Papahānaumokuākea Marine National Monument

RESEARCH Permit Application

NOTE: ***This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).***

ADDITIONAL IMPORTANT INFORMATION:

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.

- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.

- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED

Send Permit Applications to:
Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
nwhipermit@noaa.gov
PHONE: (808) 397-2660 FAX: (808) 397-2662

<u>SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.</u>

Papahānaumokuākea Marine National Monument
Permit Application Cover Sheet

This Permit Application Cover Sheet is intended to provide summary information and status to the public on permit applications for activities proposed to be conducted in the Papahānaumokuākea Marine National Monument. While a permit application has been received, it has not been fully reviewed nor approved by the Monument Management Board to date. The Monument permit process also ensures that all environmental reviews are conducted prior to the issuance of a Monument permit.

Summary Information

Applicant Name: Vas Podorean
Affiliation: Liquid Robotics, Inc., www.liquidr.com

Permit Category: Research
Proposed Activity Dates: 9/1/2013 - 9/1/2018 (5 years)
Proposed Method of Entry (Vessel/Plane): Wave Glider (surface vehicle, wave powered unmanned autonomous marine robot); Unclassified per United States Coast Guard
Proposed Locations: 23.445 N 162.279 W (23°26'42" N 162°16'43" W), Last known position of National Data Buoy Center (NOAA/NDBC) Station 51001; aka "Northwestern Hawaii One", see attached Exhibit A.

Estimated number of individuals (including Applicant) to be covered under this permit: Two (2) persons (Vas Podorean; Hawaii Operations Manager & Keith Kreider; Vice President of Operations).

Estimated number of days in the Monument: 0 days

Description of proposed activities: (complete these sentences):

a.) The proposed activity would…

Using our Wave Glider (SV2 - METOC model, see attached Exhibit B) surface vehicle we will gather weather observations, meteorology and ocean current data by employing the use of wave and water sensors to measure waves (height, direction, period and spectrum), water temperature, current depth & vector, dissolved oxygen and salinity. The Wave Glider will capture and transmit above noted data in real time via our 24 hour / 7 days a week Wave Glider Operations Center. The Wave Glider will gather and transmit data to our Operations Center every 5 minutes for the duration of the mission. The Liquid Robotics Operations Center is in 24 hour/ 7 day a week "eyes on" contact with the vehicle for risk aversion, status alarms and troubleshooting (as needed).

b.) To accomplish this activity we would ….

Using our Wave Glider we would transit into the Monument from the North of the proposed op area from location: 24.321 N 162.058 W (24°19'15" N 162°3'30" W, aka NOAA/NDBC Station 51101 "Northwestern Hawaii Two") & hold station at 23.445 N 162.279 W (23°26'42" N 162°16'43" W, aka NOAA/NDBC Station 51001 "Northwestern Hawaii One"). The Wave Glider will hold station for an extended period of time (within the scope of the permit) to monitor meteorology and ocean current data in similar fashion to a fixed/moored buoy. The Wave Glider will gather data using the following list of integrated sensors, see links and attached exhibits for associated data sheets.

c.) This activity would help the Monument by …
Gathering valuable ocean & weather data with zero environmental impact on the Monument. The data gathered on this mission will be shared with the academic community including NOAA/NDBC, NOAA/PMEL, NOAA/PacIOOS, NOAA Fisheries, University of Hawaii and others for oceanographic research purposes. The mission will also support and help validate the monitoring of marine sanctuary and marine monuments by a Wave Glider with no human presence required thus minimizing the impact on the subject sanctuary or monument.

Other information or background:
See attached Exhibits:

Exhibit A: Proposed Op Area & Transit
Exhibit B: SV2 Wave Glider Spec Sheet. http://liquidr.com/resources/downloads.html
Exhibit C: Airmar PB200WX Weather Station - Weather information (air temperature, wind speed & direction, and barometric pressure).
www.airmartechnology.com/uploads/brochures/PB200.pdf
Exhibit D: Teledyne RDI Acoustic Doppler Current Profiler (ADCP) - Measurement of ocean currents at the surface and in bins to the sensor's maximum depth:
www.rdinstruments.com/sen.aspx
Exhibit E: Datawell MOSE-G GPS-based Directional Wave Sensor - Wave height, direction, period and spectrum. http://download.datawell.nl/documentation/datawell_brochure_mose-g1000_b-17-03.pdf
Exhibit F: MSDS Li-ion Batteries
Exhibit G: Vemco Tracker - VR2 receiver-transmitter increases understanding about schooling cohesion and inter-species association(www.vemco.com).
Exhibit H: Vas Podorean, Resume/CV
Exhibit I: National Marine Sanctuary Permit #MULTI-2012-004

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Podorean, Grey, V. "Vas"

Title: Hawaii Operations Manager, Liquid Robotics Inc.

1a. Intended field Principal Investigator (See instructions for more information):
Grey "Vas" Podorean

2. Mailing address (street/P.O. box, city, state, country, zip): [redacted]

Phone: [redacted]

Fax: NA

Email: [redacted]

For students, major professor's name, telephone and email address:

3. Affiliation (institution/agency/organization directly related to the proposed project):
Liquid Robotics, Inc.
NOAA/NDBC

4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):
Keith Kreider: VP of Operations

Section B: Project Information

5a. Project location(s):

		Ocean Based	
☒ Nihoa Island	☐ Land-based	☐ Shallow water	☒ Deep water
☐ Necker Island (Mokumanamana)	☐ Land-based	☐ Shallow water	☐ Deep water
☐ French Frigate Shoals	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Gardner Pinnacles	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Maro Reef			
☐ Laysan Island	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Lisianski Island, Neva Shoal	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Pearl and Hermes Atoll	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Midway Atoll	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Kure Atoll	☐ Land-based	☐ Shallow water	☐ Deep water
☐ Other			

☐ Remaining ashore on any island or atoll (with the exception of Midway & Kure Atolls and Field Camp staff on other islands/atolls) between sunset and sunrise.

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:
Approximately 40 nautical miles NW of Nihoa Island (23.445 N 162.279 W (23°26'42" N 162°16'43" W), Last known position of National Data Buoy Center (NDBC) Station 51001; aka "Northwestern Hawaii One". Water depth: approximately 11,400 ft., see attached Exhibit A.

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

☐ Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource
☐ Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
☐ Anchoring a vessel
☐ Deserting a vessel aground, at anchor, or adrift
☐ Discharging or depositing any material or matter into the Monument
☐ Touching coral, living or dead
☐ Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
☐ Attracting any living Monument resource
☐ Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
☐ Subsistence fishing (State waters only)
☐ Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6. Purpose/Need/Scope ***State purpose of proposed activities:***
Gather weather observations, meteorology and ocean current data using the Wave Glider. To supplement the current NOAA/NDBC buoy fleet on mission to provide reliable weather & ocean current observations & data.

*Considering the purpose of the proposed activities, do you intend to film / photograph federally protected species? Yes ☐ No ☒

For a list of terrestrial species protected under the Endangered Species Act visit:
http://www.fws.gov/endangered/
For a list of marine species protected under the Endangered Species Act visit:
http://www.nmfs.noaa.gov/pr/species/esa/
For information about species protected under the Marine Mammal Protection Act visit:
http://www.nmfs.noaa.gov/pr/laws/mmpa/

7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:

The Findings are as follows:

a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?
Papahanaumokuakea is a wahi pana, and Liquid Robotics understands the need for our company to demonstrate cultural sensitivity, protocol and knowledge if we are granted the opportunity to navigate a Wave Glider in this sacred realm of the akua, na aumakua and ke kupuna. In addition to consulting with NOAA and The Office of Hawaiian Affairs "Papahanaumokuakea management team" with respect to The Native Hawaiian Plan, we will also seek guidance from cultural practitioners, including those with ancestral kuleana to Papahanaumokuakea to help us design a Wave Glider program that is pono through our on-going community outreach. We hope to work with cultural practitioners within the monument to insure protocols are respected and adhered to.

The Wave Glider is a surface vehicle that is a wave powered, unmanned autonomous marine robot capable of operating solely on wave and solar power. Liquid Robotics is currently permitted to operate within the National Marine Sanctuary System including the Hawaiian Islands Humpback Whale National Marine Sanctuary (see attached Exhibit H: Permit #MULTI-2012-004) and have been operating there in good standing and in close coordination with the Hawaii Island Programs Coordinator (Justin Viezbicke).
The Wave Glider will not approach or come in contact with any land, shallow or deep water reef structures as the proposed operational location is in approximately 11,400 ft of water,

approximately 40 nautical miles North West of Nihoa Island. All sensors onboard are non-invasive and are all commonly used, industry standard oceanographic sensors as provided in the attached exhibits. The Wave Glider does not carry any hazardous materials with the exception of the contents of the sealed Lithium ion batteries (MSDS attached, Exhibit F) that are used to store the energy harnessed from the onboard solar panels. The Wave Glider discharges no effluents or environmental releases of any kind (closed systems). Our Wave Gliders have traveled more than 300,000 nautical miles and are a proven platform.

This activity will be the first of its kind in the Monument and every effort will be made to safeguard the cultural, natural and historic resouces of the Monument. LRI is committed to expanding our understanding of our natural resouces to better aid in resource management, cultural resources, traditional ecological knowledge (TEK) & education. It is in this vein that LRI is expanding it's ability to give back to the people of Hawaiʻi through the creation of community-based social and economic development projects including STEM educational programs & training, community outreach and volunteerism. We are in the exploratory stage of discovering what these programs will look like through outreach with community leaders and organizations to receive their vision(s) and manaʻo - views and feelings regarding STEM education in Hawai'i, specifically in Kohala and the County of Hawaiʻi.
These discussions include the development of a formal LRI STEM educational/training outreach program at Kawaihae Harbor in relation to mālama ʻāina – caring for the land, creating culturally appropriate opportunities for community and social economic development and self-sufficiency. The sharing of data collected in the Monument with our community collaborators and partners will support both LRI's goal and community initiatives for advancing STEM in the County of Hawaiʻi and within our State.

