

## Workhorse Mariner

Vessel-mount System Configuration and Sales Information - January 2009

### General Product Information

The Workhorse Mariner (WHVM) product family is intended to provide short-range current profiling, when permanently mounted on small coastal vessels, or larger ocean vessels.

- WHVM models are available in a choice of operating frequencies to provide the best balance of profiling range and resolution to fit the user application.
- WHVM systems offer Broadband processing for high-precision measurement, with a user setting for longer-range operation.
- WHVM systems provide precision bottom-track reference for direct vessel speed measurement.
- The WHVM system provides a pulse output, and can accept a trigger input, for ping synchronization with an external device.
- Several larger vessels have been outfitted with both WHVM and OS systems. This allows optimal profiling while in either coastal or open-ocean depths.
- Proper installation is a critical factor in the realization of optimal system performance. Optimal system performance may also critically depend upon the quality of data input from non-Teledyne RD Instruments (RDI) sources, such as vessel heading and navigation data.

Following are specific answers to common questions on details for the Workhorse Mariner product family.

### Frequently Asked Questions

*What should be considered for a complete WHVM system?*

Ultimately, the system must meet its performance expectations when in use on the customer's vessel. While that may seem obvious, satisfactory system performance is critically dependent upon proper installation. As a system manufacturer, Teledyne RDI can only guarantee the performance of its products, *as shipped*. Unless every effort is made to insure proper installation, the performance of the *as-installed* system may be compromised. The WHVM system should ALWAYS be considered as part of a complete package, to insure the best results.

The total package should consist of:

- The WHVM model appropriate for the user application
- The recommended computer system, or equivalent
- Optional: Acoustic Window material
- Commissioning Services
- Extended Warranty or Phoenix Program
- Spare Parts
- Consideration of the provision and quality of external data input from non-Teledyne RDI sources (eg: Heading)

*What is included in the System Hardware?*

The product hardware consists of (3) major pieces; the ADCP, Power/Serial Communication Cable, and Deckbox.

- The product selection consists of (4) fixed-frequency models: 150kHz, 300kHz, 600kHz and 1200kHz.
- The WHVM ADCP has 4 piston-style transducers mounted in the ADCP head, oriented at a 20° elevation from the centerline, arranged in two opposing pairs (Janus configuration) at 90° around the centerline. The Transducers are frequency-specific; they cannot be interchanged.

- The 300kHz, 600kHz and 1200kHz models ADCP and transducer housings are plastic. The 150kHz ADCP is Aluminum. An optional naval bronze transducer housing is available for the 600kHz model, to mate to the plastic electronics housing and endcap. The ADCP plastic housings are (nominally) depth-rated to 200m.
- The WHVM ADCP is equipped with a bronze adapter ring, to allow low-profile mounting of the ADCP in the vessel hull.
- The WHVM Power/Serial Communication Cable is not frequency-specific. The STANDARD Power/Serial Communication Cable is supplied in a 25m length. The Transducer Cable length should be specified at the time of order, if a longer cable is required. Maximum Transducer Cable length can be greater than 100m, and is priced by length over 25m.
- The WHVM Deckbox is not frequency-specific. The Deckbox is 19" rack-mount, NOT weather resistant, sealed or waterproof. The Deckbox accepts 85VAC to 250VAC, 45-65Hz input power.

#### *What External Inputs are required?*

- External (vessel) heading data MUST be input to the WHVM system software running on a customer-supplied computer, from a customer-supplied heading device.
  - Most newer, commercially-available heading reference instruments will provide a digital (serial) output suitable for use with the WHVM software.
    - An example of an inexpensive & portable heading device is:  
The Crescent V100 Series GPS Heading system, manufactured by Hemisphere GPS.  
Contact Teledyne RDI Representative: Saderet Ltd. (<http://www.saderet.co.uk/>)
  - The WHVM Deckbox may, optionally, be configured with a Gyro Synchro-to-digital heading conversion board. Standard configuration is to accept Synchro input, 90V, 1:1 turn ratio. Other synchro input configurations must be specified at the time of order (no extra charge). Note: Analog Gyro is NOT required; it is an older and now less common configuration. Digital (NMEA \$HDT format) heading & attitude (\$PRDID) data is typically now input to the system computer.
- Vessel speed reference data is required to derive absolute current velocity from the ADCP data. The WHVM Bottom-tracking feature automatically performs this function with great precision, while also providing range to bottom and vessel track-over-ground. Should the vessel be operating in regions where the water depth exceeds the bottom-track range, another source of vessel speed data must be provided to the WHVM software. GPS data is most often used for this purpose. More precise and robust the GPS data will produce more precise ADCP current velocity data. Many commercially-available, inexpensive, GPS devices provide digital (serial) data output suitable for the WHVM application, including the heading device mentioned above.

#### *What System Software is provided?*

Teledyne RDI Windows-based software is supplied with the WHVM system at no additional charge, on CD-ROM media.

