalation lists. These are described in the Wave Glider *User Manual*.

3) Google Maps can be activated when Internet access is available: log in as an **admin**, click the sequence Show System Menus→Settings→Gliders. Click the Map options for "Google Map Enabled" and click "Save". This is described in the *System Administration Manual*.

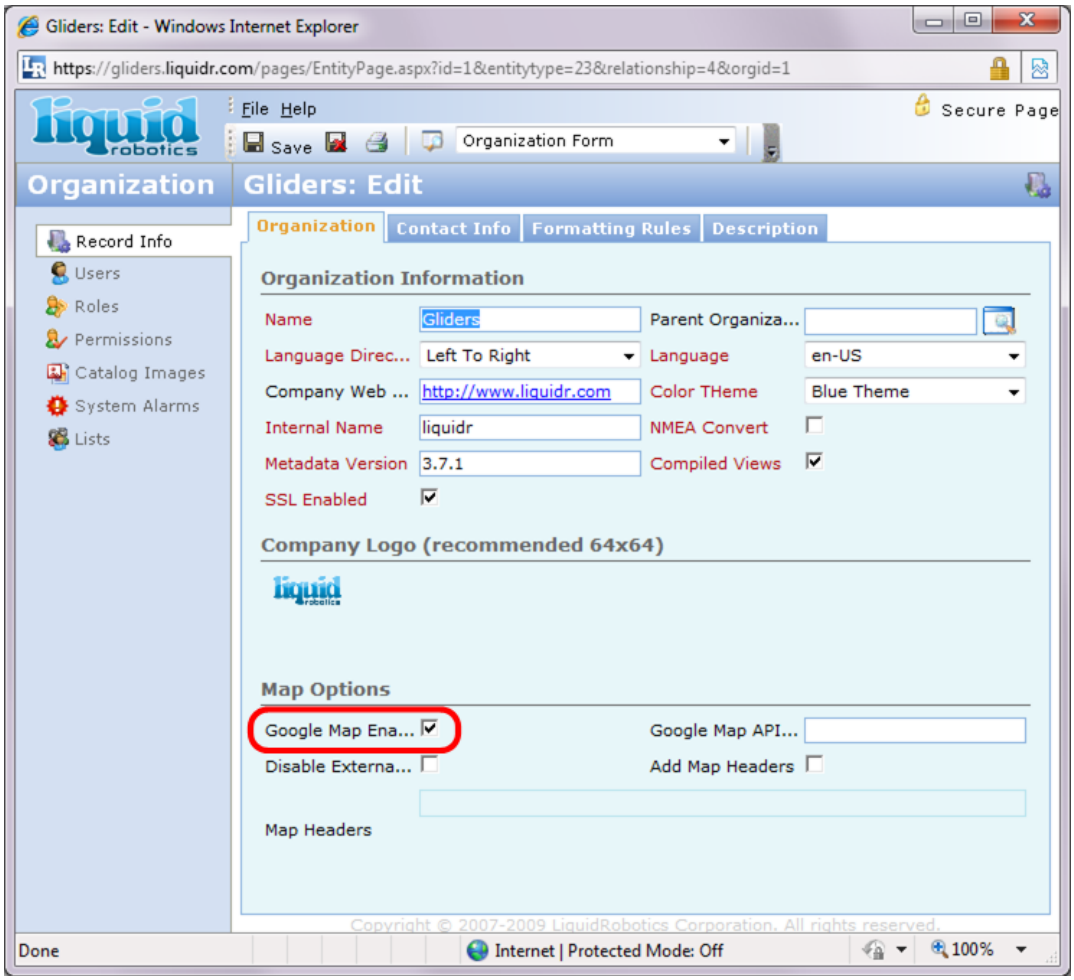

Figure 11-7: Google Map Enabled Option Selected

Note: If you leave Google Maps enabled when Internet access is not available, WGMS may issue a warning and performance may be degraded, but otherwise no harm will be done.

B.2 System Use by Others

The system may be used by other users in the same local network. For example, if the Toughbook is named "Mobile-M0", other users in the network may use IE to log in to **http://mobile-m0**. They will not have access to either the Google maps or to Coastal Explorer data. They will see an error message (below), which is normal and can be ignored.