A partial list of our community outreach, including collaborations include: National Oceanic Atmosphere Administration (NOAA), Hawaiian Islands Humpback Whale National Marine Sanctuary, South Kohala Conservation Action Plan, Na Kālai Waʻa, The Kawaihae Canoe Club, The Nature Conservancy, Kailapa Community Association (Kawaihae Hawaiian Homestead), Ala Kahakai National Historic Trail, Puʻukoholā Heiau, National Historic Site, West Hawaiʻi Explorations Academy and Kanu O ka 'Āina Charter School.

Thus far, common goals that have been identified among all levels of community include fish species inventory, invasive species monitoring, coral monitoring and water quality management. We believe this effort aligns with the safeguarding of cultural, natural and historic resources in the Monument and the State of Hawai'i as a whole.

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects? The Wave Gliders presence is the Monument will be a passive one. It will not interact with nor approach any of the Monuments resources both cultural and environmental. The Liquid Robotics Operations Center has 24/7 eyes on the vehicle via Iridium satellite connection

monitoring progress, risk aversion and troubleshooting (as needed). There will be little to no cumulative negative effect as a result of the proposed mission.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.
The proposed operational area within the Monument is due to the fact that the subject nonoperational buoy (Station 51001) is located within the Monument. There is no current technology that harnesses wave & solar power for propulsion and communications respectively and applies them in a form such as the Wave Glider. The goal of the activity is to augment the weather, meteorological & wave data typically provided by the NOAA/NDBC buoy fleet with data collected by the Wave Glider.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?
The zero impact nature of the Wave Glider presence and data acquisition weighs heavily in the favor of the use of the platform for any number of missions. One of those missions includes the strategic review of monitoring capabilities aiding in the protection of the Monument. The activity will cause no adverse impacts on the Monument's resources.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.
The proposed duration of the project will be 5 years as permitted under a muli-year permit. The operation area is greater than 3 nautical miles from land.

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
Liquid Robotics has ongoing operations w/NDBC and others in Hawaiian, Federal and International waters and is currently providing data to the NOAA/NDBC data portal; specifically Liquid Robotics has demonstrated its buoy application w/Tsunami detection and real time weather reporting. P.O.C. @ NDBC - Helmut Portman/Director. To maximize the utility of the application, Liquid Robotics is also supporting the PACIOOs group in their efforts to characterize ocean current data. P.O.C @ PACIOOS - Chris Ostrander/Director. To provide additional value to the information Liquid Robotics is also working with the Environmental Science Research Lab (ESRL) to investigate the ability to assimilate the information into ocean atmospheric coupled models for weather and long term climate prediction. P.O.C. @ ESRL - Alexander McDonald/Director.
Liquid Robotics Inc. is a pioneer in design, manufacturing and operation of wave powered unmanned autonomous marine robots. We currently employ a team of engineers, field technicians, scientists, programmers and sales staff totaling 112 people. We have been operating Wave Gliders and other marine engineering & oceanographic equipment in Hawaiian waters since 2007. We have a marine engineering testing & evaluation facility located in Kawaihae, HI and has conducted thousands of marine operations missions in Hawaiian waters and around the globe. Some of our Guinness World Records include: Longest distance traveled by an autonomous vehicle (9,000 miles). Throughout this journey, the Wave Glider navigated along a prescribed route under autonomous control collecting and transmitting unprecedented amounts of

high-resolution ocean data never before available over these vast distances or timeframes. Please see attached link for White Papers & Case Studies completed based on previous Wave Glider projects. http://liquidr.com/resources/downloads.html

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.
Liquid Robotics®, a leading provider of autonomous ocean robots and high value ocean data services, on March 19, 2013 LRI announced that it has closed a $45 million Series E funding round led by Riverwood Capital, a growth-focused technology private equity firm, with participation from existing investors, including VantagePoint Capital Partners. The funding will be used to expand the Company's global sales, partner, and services organizations to meet the increasing demand for its ocean observation & monitoring services. See link, http://liquidr.com/news_events/press/2013/2013-03-19-series-e-funding.html

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.
The activity will include a transit from the North side of the Monument boundary, minimizing the time and distance in transit to the proposed operational area. The Wave Gliders presence in the Monument will not result in any negative impact on the Monument.

i. Has your vessel been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?
No, we are technically "Unclassified" per the Code of Federal Regulations via the United States Coast Guard thus would be exempt from the above noted requirement. The Wave Glider does have an integral Iridium satellite connection as well as an independent NAL Iridium Shout Tracker (in the event of total system power loss), two independent systems that track and maintain constant contact with the Wave Glider.

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.
The Wave Glider is a proven ocean going data collection platform as supported in all available literature. The Wave Glider has traveled over 300,000 miles through five hurricanes and three cyclones. The platform's rugged performance makes it an ideal tool to collect valuable ocean data while leaving no ecological or cultural footprint as a result of its presence in the Monument.

8. Procedures/Methods:
As noted, the Wave Glider will transit to the proposed op area, hold station for the maximum allowable time as outlined by the permit. It will hold station collecting data then transit out of the Monument following proposed deployment. While the Wave Glider is deployed in the Monument, no maintenance will be required. The Wave Glider is a robust ocean going platform that can remain at sea for long periods of time (6-12 months) without operator intervetion or maintenance. In the unlikely event that maintenance is required during the proposed

deployment, the Wave Glider will be piloted out of Monument waters to be repaired or recovered as needed. A more detailed operational plan can be made available upon request.

NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding, as a customized application will be needed. For more information, contact the Monument office on the first page of this application.

9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):

Common name:
NA

Scientific name:
NA

& size of specimens:
NA

Collection location:
NA

☐ Whole Organism ☐ Partial Organism

9b. What will be done with the specimens after the project has ended?
NA

9c. Will the organisms be kept alive after collection? ☐ Yes ☐ No
NA

• General site/location for collections:
NA

• Is it an open or closed system? ☐ Open ☒ Closed
NA

• Is there an outfall? ☐ Yes ☒ No
NA

• Will these organisms be housed with other organisms? If so, what are the other organisms?
NA

• Will organisms be released?

NA

10. If applicable, how will the collected samples or specimens be transported out of the Monument?
NA

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:
Coordination and logistics for data sharing and collaborative activities with proposed partners is currently ongoing. Wave & meteorological data will be transmitted to NOAA/NDBC Data Center in real time for display on NDBC website via proprietary web-based interface. Project is intended to supplement the NDBC buoy database until the non-operational buoy can be replaced. Current data (ADCP) will require some limited processing by LRI prior to transmitting to proposed partners, data will also be transmitted via proprietary web-based interface or via File Transfer Protocol (FTP) or direct download. This ocean current data will be used by potential partners to verify/update existing current models for the subject operational area & transit areas.

12a. List all specialized gear and materials to be used in this activity:
The Wave Glider would be considered specialized gear and equipment. Please refer to the spec sheets attached for Wave Glider product and integrated sensor spec/data sheets.

12b. List all Hazardous Materials you propose to take to and use within the Monument:
Sealed Lithium Ion batteries (see attached MSDS). No discharge of materials of any kind is expected.

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:
NA

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:
All data will be transmitted to Liquid Robotics Operations Center in real time. Coordination and logistics for data sharing with proposed partners is currently ongoing. Wave & meteorological data will be transmitted to NOAA/NDBC Data Center in real time for display on NDBC website via proprietary web-based interface. Current data (ADCP) will require some limited processing by LRI prior to transmitting to proposed partners; time line for delivery to proposed partners is expected in 2-4 weeks following acquisition of said data and will also be transmitted via proprietary web-based interface. Additional methods of data sharing may include File Transfer Protocol (FTP) or direct download from recovered sensors.

15. List all Applicants' publications directly related to the proposed project:

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as "confidential" prior to posting the application.

Signature _____ Date 5/30/13

SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE BELOW:

Papahānaumokuākea Marine National Monument Permit Coordinator
6600 Kalaniana'ole Hwy. # 300
Honolulu, HI 96825
FAX: (808) 397-2662

DID YOU INCLUDE THESE?

- ☒ Applicant CV/Resume/Biography
- ☒ Intended field Principal Investigator CV/Resume/Biography
- ☒ Electronic and Hard Copy of Application with Signature
- ☐ Statement of information you wish to be kept confidential
- ☒ Material Safety Data Sheets for Hazardous Materials