- VMDAS is the primary program, supplying system control, data acquisition, display and data logging functions. VMDAS is compatible with Windows 95/98, Windows 2000, XP and NT operating systems. No testing has been done on Windows ME or Vista. See recommended computer specification, below.
- WinADCP is supplied to provide the function of time-series display. WinADCP can be automatically invoked by VMDAS.
- Teledyne RDI Tools system utility support software.
- Free software updates are available from the Teledyne RDI website.

#### *What are the requirements for a dedicated Computer System to support the WHVM?*

Teledyne RDI recommends the use of a commercial PC as the most economical approach to providing WHVM system support. Commercial PCs are generally suited for use on larger vessels and, when used in the typical shipboard lab environment, should have a useful life of about 3 years. Industrial, ruggedized, rack-mount, or military-specified computer hardware is also acceptable, but generally is much more expensive for similar technology, and not necessarily more cost-effective.

The recommended computer system, described below, will support multiple sessions of VMDAS and WinADCP, to control one or more systems.

- Pentium® III Processor at 866MHz, (or similar, or more capable processor: ie: AMD, P4, etc.)
- Windows 95/98, 2000, XP or NT operating system (NOT Windows ME)
- 128MB RAM, (64MB minimum)
- 20GB HD, (12GB minimum)
- CDRW, (CD-ROM read-only, minimum)
- Ethernet Card,
- 4-port SIIG PCI Card,
- 19" Monitor. (15" minimum)

The price and availability of computer technology continues its' rapid change. A typical system, available as of January 2009, is the Dell OptiPlex® 740 Series PC. However, Teledyne RDI is not necessarily endorsing this brand of PC; it is just one example of a system that meets the PC capability requirements. Teledyne RDI cannot evaluate the many brands of PC and accessories that provide similar capability. It is probably best to choose a PC manufacturer with a significant sales volume in your region, as any PC warranty & repair issues will be handled directly between the end-user and the PC manufacturer. For small vessel operation, various models of commercially-available laptop computers may also be suitable.

*Can the customer use their existing computer system to support the WHVM?*

So long as the system meets the minimum specifications, above, it should be adequate. Processor speed, memory, disk space and number of serial ports are important factors in operating the system. Monitor size is important in taking advantage of the capability to display several information windows simultaneously.

*Can the customer use their existing vessel network to communicate with the WHVM computer?*

The computer for the WHVM system should have an ethernet card installed. VMDAS software allows WHVM data to be saved to, or read from, any network drive the WHVM computer can see. WHVM system timing is set from the computer. If the computer has access to the network, or has its own GPS timing card, the WHVM system computer time can be synchronized with the shipboard time, therefore allowing the WHVM system to be synchronized with shipboard time.

*What affects the performance of the WHVM system?*

The Workhorse Mariner (WHVM) is a Doppler sonar system, which transmits acoustic signals and listens to the echoes of those signals returned from materials floating with the currents throughout the water column. The performance of the system is generally related to the amount of energy transferred into the water, and the strength of the returned echoes in relation to other, unwanted, acoustic energy (noise). Nominal system performance, as represented in advertised specifications, can be expected so long as reasonable care is taken in system installation, good quality external sensor data (vessel heading & navigation) is provided, and environmental conditions (backscatter material concentration) are typical. The most common cause of poor system performance is inadequate installation. Excessive shipboard mechanical noise, water flow noise, bubble-layer interference, mutual interference with other shipboard acoustic sensors, poor navigation data, improper transducer alignment, and other similar chronic conditions can be minimized with proper attention to system installation. With adequate installation, system performance should be consistent with advertised specifications under typical vessel operating conditions. System performance, generally in terms of profiling range, will vary with density and distribution of backscatter material present in the water column, and with vessel attitude dynamics. Advertised performance specifications can be expected under typically-experienced conditions of sea state, backscatter intensity, and vessel survey operations.

*What are the choices for WHVM system installation?*

Proper transducer mounting is critical to system performance. There are four basic variations for vessel-mount system installation: (1) within an acoustic well, (2) within a moonpool, (3) through a gate valve near the keel, on a stem or pole that may be extended or retracted, or (4) on a pole over-the side. The strongly preferred method is within an acoustic well that also allows access to the ADCP from inside the vessel. This results in optimal system performance, along with ease of maintenance. An acoustic well may also be contained in a separate structure (Gondola) suspended below the hull. Such "Gondolas" may have superior characteristics due to isolation from vessel mechanical noise and location beneath the bubble-layer, but may also allow mutual interference from other, closely-placed acoustic devices. Moonpool mounting can be acceptable, if care is taken