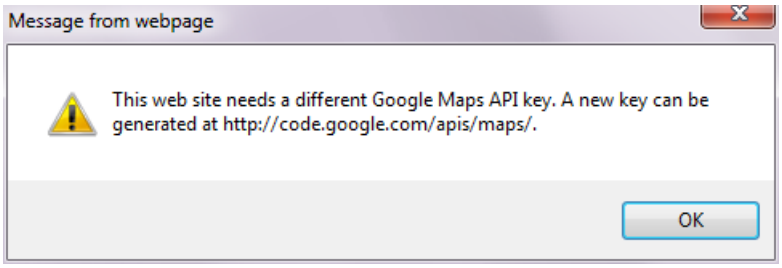

Figure 11-8: Google Maps Error Message

Appendix C: Exporting Waypoints to Coastal Explorer

1. Start Coastal Explorer

If not already done, open Coastal Explorer using the icon on the screen. Or use the Windows **Start** button.

2. Verify the Com Settings

Coastal Explorer can lose the data port settings if it has been shut down. Do the following to check/set the correct values.

1) Click **Tools → Configure Vessel and Electronics**. This should bring up the dialog:

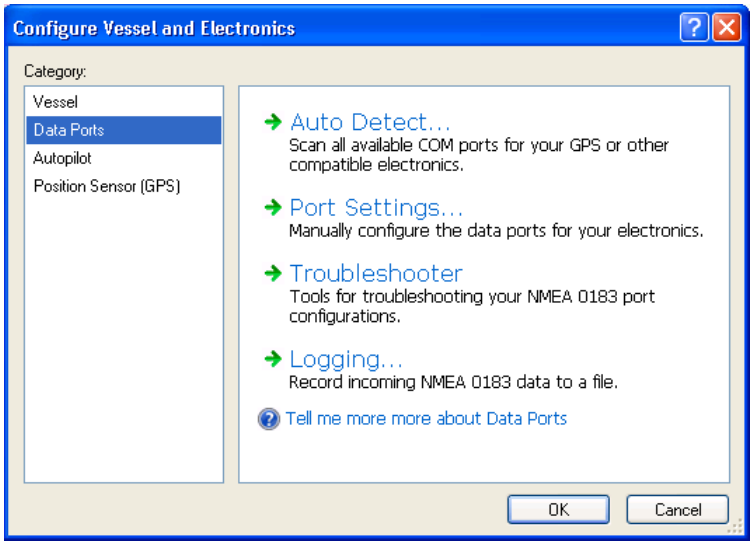

Figure 11-9: CE Configure Vessel and Electronics Dialog

2) Select the **Data Ports** category
3) Click on **Port Settings**.

That should bring up the dialog:

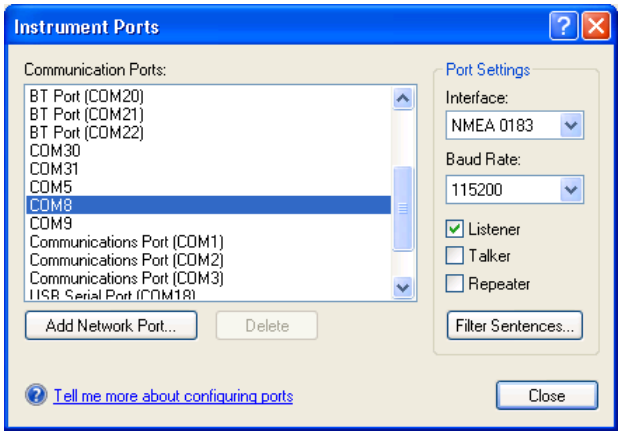

Figure 11-10: CE Instrument Ports Dialog

4) In the "Communications Ports" box, select **COM8**
5) In the "Interface" box, select **NMEA0183**

6) Select the "Baud Rate" of **115200**
7) Click the **Close** button.