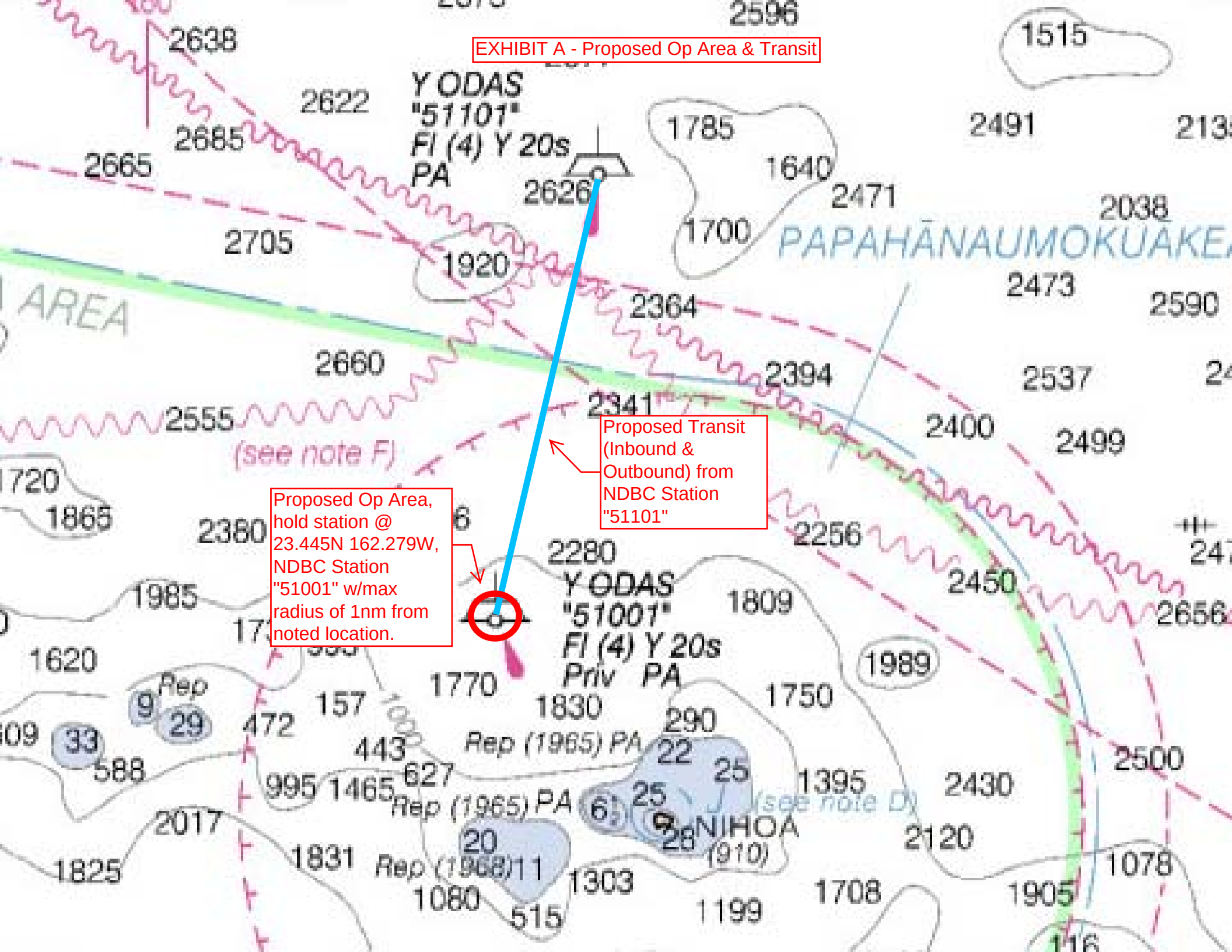


EXHIBIT A - Proposed Op Area & Transit
Y ODAS
"51101"
Fl (4) Y 20s
PA
Proposed Transit (Inbound & Outbound) from NDBC Station "51101"
Proposed Op Area, hold station @ 23.445N 162.279W, NDBC Station "51001" w/max radius of 1nm from noted location.
Y ODAS
"51001"
Fl (4) Y 20s
Priv PA
PAPAHĀNAUMOKUAKEA
AREA
(see note F)
(see note D)
NIHOA
(910)
Rep (1965) PA
Rep (1968)
Rep

EXHIBIT B

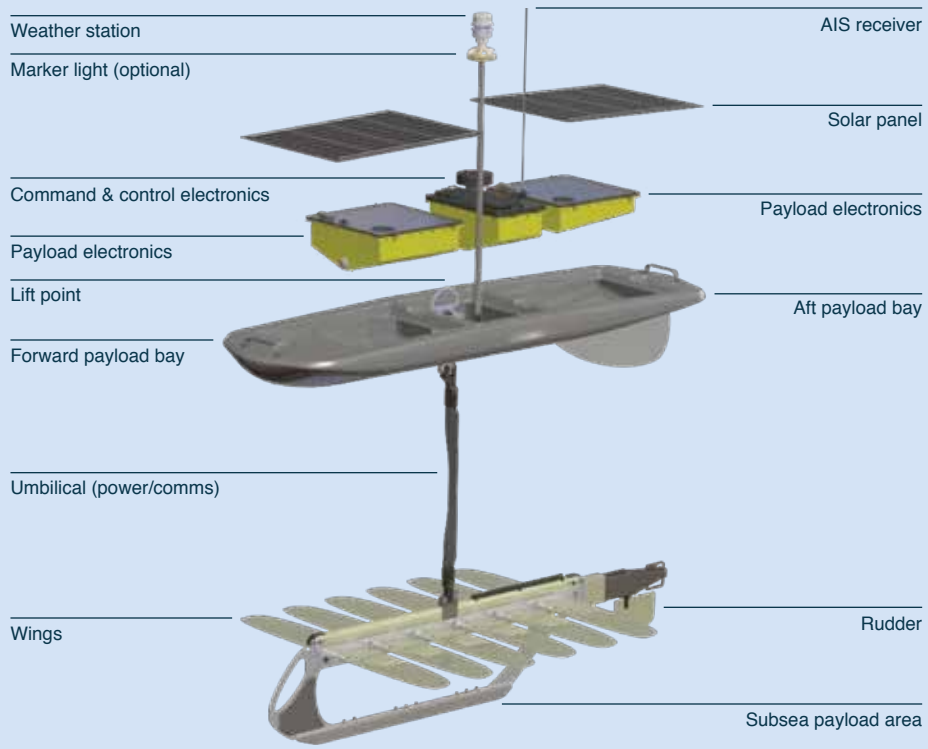
Liquid Robotics
Product Specifications

Wave Glider® SV2

Wave Glider SV2

Proven
With over 200 Wave Glider SV2s produced, five hurricanes and three cyclones survived, and over 300,000 nautical miles under its belt, the SV2 platform's rugged performance has brought the revolutionary Wave Glider technology to bear on the success of over 100 customer missions to date.

Optimized
The Wave Glider SV2 is optimized for individual or small group deployments carrying preconfigured suites of sensors for specific science and security missions. With enough power to support a broad array of cross-compatible sensor payloads, WiFi and cellular communications options, as well as signifiant onboard processing power, the Wave Glider SV2 is a reliable and flexible long-endurance platform.



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Wave Glider SV2: Basic specifications

GENERAL

Vehicle configuration	Sub and Float joined by 6m (20ft) tether
Dimensions	Float: 210cm x 60cm (83in x 24in) Sub: 40cm x 191cm (16in x 75in) Wings: 107cm wide (42in)
Weight	90kg (200lb)
Endurance	Operate for years at sea (with regularly scheduled maintenance)
Water speed	SS1: 0.5kts SS4: 1.3kts
Depth rating	Continuous wash and spray Brief submergence to 2m (6.5ft)
Observability	Silent propulsion system Minimal visual & radar signature Optionally increased by visibility mast, marker light and radar target enhancer
Transportation & shipping	Air freight compatible Ships in 2 wooden crates Crate dimensions: 305cm x 61cm x 61cm (10ft x 2ft x 2ft) Crate 1 weight: 136kg (300lb) Crate 2 weight: 104kg (230lb)

SAFETY

Emergency location	Shore-activated light Redundant RF beacons 2-Year Redundant Iridium® tracker
Health sensors	Pressure, temperature & leak sensors
Battery compliance	Individual batteries are isolated from each other Automatic charge/discharge cut-off (for temperature and/or voltage)

OPERATION

Mission control	Chart-based GUI Waypoint & course generation
Status monitoring	Text & visual status indicators accessible via web interface SMS and email alerts Programmable inclusion/exclusion zones
Autonomous navigation	Programmable waypoint course Follow course and hold/loop Station keeping at target

PAYLOAD

Architecture	Modular mechanical, electrical, and software interfaces to general purpose housing Support for 3rd party payloads
Base integration	Water speed sensor AIS receiver Radar reflector, light, and flag
Continuous available power	System maximum: 10A Continuous at 13.2V (system-wide)
Payload ports	Float: 3; Sub: 1 8-pin 5/8” wet mateable connector 13.2V, 3A, RS232/422/485, GPS, PPS
Power expansion ports	Float: 1 6-pin 5/8” wet mateable connector 13.2V, 6A
Max. discrete payloads	2 (Payload boxes)
Max. payload weight	18kg (40lb)
Max. payload volume	40L (1.4ft^3)
Peak payload power	40W

POWER

Propulsion	Mechanical conversion of wave energy into forward thrust
Battery	665 Wh Li-Ion rechargeable
Solar power	112W (peak)

COMMUNICATIONS

Satellite	Iridium® 9602 RUDICS (option)
Cellular	Option
Local	X-Bee Pro® 2.4GHz modem 100ft range (typical)

NAVIGATION

Heading	Solid state magnetometer
GPS	12 channel WAAS capable
Accuracy	3m radius CEP50
Station keeping	40m radius CEP90 (SS3: current <0.5kts)

All specifications are accurate at time of printing and are subject to change without prior notice.

liquid robotics

Corporate Headquarters
[redacted]

Engineering & Test Center
[redacted]

Federal Business Unit
Liquid Robotics Federal
[redacted]

[redacted]

www.liquidr.com

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EXHIBIT C

PB200

Integrated Sensors Provide a Mini-Network

The PB200 WeatherStation® Instrument informs you of instantaneous changes in the weather. Wind, Speed, and Direction are measured using four ultrasonic transducers. No moving parts results in better durability and reliability. The internal WAAS/EGNOS GPS engine and three-axis solid-state compass make it possible for the PB200 to provide both Apparent and True Wind Speed and Direction without the need to add additional sensors. The WAAS/EGNOS GPS provides navigation data as well as magnetic variation and is suitable as your primary GPS source. The internal temperature and barometric pressure sensors help predict changing weather patterns. Combined with the internal heading sensor, most of your navigation needs are provided! No other sensor on the market incorporates all of these features in one compact housing.

Unsurpassed Heading

What sets us apart from the competition and the original PB100 is the ability to provide 2° heading accuracy under dynamic conditions, such as rough seas. Airmar's unique dynamic motion correction software is the key difference. The PB200's heading is highly accurate and stable under most sea conditions—even if the vessel is pitching and rolling up to 30° in rough seas. Also unique to the PB200 is that the 3D accelerometer and rate gyro are temperature compensated, resulting in precise tilt and rate of turn data. This allows the PB200 to accurately measure True Wind Speed and Direction even when tilted up to 30°.

AIRMAR® TECHNOLOGY CORPORATION

Sensing Technology

Ultrasonic WeatherStation® Instrument

Features

- True wind speed and direction
- Apparent wind speed and direction
- Barometric pressure
- Air temperature
- Wind chill temperature
- Measures wind speed and direction ultrasonically
- Internal WAAS/EGNOS GPS
- Three-axis solid-state compass
- Three-axis accelerometer provides stabilized pitch and roll information in dynamic conditions
- Better than 1° static compass accuracy
- Best-in-class 2° dynamic compass accuracy
- Yaw rate gyro provides rate of turn data
- Outputs both NMEA 0183 and NMEA 2000® data
- Plastic housing is less prone to lightning strikes
- WeatherCaster™ Software
- 360° calibration results in precise wind direction accuracy
- Very easy installation and two-year warranty
- Maintenance-free operation—no moving parts
- Recommended for large powerboats and commercial vessels

www.airmar.com

PB200 Ultrasonic WeatherStation® Instrument

How the WeatherStation® Instrument Works

The Airmar WeatherStation Instrument is the only all-in-one weather sensor that calculates apparent wind speed and direction, barometric pressure, air temperature, and wind chill temperature. With the internal compass and WAAS/EGNOS GPS, true wind speed and direction can also be calculated. The UV stabilized, compact housing is fully waterproof and resistant to sunlight and chemicals.

The ultrasonic wind sensor (an ultrasonic anemometer) measures apparent wind speed and direction. The WeatherStation Instrument contains four ultrasonic transducers, visible through the four holes in the top of the sensor's wind channel (see figure 1). These transducers operate in pairs—one transducer injects a pulse into the air. The pulse bounces off the metal plate at the bottom of the wind channel and is carried by the wind to arrive at the listening transducer a short time later.

When there is no wind, the pulse travels at the speed of sound from the sender to the receiver. Whenever the wind is blowing in that direction, the pulse will arrive sooner than if the air is still. Similarly, whenever the wind is blowing in the opposite direction, the pulse will arrive later than if the air is still. The four transducers take turns in sending and receiving pulses.

A microprocessor within the WeatherStation Instrument then combines the measurements from all four transducers to calculate the resultant wind speed and direction. Throughout this process, the sensor monitors the air temperature, to compensate for the fact that the speed of sound in air changes with temperature.

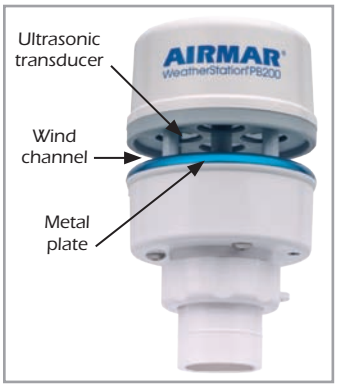


Figure 1

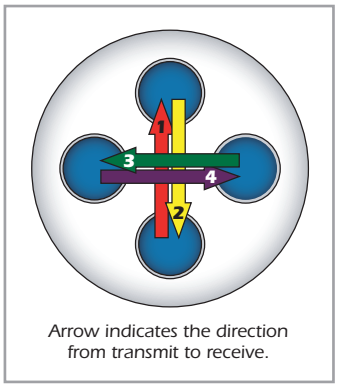


Figure 2

Understanding True and Apparent Wind

The WeatherStation Instrument has the unique ability to display both true and apparent wind. True wind is the actual motion of the air relative to the earth. Apparent wind is the wind which an observer experiences while moving or on board a boat. It is the result of two motions—the actual motion of the air (the true wind) and the motion of the boat. If the vessel is not moving, then the true and apparent wind will be the same.

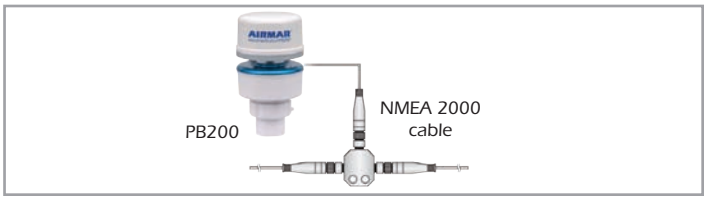
Enhanced Performance

The Airmar PB200 WeatherStation Instrument offers enhanced performance over the PB100 and the competition. Advanced features such as a three-axis solid-state compass, three axis accelerometer, yaw rate gyro and WAAS/EGNOS GPS result in unsurpassed performance under all sea conditions. The sensor can also be fully integrated with your existing NMEA 0183 electronics or NMEA 2000 network. Unique to the sensor is its ability to output both NMEA 0183 and NMEA 2000 simultaneously to various devices on-board. Coupled with Airmar's intuitive WeatherCaster PC software, the PB200 is also a powerful stand alone solution.

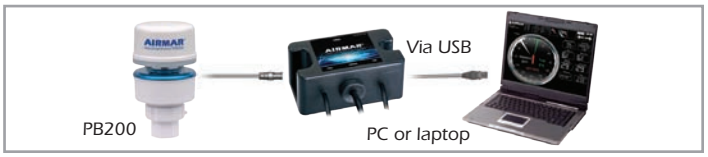
The WeatherStation Instrument comes with our intuitive WeatherCaster™ Software. Data can be viewed in both digital and analog format and can be saved for a set period of time. The log time can be adjusted in intervals from 6 to 72 hours. Standard NMEA sentences and an RS485 interface allows for the flexibility of designing your own software program to fit your specific application. Our comprehensive technical manual makes the job easy!

Airmar's WeatherStation Instrument includes a standard 1-14" UNS marine thread connections to accommodate standard mounting hardware. The waterproof base connector assures trouble-free installation and servicing, while a quick disconnect feature allows for installations on vessels of all types and sizes.

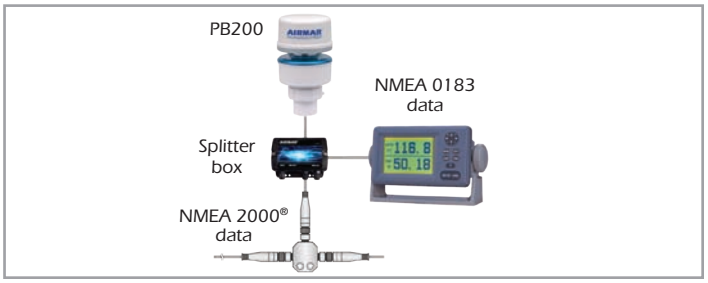
Connecting the PB200 to a NMEA 2000® Network
When connecting the PB200 WeatherStation® Instrument to a NMEA 2000 network backbone, a devicenet cable is needed.



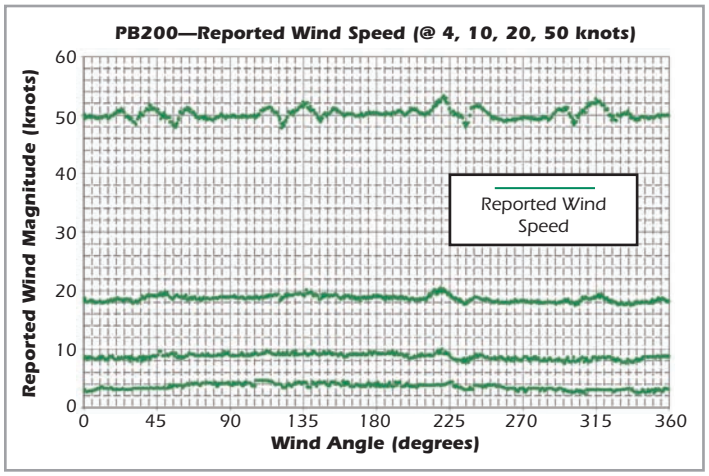
Connecting the PB200 to a PC—
When connecting the PB200 to a PC only, a USB Converter is required to use the WeatherCaster™ PC Software.

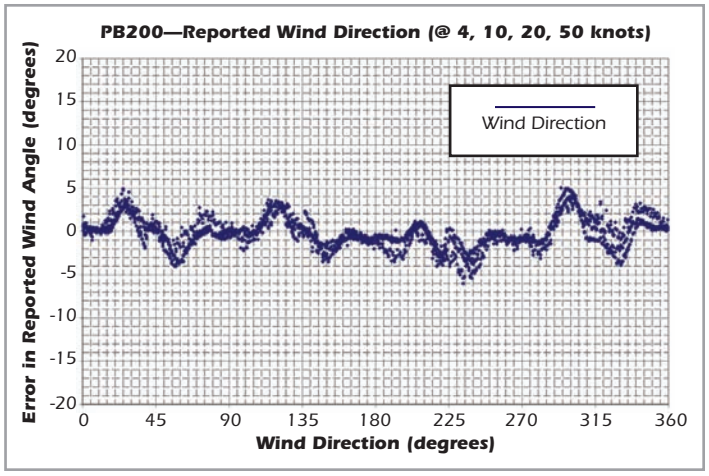


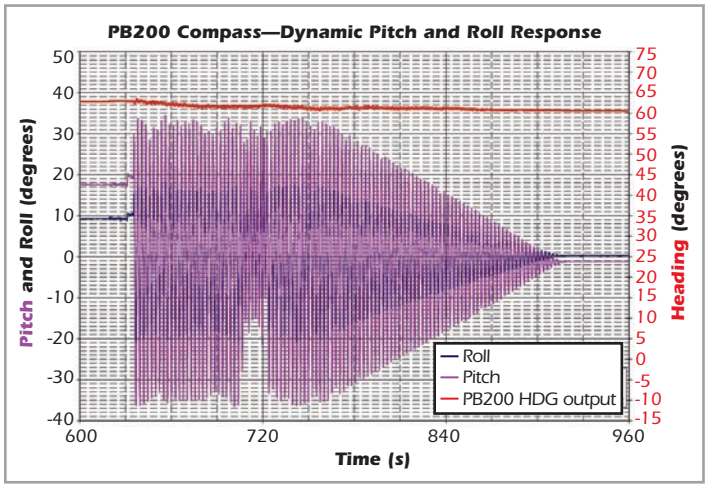
Connecting the PB200 to a NMEA 0183 and NMEA 2000® Networks
When simultaneously connecting the PB200 to both NMEA 0183 and NMEA 2000 networks, a combination cable kit is required. This kit contains either a 15 m (50') or 30 m (100') combination cable, splitter box, 3M connectors, and a 6 m (20') devicenet cable for connecting to the NMEA 2000 network.