3. Import Waypoints into Coastal Explorer

To import Waypoints from WGMS, do the following steps:

1) From the Coastal Explorer main screen, open the **File** menu and select **Import**.
   That should bring up the dialog:

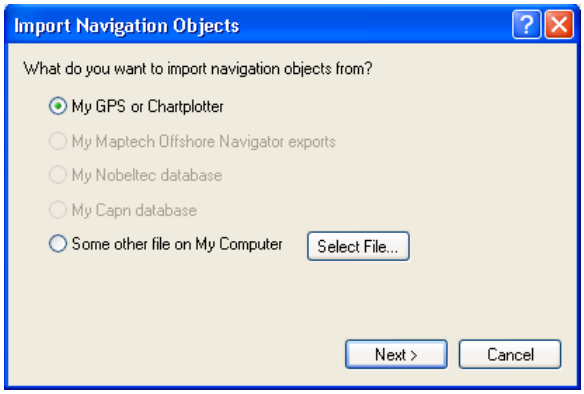

Figure 11-11: CE Import Navigation Objects Location Dialog

2) Select **My GPS or Chartplotter**
3) Click the **Next** button.
   That should bring up the dialog:

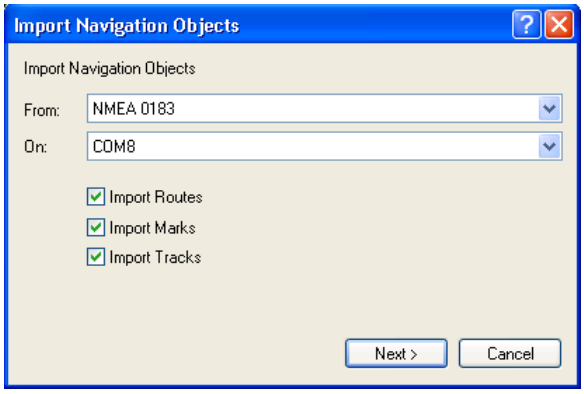

Figure 11-12: CE Import Nav Objects Interface/Port Dialog

4) Select the following settings:
   From: **NMEA 0183**
   On: **COM8**
   Check to select all three boxes (**Import Routes**, **Import Marks**, **Import Tracks**)

5) Click the **Next** button. That should bring up the confirmation dialog:

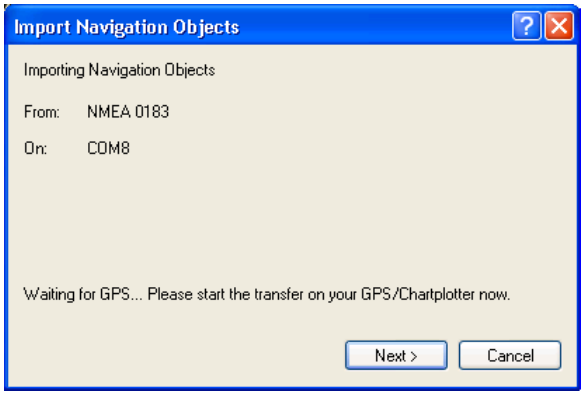

Figure 11-13: CE Import Nav Objects Confirmation Dialog

At this point, Coastal Explorer is waiting for you to send it the Waypoints.

4. Transfer the Waypoints

You now need to go into WGMS to send the Waypoints.

1) Start up WGMS, if it is not already running.
2) Double-click on the icon next to the Vehicle name to bring up the Vehicle page.
3) Click on "Waypoints" in the left margin to bring up a list of the defined Waypoints for the Vehicle.