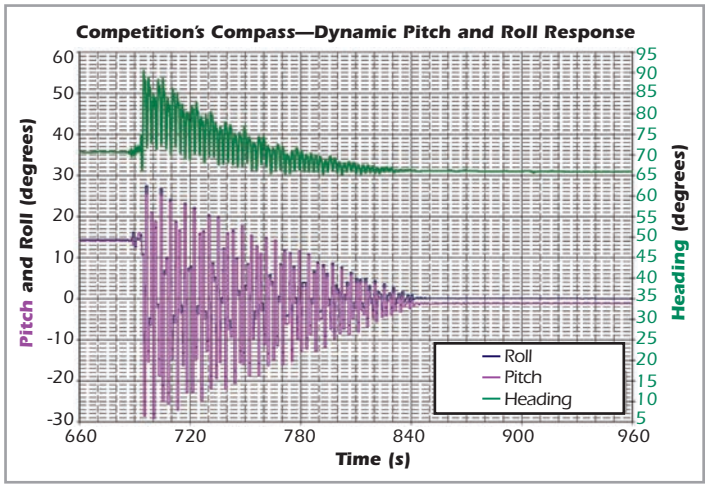


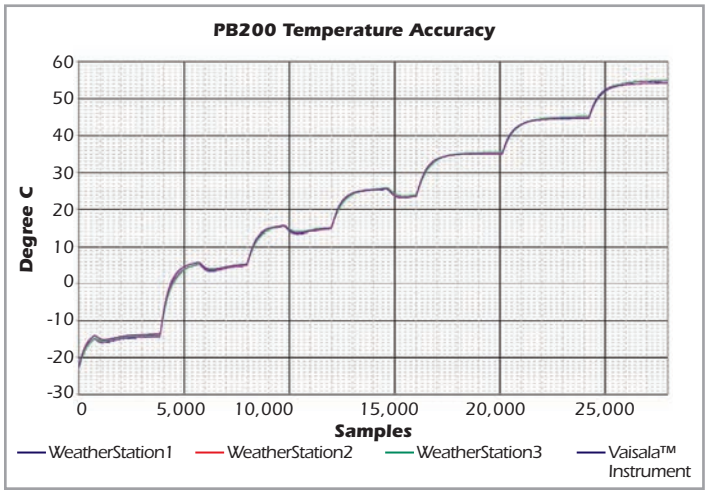
PB200 Performance Accuracy and Graphs









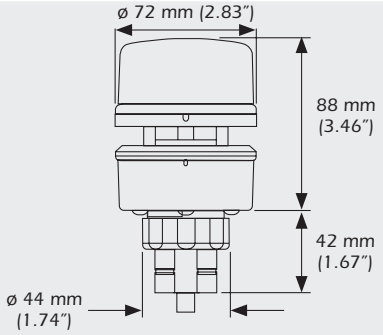


State-of-the-Art Wind Tunnel
Airmar's on-site wind tunnel is calibrated with a pitot tube, which in turn was calibrated with a National Institute of Standards and Technology (NIST) traceable pitot tube.

PB200

Technical Information

DIMENSIONS



- **Standard 1"-14 standard marine mount connection accommodates existing mounting hardware.**
- **NMEA 2000® cables longer than 6 m (20') have a molded in terminating resistor**

SPECIFICATIONS

Wind Speed Range: 0 knots to 80 knots (0 MPH to 92 MPH)
Wind Speed Resolution: 0.1 knots (0.1 MPH)
Wind Speed Accuracy @ 0°C to 55°C (32°F to 131°F), no precipitation*:
— Low Wind Speeds: 0 knots to 10 knots (0 MPH to 11.5 MPH); RMS error of 1 knot (1.1 MPH) +10% of reading
— High Wind Speeds: 10 knots to 80 knots (11.5 MPH to 92 MPH); RMS error of 2 knots (2.3 MPH) or 5% RMS, whichever is greater
Wind Speed Accuracy in wet conditions:** 5 knots (5.7 MPH) RMS
Wind Direction Range: 0° to 360°
Wind Direction Resolution: 0.1°
Wind Direction Accuracy @ 0°C to 55°C (32°F to 131°F), no precipitation*:
— Low Wind Speeds: 4 knots to 10 knots (4.6 MPH to 11.5 MPH)—5° RMS typical
— High Wind Speeds: >10 knots (>11.5 MPH)—2° RMS typical
Wind Direction Accuracy in wet conditions:**
>8 knots (9.2 MPH)—8° RMS typical
Compass Accuracy:
—1° static heading accuracy
—2° dynamic heading accuracy
Rate-of-Turn: 0° to 70° per second
Rate-of-Turn Accuracy: 1° per second
Rate-of-Turn Data Output Update Rate:
— 2 Hz—NMEA 0183 (Adjustable up to 10 Hz)
— Adjustable up to 20 Hz—NMEA 2000
Pitch and Roll Range/Accuracy: ±50° / <1°
Air Temperature Range: -25°C to 55°C (-13°F to 131°F)
Air Temperature Resolution: 0.1°C (0.1°F)
Air Temperature Accuracy: ±1°C (±1.8°F)* @ >4 knots (>4.6 MPH) wind
Barometric Pressure Range:
850 mbar to 1150 mbar (25 inHg to 34 inHg, 850 hPa to 1150 hPa)
Barometric Pressure Resolution: 0.1 mbar (0.029 inHg, 0.1 hPa)
Barometric Pressure Accuracy:
±2 mbar (±0.059 inHg, ±2 hPa) when altitude correction is available
GPS Position Accuracy: 3 m (10') with WAAS/EGNOS (95% of the time, SA off)
Operating Temperature Range: -25°C to 55°C (-13°F to 131°F)
Supply Voltage: 9 VDC to 16 VDC
Supply Current: <220 mA
Weight: 285 grams (0.7 lb)
Sensor Baud Rate (NMEA 0183 Interface Only):
4,800 bps (can be increased to 38,400 bps with a command)
NMEA 2000® Load Equivalency Number (LEN): 5
Thread Sizes on Base: 1"-14 UNS standard marine mount
Certifications and Standards: CE, IPX6, RoHS, NMEA 2000®, IEC61000-4-2, IEC60945

DATA OUTPUT PROTOCOL

NMEA 0183 Sentence Structure
$GPDTM .....Datum Reference
$GPGGA .....GPS Fix Data
$GPGLL.....Geographic Position—Latitude and Longitude
$GPGSA.....GNSS DOP and Active Satellite
$GPGSV.....Satellites in View
$GPRMC .....Recommended Minimum GNSS
$GPVTG.....COG and SOG
$GPZDA.....Time and Date
$HCHDG.....Heading, Deviation, and Variation
$HCHDT .....True Heading
$TIROT.....Rate of Turn
$WIMDA.....Meteorological Composite
$WIMWD ...Wind Direction and Speed
$WIMWV....Wind Speed and Angle
$WIMWR....Relative Wind Direction and Speed
$WIMWT ....True Wind Direction and Speed
$YXXDR .....Transducer Measurements

NMEA 2000® Supported PGNs
59392.....ISO Acknowledgement
060928....ISO Address Claim
126208....Acknowledge Group Function
126464....PGN List
126992....System Time
126996....Product Information
126998....Configuration Information
127250....Vessel Heading
127251....Rate of Turn
127257....Attitude
127258....Magnetic Variation
129025....Position and Rapid Update
129026....COG and SOG, Rapid Update
129029....GNSS Position Data
129033....Time and Date
129044....Datum
129538....GNSS Control Status
129539....GNSS DOPs
129540....GNSS Sats in View
130306....Wind Data
130310....Environmental Parameters
130311....Environmental Parameters
130323....Meteorological Station Data

RMS—Root Mean Square, LEN—Load Equivalency Number

*When the wind speed is less than 4 knots (4.6 MPH) and/or air temperature is below 0°C (32°F), wind and temperature readings will be less accurate.

**Wet conditions include moisture, rain, frost, dew, snow, ice and/or sea spray in the wind channel.

AIRMAR® TECHNOLOGY CORPORATION
Sensing Technology

RoHS COMPLIANT
ISO CERTIFIED CE

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As Airmar constantly improves its products, all specifications are subject to change without notice. All Airmar products are designed to provide high levels of accuracy and reliability, however they should only be used as aids to navigation and not as a replacement for traditional navigation aids and techniques. WeatherStation® and WeatherCaster™ are registered trademarks and trademarks of Airmar Technology Corporation. Other company or product names mentioned in this document may be trademarks or registered trademarks of their respective companies, which are not affiliated with Airmar.

EXHIBIT D

Teledyne RD Instruments

Workhorse Monitor

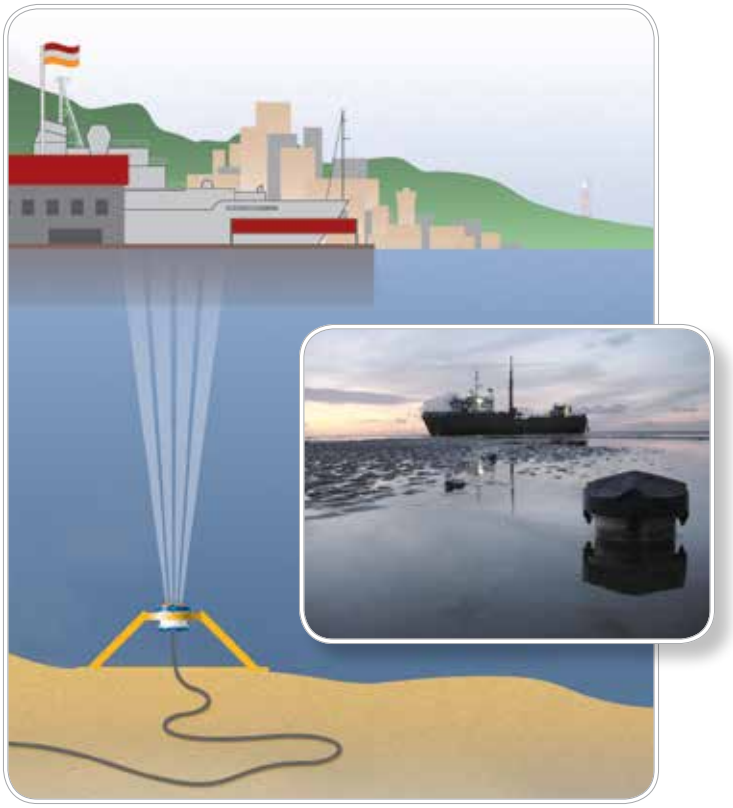
Direct Reading 1200, 600, 300 kHz ADCP

Real-Time Current Monitoring

The MONITOR is Teledyne RD Instruments' most popular direct-reading Acoustic Doppler Current Profiler (ADCP). The unit is typically bottom frame-mounted and hard-wired to shore to provide real-time monitoring of coastal currents.

The Monitor's high data accuracy and reliability make it a favorite for deployments in high-volume traffic areas such as ports and harbors, where the data is often integrated into a Vessel Traffic Monitoring System. In fact, the Monitor has been selected for most major port programs undertaken in the United States.

The Monitor offers a choice of three frequencies and ranges, to meet a wide array of data requirements. The unit also offers a flexible upgrade path, which includes an external battery pack, pressure sensor, bottom tracking capability for moving boat applications, and directional wave measurement.

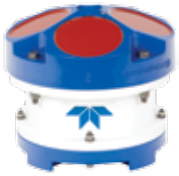


PRODUCT FEATURES

- **Extreme accuracy and reliability:** The Monitor is ideally suited for the most demanding environments, including high traffic areas such as ports and harbors.
- **Versatility:** This direct reading unit can easily be upgraded to tackle a wide variety of coastal applications. Typical upgrades include pressure sensor, external battery pack, bottom tracking, and directional wave measurement—a single instrument can do it all!
- **Precision data:** Teledyne RDI's Broadband signal processing delivers very low-noise data, resulting in unparalleled data resolution and minimal power consumption.
- **A four-beam solution:** Teledyne RDI's 4-beam design improves data reliability by providing a redundant data source in the case of a blocked or damaged beam; improves data quality by delivering an independent measure known as error velocity; and improves data accuracy by reducing variance in your data.

Workhorse Monitor

Direct Reading 1200, 600, 300 kHz ADCP



TECHNICAL SPECIFICATIONS

Water Profiling	Depth Cell Size[1]	Typical Range[2] 12m **1200kHz**		Typical Range[2] 50m **600kHz**		Typical Range[2] 110m **300kHz**	
	Vertical Resolution	Range[3]	Std. Dev.[4]	Range[3]	Std. Dev.[4]	Range[3]	Std. Dev.[4]
	0.25m	11–15m	12.9cm/s				
	0.5m	12–16m	6.1cm/s	38-52m	12.9cm/s	see note [1]	
	1m	14–17m	3.0cm/s	42-56m	6.1cm/s	83-117m	12.8cm/s
	2m	15–19m[2]	2.0cm/s	46-61m	3.0cm/s	93-128m	6.1cm/s
	4m	see note [1]		52-67m[2]	2.0cm/s	104-141m	3.0cm/s
	8m					116-154m[2]	2.0cm/s
Long Range Mode	2m	24m	3.8m/s				
	4m			70m	4.2cm/s		
	8m					165m	4.2cm/s
Profile Parameters	Velocity Accuracy	0.3% of water velocity relative to ADCP ±0.3cm/s		0.3% of water velocity relative to ADCP ±0.3cm/s		0.5% of water velocity relative to ADCP ±0.5cm/s	
	Velocity resolution	0.1cm/s		0.1cm/s		0.1cm/s	
	Velocity range	±5m/s default, ±20m/s max		±5m/s default, ±20m/s max		±5m/s default, ±20m/s max	
	Number of depth cells	1–128		1–128		1-128	
	Ping rate	2Hz (typical)		2Hz (typical)		2Hz (typical)	
Echo Intensity Profile	Vertical resolution	Depth cell size, user configurable					
	Dynamic range	80dB					
	Precision	±1.5dB					
Transducer and Hardware	Beam angle	20°					
	Configuration	4-beam, convex					
	Internal memory	Two PCMCIA card slots; no memory card included					
	Communications	Serial port selectable by switch for RS-232 or RS-422. ASCII or binary output at 1200-115,200 baud					
Environmental	Standard depth rating	200m; optional to 500m, 1000m, 6000m					
	Operating temperature	-5° to 45°C					
	Storage temperature (without batteries)	-30° to 60°C					
	Weight in air	7.6kg					
	Weight in water	3.0kg					
Software	TRDI's Windows™-based software included: **WinSC**—Data Acquisition System; **WinADCP**—Data Display and Export; **Velocity**						
Power	Input Power	20–50VDC					
Standard Sensors	Temperatures (mounted on transducer)	Range -5° to 45°C, Precision ±0.4°C, Resolution 0.01°					
	Tilt	Range ±15°, Accuracy ±0.5°, Precision ±0.5°, Resolution 0.01°					
	Compass (fluxgate type, includes built-in field calibration feature)	Accuracy ±2°[5], Precision ±0.5°[5], Resolution 0.01°, Maximum tilt ±15°					
Available Options	• Memory: 2 PCMCIA slots; total 4GB • Pressure sensor • External battery case • High-resolution water-profiling modes • Bottom tracking • AC/DC power converter, 48VDC output • Conversion kit for internal power supply and memory • Directional Waves Array						
Dimensions	228.0mm wide x 201.5.0mm long *(line drawings available upon request)*						

1 User's choice of depth cell size is not limited to the typical values specified.
2 Longer ranges available.
3 Profiling range based on temperature values at 5°C and 20°C, salinity = 35ppt.
4 BroadBand mode single-ping standard deviation (Std. Dev.).
5 <±1.0° is commonly achieved after calibration.

Specifications subject to change without notice.
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TELEDYNE
RD INSTRUMENTS
Everywhereyoulook™
www.rdinstruments.com

Teledyne RD Instruments
[redacted]

EXHIBIT E

MOSE-G1000

Datawell - Oceanographic Instruments

GPS-based motion sensor for periods up to 1000 s

To measure long period motions of floating platforms and large buoys Datawell offers the MOSE-G1000 sensor.

The MOSE-G1000 measures its three-dimensional motion in 3 frequency regimes where each regime has its own precision. Centimetre precision is achieved in the high frequency regime (1-100 s periods). Here the MOSE-G1000 works just like the Datawell DWR-G directional wave buoys. For very low frequencies the GPS position is output every 10 seconds with a precision of several meters. In addition to these high and very low frequency regimes the MOSE-G1000 covers the low frequency regime (10-1000 s periods) in between. In this regime the precision amounts to several centimetres depending on the filter selected.

As the measurement noise increases with longer periods, 3 filters with cut-off periods of 300, 600 or 1000 s have been implemented. The correct choice of filter will minimize the noise while preserving the motion periods of interest. To eliminate unwanted motion on the short period side 2 filters with a 10 or 30 s cut-off period are available. These latter 2 filters have no effect on the noise.

All data are output through one RS232 port. The MOSE-G1000 is NMEA compliant. Human readable NMEA proprietary messages are output. A single cable carrying power and signal lines enters the unit. The unit has a base plate with 4 holes for mounting. Since GPS refers directly to the WGS84 reference frame no special alignment is required.

As an example of an interesting MOSE-G1000 application refer to the Waveguide On Board (WOB) on the Radac website www.radac.nl.

Datawell BV
Zomerluststraat 4
[redacted]

T +31 23 531 60 53
[redacted]

Specifications

Motion sensor	Sensor	single GPS (not differential)
	Periods	1 - 100 s (high frequency) 10 - 1000 s (low frequency)
	Precision	1 - 2 cm (high frequency) 5 - 10 cm (low frequency, 1000 s cut-off) 3 - 5 cm (600 s cut-off) 2 - 3 cm (300 s cut-off) all 1σ, lower limit horizontal precision, upper limit vertical precision
	Calibration	not required ever
	Exclusion	Selective Availability (SA, may be switched on by US Department of Defence for strategic reasons) will have the following effect: low frequency motion not resistant to SA high frequency motion period range reduces to 1 - 30 s
Motion data	Data	date, time, local north, local west, local vertical, GPS gap indicator (high and low frequency)
	Resolution	1 mm
	Rate	2 Hz (high frequency) 0.2 Hz (low frequency)
	Latency	approx. 4 min (high frequency) approx. 40 min (low frequency)
	Reference	WGS84
Position	Sensor	GPS
	Precision	5 - 10 m, 1σ
	Rate	every 10 sec.
	Exclusion	SA will reduce position precision to 100 m
	Data	date, time, longitude, latitude, height, HDOP, VDOP
Interface	Port	RS232, NMEA compliant
	Format	NMEA proprietary messages
General	Outer dimensions	height 0.16 m (incl. GPS ant.) base plate 0.20 m × 0.20 m
	Weight	approx. 5 Kg
	Housing material	stainless steel AISI316
	Power	10 – 30 V, 1.5 W

EXHIBIT F

Product Information Sheet

Panasonic Batteries
Panasonic Industrial Company
A Division of Panasonic Corporation of North America
[redacted]

Product: **Lithium-ion Batteries (Li-ion)**
Applicable models/sizes: All Cylindrical and Prismatic Lithium-ion batteries

Revision: M – January 1, 2011

The batteries referenced herein are exempt articles and are not subject to the OSHA Hazard Communication Standard requirement. This sheet is provided as a service to our customers.