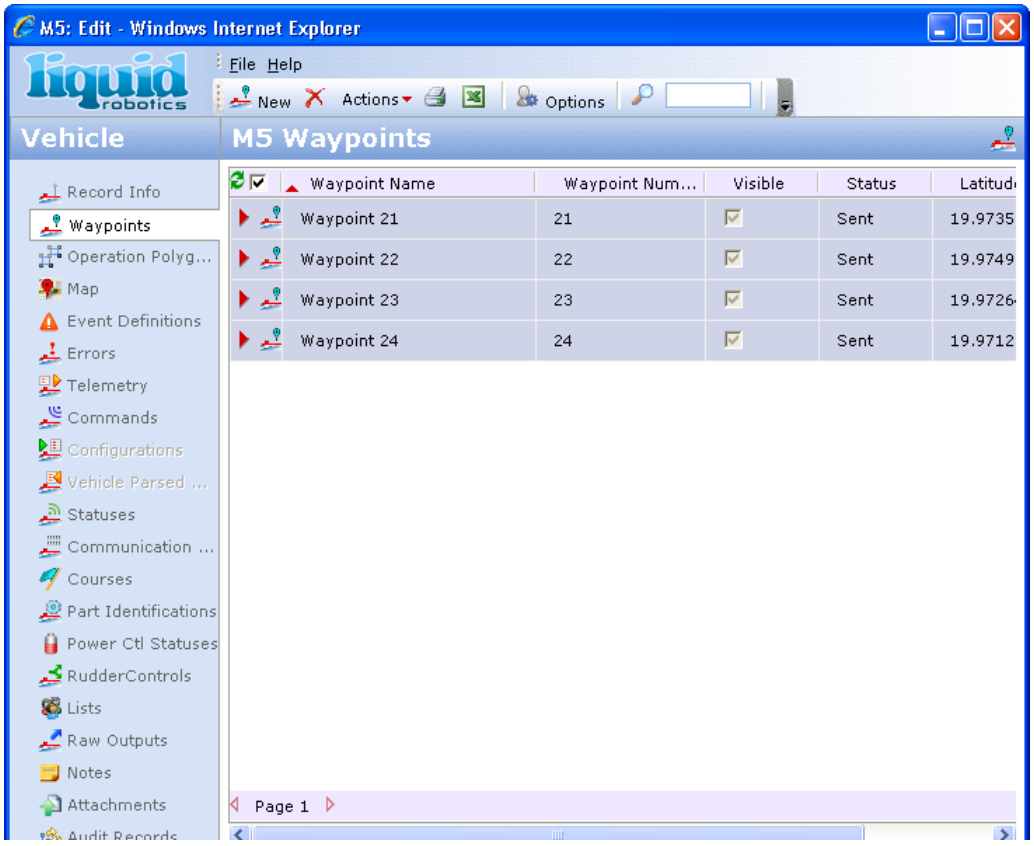

Figure 11-14: WGMS Vehicle Waypoints Listing

4) Highlight the Waypoints you want to transfer, by either
   > Using Ctrl-Click on the Waypoint name
   > Clicking the checkbox at the upper left to select all Waypoints on the page. (This can only select only up to 20 waypoints at a time)
5) Click the **Actions** button at the top, then select **Convert waypoints to NMEA strings**

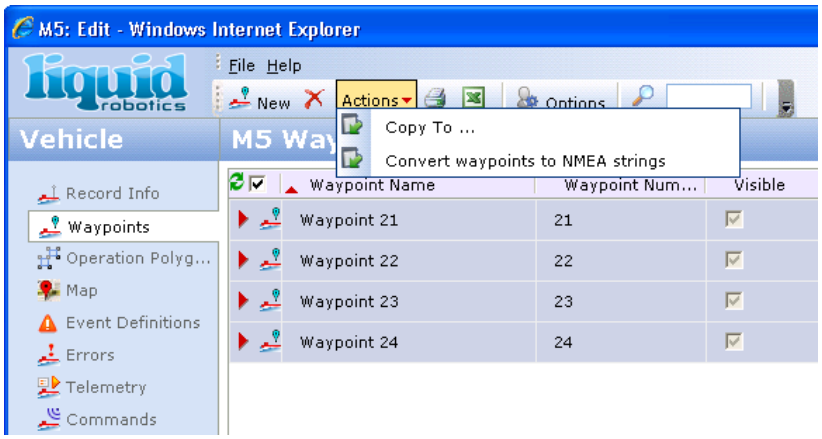

Figure 11-15: WGMS Convert Waypoints to NMEA Strings

6) WGMS will ask for verification:

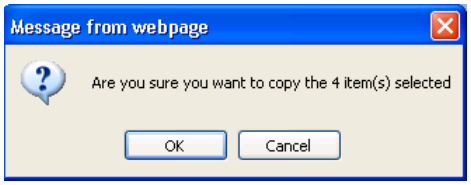

Figure 11-16: WGMS Conversion Confirmation Request

7) Click the **OK** button. This should bring up the notice:

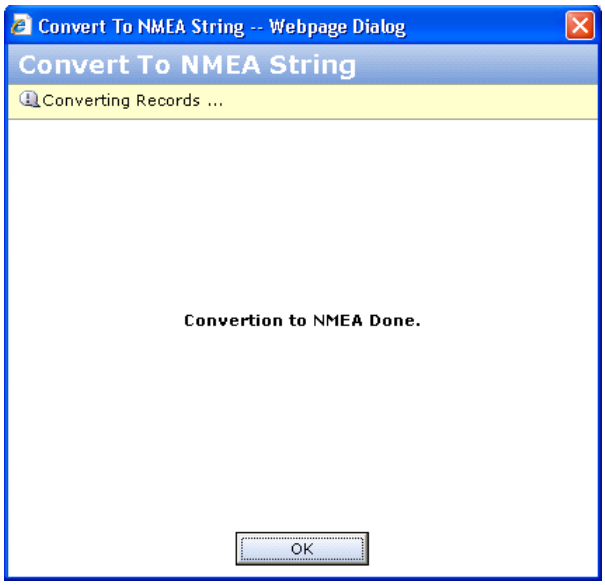

Figure 11-17: WGMS Conversion Done Confirmation

8) Click the **OK** button.

5. Check the Waypoints in Coastal Explorer

To check that the Waypoints were transferred successfully, return to Coastal Explorer.

1) Wait **2** minutes. You should then see a confirmation message that the waypoints have been imported ("Imported 4 marks").

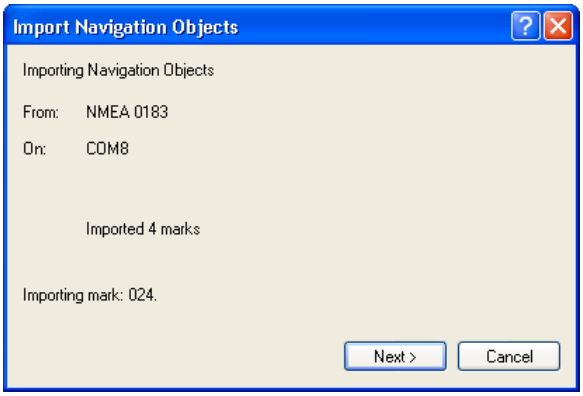

Figure 11-18: CE Import Navigation Objects Confirmation

2) Click the **NEXT** button. This will bring up the main Coastal Explorer screen:

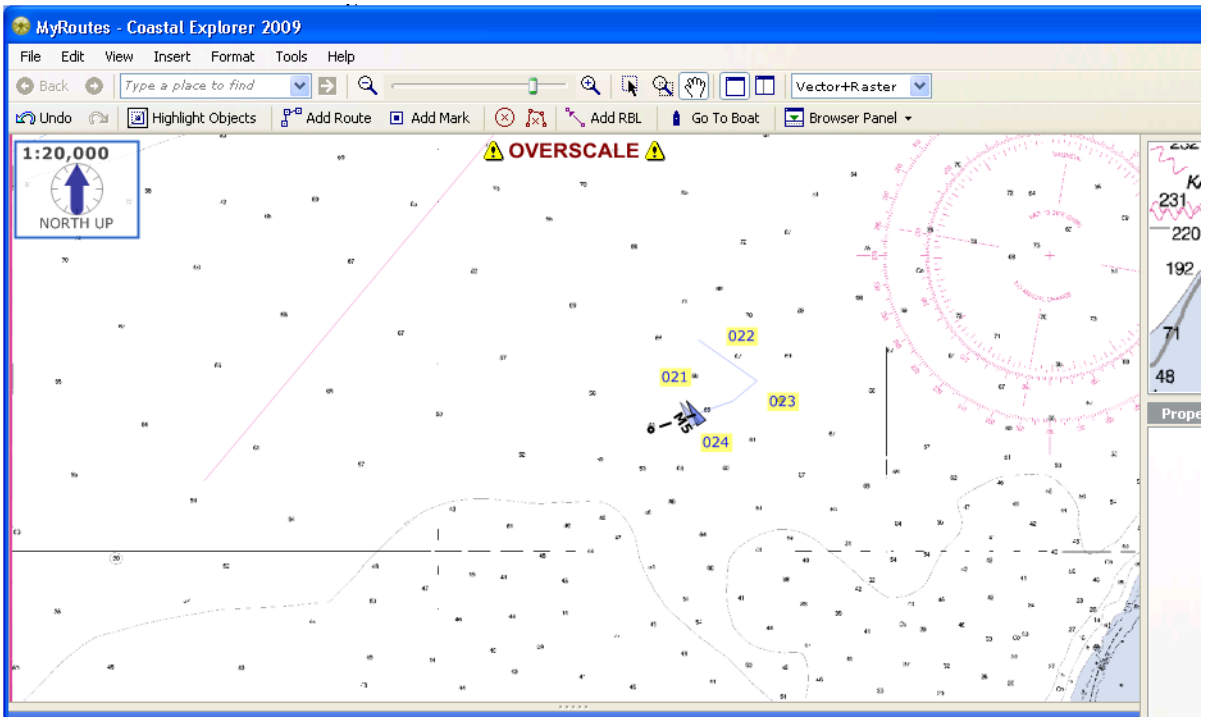

Figure 11-19: Coastal Explorer Screen with New Waypoints

Note: you may have to zoom in close to see the location of the Waypoints.

You can find and look at Waypoints using the following procedure:

1) From the top menu bar, select **View→Browser Panel→Navigation Objects**

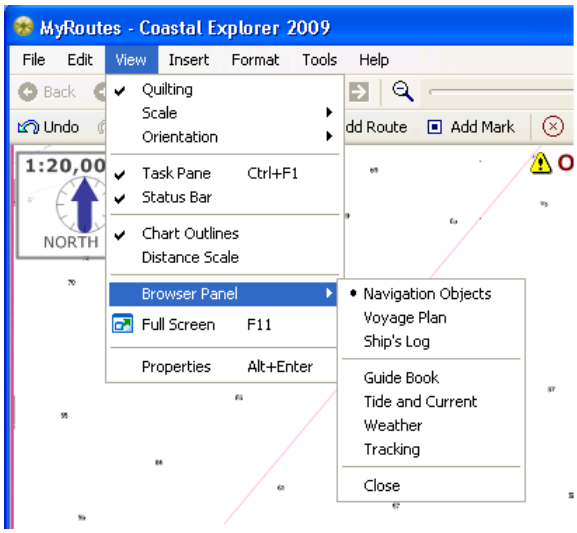

Figure 11-20: CE Selecting Navigation Objects

2) In the "Navigation Objects" browser at the bottom, click on the **Waypoints** tab on the left.

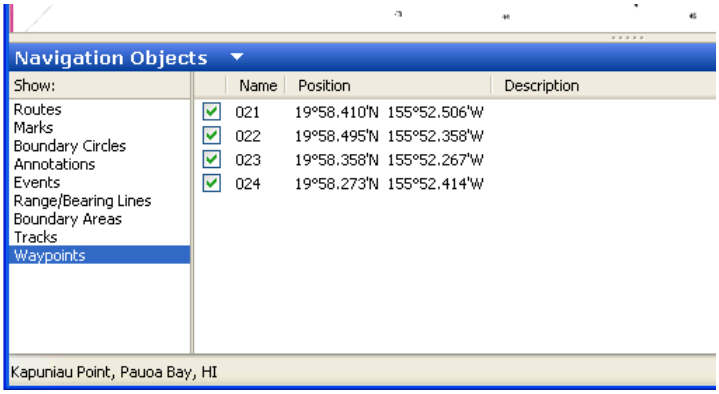

Figure 11-21: CE Navigation Objects Selection

3) Double click on a Waypoint name to center it in the view.
4) Zoom in (You must zoom in close) to see the mark.

6. Import Any Additional Waypoints

You can repeat the above procedure to import additional Waypoints.

However, to import more waypoints you will need to close and then reopen the Vehicle window in WGMS. If you do not close and then re-open, the selected Waypoints will not be sent.