MSDS

Material Safety Data Sheets (MSDS) are a sub-requirement of the Occupational Safety and Health Administration (OSHA) Hazard Communication Standard, 29 CFR Subpart 1910.1200. This Hazard Communication Standard does not apply to various subcategories including anything defined by OSHA as an "article". OSHA has defined "article" as a manufactured item other than a fluid or particle; (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g. minute or trace amounts of a hazardous chemical, and does not pose a physical hazard or health risk to employees.

Because all of our batteries are defined as "articles", they are exempt from the requirements of the Hazard Communication Standard, hence a MSDS is not required.

The following components are found in a Panasonic Lithium Ion battery:

Nickel Manganese Cobalt Type

Component	Material	Formula
Positive Electrode	Lithium Nickel Manganese Cobalt Oxide	$LiNMnCoO_2$
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate – Solvent	$C_3H_4O_3$
	Diethyl Carbonate – Solvent	$C_5H_{10}O_3$
	Lithium Hexaflurophosphate – Salt	$LiPF_6$

Cobalt Type

Component	Material	Formula
Positive Electrode	Lithium Cobalt Oxide	$LiCoO_2$
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate – Solvent	$C_3H_4O_3$
	Diethyl Carbonate – Solvent	$C_5H_{10}O_3$
	Lithium Hexaflurophosphate – Salt	$LiPF_6$

Nickel Cobalt Aluminum Type

Component	Material	Formula
Positive Electrode	Lithium Cobalt Nickel Aluminum Oxide	$LiCoNiAlO_2$
Negative Electrode	Graphite	C
Electrolyte	Ethylene Carbonate – Solvent	$C_3H_4O_3$
	Diethyl Carbonate – Solvent	$C_5H_{10}O_3$
	Lithium Hexaflurophosphate – Salt	$LiPF_6$

Notice: The information and recommendations set forth are made in good faith and are believed to be accurate at the date of preparation. Panasonic Industrial Company makes no warranty expressed or implied.

DISPOSAL

All Panasonic Lithium ion batteries are classified by the federal government as non-hazardous waste and are safe for disposal in the normal municipal waste stream. These batteries, however, do contain recyclable materials and are accepted for recycling by the Rechargeable Battery Recycling Corporation's (RBRC) Battery Recycling Program. Please call 1-800-8-BATTERY for information on recycling your used Lithium Ion battery or go to the RBRC website at www.rbrc.org for additional information.

TRANSPORTATION

Effective October 1, 2008, all Panasonic lithium ion batteries are not subject to the other requirements of the US Department of Transportation (DOT) Subchapter C, Hazardous Materials Regulations if shipped in compliance with 49 CFR 173.185 and Special Provision 188.

Effective January 1, 2011 all Panasonic lithium ion batteries can be shipped by air in accordance with International Civil Aviation Organization (ICAO) 2011-2012 edition, Section II or International Air Transport Association (IATA), 51st edition, Section II, Packing Instructions (PI) 965 (Batteries), PI 966 (Batteries, packed with equipment) and PI 967 (Batteries, contained in equipment) as appropriate.

Currently all Panasonic lithium ion batteries are regulated by the International Maritime Organization (IMO), 2010 edition under Special Provisions 188 and 230.

If you build any of our lithium ion cells into a battery pack, you must also assure that they are tested in accordance with the UN Model Regulations, Manual of Test and Criteria. Part III, subsection 38.3, 5th revised edition. If you plan on transporting any untested prototype battery packs contact your Panasonic Sales Representative for regulatory information.

FIRST AID

If you get electrolyte in your eyes, flush with water for 15 minutes without rubbing and immediately contact a physician. If you get electrolyte on your skin wash the area immediately with soap and water. If irritation continues, contact a physician. If the battery is ingested, call the National Capital Poison Center (NCPC) at 202-625-3333 (Collect) or your local poison center immediately.

GENERAL RECOMMENDATIONS

CAUTION: Risk of fire, explosion and burns. Do not short-circuit, crush, incinerate or disassemble battery.

FIRE SAFETY

In case of fire, you can use dry chemical, alcohol resistant foam or carbon dioxide fire extinguishers. Cooling the exterior of the batteries will help prevent rupturing. Burning of these batteries will generate toxic fumes. Fire fighters should use self-contained breathing apparatus. Detailed information on fighting a lithium ion battery fire can be found in Guide 147 (Lithium Ion Batteries) of the US DOT Emergency Response Guide.

Notice: The information and recommendations set forth are made in good faith and are believed to be accurate at the date of preparation. Panasonic Industrial Company makes no warranty expressed or implied.

RECEIVERS

EXHIBIT G

VEMCO Mobile Transceiver (VMT)

A division of AMIRIX

Miniature VR2 receiver-transmitter increases understanding about schooling cohesion and inter-species association

The VEMCO Mobile Transceiver (VMT) is a hybrid between a 69 kHz coded transmitter and a 69 kHz monitoring receiver (similar to the VR2W-69 kHz). It can be externally attached to an animal and is capable of detecting all VEMCO coded transmitters at 69 kHz. The VMT also behaves as a VEMCO coded transmitter and can be detected by other VEMCO receivers. The VMT can also detect other tagged fish in its presence.

Typical Applications

- Externally attached to larger animals, the VMT is used to determine predator/prey interaction and inter-species association (i.e. the interaction between elephant seals and salmon, and grey seals and cod). It can also be used to study schooling behaviour in animals such as sharks and tuna.
- By attaching the VMT to a long ranging animal or a glider module, a mobile receiving station is created to extend detection ranges beyond the traditional fixed arrays - which are typically restricted to coastal locations.
- The VMT can operate at depths up to 1000m making it suitable for studies in deep water environments.
- Stationary objects such as FADs or buoys can be tagged with a VEMCO coded transmitter. The VMT can then collect data on the length of time an animal spends near the FAD or buoy.

Specifications

- Depth rating 1000m
- Battery life, 100% receiver duty cycle up to 10 months (battery life can be extended by changing the duty cycle; battery is factory replaceable)
- Size 35mm diameter, 180mm length
- Weight 280g in air; 122g in water
- Transmit output power similar to V16-6x
  156 dB re 1µPa @ 1 m (L mode)
  161 dB re 1µPa @ 1 m (H mode)
- User programmable options - vary receiver on time (duty cycle), and some tag options

VMT Optical Reader
The VMT data is stored in the tag memory and can be retrieved using the VMT Optical Reader.

VEMCO

211 Horseshoe Lake Drive
[redacted]

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Exhibit I

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE

November 19, 2012

Mr. John Appelgren
Liquid Robotics, Inc.
1329 Moffett Park Drive
Sunnyvale, CA 94089

Dear Mr. Appelgren: JOHN

The National Oceanic and Atmospheric Administration, Office of National Marine Sanctuaries (ONMS) has approved the issuance of amendment A1 to permit number MULTI-2012-004 to conduct activities within the National Marine Sanctuary System, which includes: Olympic Coast National Marine Sanctuary (OCNMS), Cordell Bank National Marine Sanctuary (CBNMS), Gulf of the Farallones National Marine Sanctuary (GFNMS), Monterey Bay National Marine Sanctuary (MBNMS), Channel Islands National Marine Sanctuary (CINMS), Thunder Bay National Marine Sanctuary (TBNMS), Stellwagen Bank National Marine Sanctuary (SBNMS), Monitor National Marine Sanctuary (MNMS), Gray's Reef National Marine Sanctuary (GRNMS), Flower Garden Banks National Marine Sanctuary (FGBNMS), Florida Keys National Marine Sanctuary (FKNMS), Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS), and National Marine Sanctuary of American Samoa (NMSAS) for research purposes. Activities are to be conducted in accordance with the permit application and all supporting materials submitted to the sanctuary, and the terms and conditions of permit number MULTI-2012-004-A1 (enclosed).

This permit is not valid until signed and returned to the ONMS. Retain one signed copy and carry it with you while conducting the permitted activities. Additional copies must be signed and returned, by either mail or email, to the following individual within 30 days of issuance and before commencing any activity authorized by this permit:

National Permit Coordinator
NOAA Office of National Marine Sanctuaries
1305 East-West Highway (N/NMS2)
SSMC4, 11th Floor
Silver Spring, MD 20910
nmspermits@noaa.gov

Your permit contains specific terms, conditions and reporting requirements. Review them closely and fully comply with them while undertaking permitted activities.

If you have any questions, please contact Vicki Wedell at 301-713-7237. Thank you for your continued cooperation with the ONMS.

Sincerely,

Dan Basta
Director

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SERVICE

RESEARCH PERMIT

Permittee:
Mr. John Appelgren
Liquid Robotics Inc.
1329 Moffett Park Drive
Sunnyvale, CA 94089

Permit Number: MULTI-2012-004-A1
Effective Date: November 19, 2012
Expiration Date: November 30, 2014

Project Title: Wave Glider Operations: Conducting Marine Research

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This permit is issued for activities in accordance with the National Marine Sanctuaries Act (NMSA), 16 USC §1431 *et seq.*, and regulations thereunder (15 CFR Part 922). All activities must be conducted in accordance with those regulations and law. No activity prohibited in 15 CFR Part 922 is allowed except as specified in the activity description below.

Subject to the terms and conditions of this permit, the National Oceanic and Atmospheric Administration (NOAA), Office of National Marine Sanctuaries (ONMS) hereby authorizes the permittee listed above to conduct research activities within the National Marine Sanctuary System, which includes: Olympic Coast National Marine Sanctuary (OCNMS), Cordell Bank National Marine Sanctuary (CBNMS), Gulf of the Farallones National Marine Sanctuary (GFNMS), Monterey Bay National Marine Sanctuary (MBNMS), Channel Islands National Marine Sanctuary (CINMS), Thunder Bay National Marine Sanctuary (TBNMS), Stellwagen Bank National Marine Sanctuary (SBNMS), Monitor National Marine Sanctuary (MNMS), Gray's Reef National Marine Sanctuary (GRNMS), Flower Garden Banks National Marine Sanctuary (FGBNMS), Florida Keys National Marine Sanctuary (FKNMS), Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS), and National Marine Sanctuary of American Samoa (NMSAS). All activities are to be conducted in accordance with this permit and the permit application received September 04, 2012. The permit application is incorporated into this permit by reference; provided, however, that if there are any conflicts between the permit application and the terms and conditions of this permit, the terms and conditions of this permit shall be controlling.

Permitted Activity Description:
The following activities are authorized by this permit:

Temporary discharge of wave gliders for approximately two hundred (200) wave glider missions to conduct various research projects.

No further violation of sanctuary regulations is allowed.

Permitted Activity Location:
The permitted activity is allowed only in the following location(s):

Throughout the National Marine Sanctuary System.

Special Terms and Conditions:

1. All authorized activities may be conducted from November 19, 2012 through November 30, 2014. All equipment shall be removed from national marine sanctuaries no later than the expiration date of this permit. The permittee may request an amendment from the ONMS Director in advance of this expiration date, to extend the effective date of this permit.

2. Permitted activities shall include temporary discharge of autonomous vehicles (i.e., wave gliders), provided all such devices are recovered from the sanctuaries.

3. The equipment and support structures authorized by this permit shall be used in accordance with the methods and objectives identified in the permit application and special conditions included here. The permittee shall contact the ONMS national permit coordinator for approval of additional payload equipment not identified in the application.

4. No activity authorized by this permit shall disturb or impact any historical or marine archaeological resources of the sanctuary. If historical or marine archaeological resources are encountered at any time, the permittee shall cease all further activities under this permit and immediately contact the ONMS Director.

5. All items (e.g. batteries, data recorders, etc.) removed from instrument packages attached to platforms must be stored or disposed of properly ashore. At no time may batteries be exposed to the sea or discarded within the sanctuary.

6. All equipment authorized under this permit shall be removed when such equipment is no longer in use, or sooner if directed by sanctuary superintendent(s) if such equipment is causing or may cause unacceptable harm to sanctuary resources or qualities. Intentional abandonment of equipment or any item is prohibited. The location and description of any equipment abandoned or lost in the sanctuary for any reason shall be noted in the annual report (see Special Condition #10) with an explanation why the equipment was not recovered.

7. If a wave glider or associated equipment is lost, contact the ONMS National Permit Coordinator and sanctuary-specific point of contact (see Special Condition #8) within 24 hours indicating when and where glider or equipment was lost. Any plan of recovery that includes seafloor contact will require approval from the sanctuary superintendent before implementation. The permittee may be required to pay any or all expenses associated with the locating of and/or removal by NOAA or its designee of any equipment that is not recovered by the permittee.

8. Not less than two weeks in advance, provide notification to the appropriate sanctuary office for each deployment that may enter a sanctuary (or occur in the Santa Barbara region), including timing of entry and estimated duration of work in the sanctuary. Notification should include the following: deployment or mission objectives, proposed or approximate track lines; list of instruments on board and any potential toxic materials (batteries, other); anticipated duration of activity in each sanctuary; and general description of the Wave Glider (e.g., color, other descriptive characteristics) to be deployed. The following **pre-survey notifications** are required:

POINT OF CONTACT	AFFILIATION	CONTACT INFORMATION
Liam Antrim	OCNMS Permits	Liam.Antrim@noaa.gov 360-457-6622 x16
Michael Carver	CBNMS Permits	Michal.Carver@noaa.gov 415-663-1437
Max Delaney	GFNMS Permits	Max.Delaney@noaa.gov 415-970-5255
Erica Burton	MBNMS Permits	Erica.Burton@noaa.gov 831-647-4246
Dani Lipski	CINMS Permits (or Santa Barbara Region)	Danielle.Lipski@noaa.gov 805-966-7107 x422
Jeff Gray	TBNMS Superintendent	Jeff.Gray@noaa.gov 989-356-8805 x12
Ben Haskell	SBNMS Permits	Ben.Haskell@noaa.gov 781-545-8026 x207
Joe Hoyt	MNMS Permits	Joseph.Hoyt@noaa.gov 757-591-7336
Becky Shortland	GRNMS Permits	Becky.Shortland@noaa.gov 912-598-2381
Joanne Delaney	FKNMS Permits	Joanne.Delaney@noaa.gov 978-471-9653
Emma Hickerson	FGBNMS Permits	Emma.Hickerson@noaa.gov 409-621-5151 x111
Malia Chow	HIHW Superintendent	Malia.Chow@noaa.gov 808-397-2651 x251
Wendy Cover	NMSAS Permits	Wendy.Cover@noaa.gov 684-633-5155 x270
Robert Yerena	NOAA Enforcement Officer (West Coast)	Robert.Yerena@noaa.gov 831-647-4203

9. If contacted by MBNMS Sanctuary Integrated Monitoring Network (SIMoN) staff, the permittee agrees to provide project metadata from these permitted activities to the MBNMS Sanctuary Integrated Monitoring Network via a web-based interface. The permittee shall provide the information to the MBNMS within three (3) months of the request date. See http://www.sanctuarysimon.org for more information.

10. The permittee shall submit an annual report of all activities conducted under this permit to the ONMS National Permit Coordinator **no later than October 31st of each year this permit is valid**. The report should include information regarding daily activities such as location (latitude and longitude) of samples, discovery or disturbance of historical artifacts, problems encountered, equipment lost, efforts to retrieve lost equipment, etc. The annual report shall also include a synopsis of research results to date.

11. This activity may also require permission from other agencies. The enclosed permit is not valid until all other necessary permits and/or authorizations are obtained. Any direct or incidental harassment of marine mammals requires a permit from the National Marine Fisheries Service (for West Coast sanctuaries - contact Monica DeAngelis at 562-980-3232) and/or U.S. Fish and Wildlife Service (for West Coast sanctuaries - contact Douglass Cooper at 805-644-1766). Direct or incidental harassment of seabirds requires a permit from the U.S. Fish and Wildlife Service. Deployment of mooring or surface buoys may require authorization from the US Coast Guard (for West Coast sanctuaries - contact Brian Aldrich at 510-437-2983). Research conducted within California state waters or California state marine protected areas (MPA) may require permission from the California Department of Fish and Game (contact Brian Owens at bowens@dfg.ca.gov). For other sanctuaries, contact the person in Special Condition #8 for assistance.

General Terms and Conditions:

1. Within 30 (thirty) days of the date of issuance, the permittee must sign and date this permit for it to be considered valid. Once signed, the permittee must send copies, via mail or email, to the following individuals:

   National Permit Coordinator
   NOAA Office of National Marine Sanctuaries
   1305 East-West Highway (N/ORM6)
   SSMC4, 11th Floor
   Silver Spring, MD 20910
   nmspermits@noaa.gov

2. It is a violation of this permit to conduct any activity authorized by this permit prior to the ONMS having received a copy signed by the permittee.

3. This permit may only be amended by the ONMS. The permittee may not change or amend any part of this permit at any time. The terms of the permit must be accepted in full, without revision; otherwise, the permittee must return the permit to the sanctuary office unsigned with a written explanation for its rejection. Amendments to this permit must be requested in the same manner the original request was made.

4. All persons participating in the permitted activity must be under the supervision of the permittee, and the permittee is responsible for any violation of this permit, the NMSA, and sanctuary regulations for activities conducted under, or in junction with, this permit. The permittee must assure that all persons performing activities under this permit are fully aware of the conditions herein.

The permittee must assure that all persons performing activities under this permit are fully aware of the conditions herein.

5. This permit is non-transferable and must be carried by the permittee at all times while engaging in any activity authorized by this permit.

6. This permit may be suspended, revoked, or modified for violation of the terms and conditions of this permit, the regulations at 15 CFR Part 922, the NMSA, or for other good cause. Such action will be communicated in writing to the applicant or permittee, and will set forth the reason(s) for the action taken.

7. This permit may be suspended, revoked or modified if requirements from previous ONMS permits or authorizations issued to the permittee are not fulfilled by their due date.

8. Permit applications for any future activities in the sanctuary or any other sanctuary in the system by the permittee might not be considered until all requirements from this permit are fulfilled.

9. This permit does not authorize the conduct of any activity prohibited by 15 CFR § 922, other than those specifically described in the "Permitted Activity Description" section of this permit. If the permittee or any person acting under the permittee's supervision conducts, or causes to be conducted, any activity in the sanctuary not in accordance with the terms and conditions set forth in this permit, or who otherwise violates such terms and conditions, the permittee may be subject to civil penalties, forfeiture, costs, and all other remedies under the NMSA and its implementing regulations at 15 CFR Part 922.

10. Any publications and/or reports resulting from activities conducted under the authority of this permit must include the notation that the activity was conducted under National Marine Sanctuary Permit MULTI-2012-004-A1 and be sent to the ONMS official listed in general condition number 1.

11. This permit does not relieve the permittee of responsibility to comply with all other federal, state and local laws and regulations, and this permit is not valid until all other necessary permits, authorizations, and approvals are obtained. Particularly, this permit does not allow disturbance of marine mammals or seabirds protected under provisions of the Endangered Species Act, Marine Mammal Protection Act, or Migratory Bird Treaty Act. Authorization for incidental or direct harassment of species protected by these acts must be secured from the U.S. Fish and Wildlife Service and/or NOAA Fisheries, depending upon the species affected.

12. The permittee shall indemnify and hold harmless the Office of National Marine Sanctuaries, NOAA, the Department of Commerce and the United States for and against any claims arising from the conduct of any permitted activities.

13. Any question of interpretation of any term or condition of this permit will be resolved by NOAA.

Your signature below, as permittee, indicates that you accept and agree to comply with all terms and conditions of this permit. This permit becomes valid when you, the permittee, countersign and date below. Please note that the expiration date on this permit is already set and will not be extended by a delay in your signing.

2/20/13

Mr. John Appelgren
Director, Customer Support Operations
Liquid Robotics Inc.

Date

11/19/12

Dan Basta
Director
Office of National Marine Sanctuaries

Date