to prevent excessive water movement (sloshing) around the ADCP. Moonpools tend to be larger than a properly designed acoustic well, and may therefore resonate with the transducer ping (ringing), resulting in velocity measurement error. Stem (or pole) mounting of an unprotected ADCP may be practical for the WHVM, however there are serious considerations. Since the stem puts the transducer out into the water, there is turbulent flow around the transducer, causing flow noise that will reduce system range performance. If a stem is built to be extended and retracted, care must be taken to prevent the rotation of the transducer when the stem moves. Changes in transducer orientation will cause errors in water velocity measurements. A properly (hydrodynamically) designed pod, housing the transducer, affixed to the outside of the hull with a stem penetration, can be suitable. Over-the-side mounts have the same drawbacks as stems, and are often not mechanically stable at higher vessel speeds, causing transducer vibration that will affect performance. Care must be taken to construct a mounting arrangement that will remain stable at anticipated vessel survey speeds. Regardless of the method, all installations must be carefully designed to isolate the transducer from mechanical hull noise, and prevent the accumulation of bubbles in front of the transducer that will block the acoustic signal.

#### *Does Teledyne RDI provide Acoustic Well designs?*

Teledyne RDI provides generic, conceptual drawings for various types of ADCP mountings, and general advice on mounting criteria affecting ADCP operation. These are simple drawings, provided to illustrate basic ideas for acoustic well arrangement and transducer mounting. Each vessel is unique as to hull design, machinery layout, and instrument & well location. Teledyne RDI cannot supply specific, certified, mechanical design drawings, because we are not prepared to offer professional marine architectural services at the level required to enter into contractual relationships with shipyards. Refer to the Workhorse Installation Guide for details.

#### *What are the issues regarding interference with other shipboard acoustic sensors?*

Multiple shipboard acoustic systems have the potential for mutual interference. As more sensors are installed on a particular vessel, the likelihood of interference increases. Factors affecting mutual interference include the proximity of transducers, orientation of beam angles, similarity in operating frequency and bandwidth, and nature of transmit/receive timing. Teledyne RDI can offer advice, based on its accumulated knowledge and judgment gained from 20 years of vessel-mount ADCP installation experience, to optimize the installed performance of the Ocean Surveyor systems. However, Teledyne RDI cannot determine, before installation & testing, the exact nature of interference that might occur.

Teledyne RDI can advise on design and placement of the WHVM ADCP. The WHVM includes a trigger-in/pulse-out feature to allow transmit pulse timing synchronization with other acoustic systems, to minimize mutual interference. Teledyne RDI does not supply devices for ping synchronization or integration of multiple systems. Teledyne RDI can also advise on, but cannot accept responsibility for, multi-system integration, including the strategy for multi-system ping synchronization, which may be desired to attempt to minimize mutual interference among all shipboard acoustic sensor systems. Teledyne RDI cannot be held responsible for the proper operation of non-Teledyne RDI-supplied systems. Interference from other acoustic systems, if any, which degrades the performance of the ADCP, cannot constitute a basis for failure of Workhorse Mariner acceptance tests.

#### *What installation support services are offered?*

Teledyne RDI offers installation support services in the form of a “Commissioning Service”. This service is quoted as a standard service product, consisting of 4 days of on-site engineer time, including travel and expenses. Teledyne RDI does NOT offer to perform the physical installation of the system hardware components. Teledyne RDI can also supervise the installation process in a short separate visit, prior to commissioning.

The full Commissioning Service is intended to:

- Survey the physical installation and WHVM system interface with external systems,
- Perform initial system start-up,
- Perform system static tests,
- Perform system underway (dynamic) tests,
- Perform operator training.

The time required should be 4 days, depending on the ship availability schedule. One day, dockside, is enough for static system checkout, assuming all hardware is physically installed properly. There should be underway tests, to test system integration, validate overall performance against the installation, and identify any

installation issues that need attention. This testing could easily stretch out over a few days, in light of other sea-trial commitments that prevent dedicated testing of the ADCP. The sea trial period should also serve as training time. Naturally, the dockside and sea trial days should be contiguous. The standard Commissioning Service does not cover extended stays, or multiple visits, however services can be purchased on a day-rate basis.

*What if the customer declines to buy installation support services?*

Often, customers will insist on purchasing only the WHVM system, without commissioning, or a computer. The customer may be forced by administrative rules to consider those items separately, or may already have an acceptable alternative to the computer. Installation support is so important, however, that it should be stressed that *without formal system acceptance, Teledyne RDI cannot properly address reports of poor system performance*. It is in everyone's best interest to commission every WHVM system.

*What is the Factory Warranty?*

RD Instruments offers a one-year, standard, limited warranty on the Workhorse Mariner. This warranty is intended to cover manufacturing defects, and is NOT an *as-installed* performance warranty. This warranty offers repair or replacement, at Teledyne RDI's option, for covered defects in equipment returned to the factory, shipped at the owner's expense. An Extended Warranty is available, extending the period of the original factory warranty.

*Are there any recommended spare parts?*

Spare parts are rarely recommended for WHVM systems, although board-level parts are available. The Deckbox is recommended as a spare part, only for those clients who routinely order spares as a line item in a capital equipment procurement program. The WHVM Power/Serial Communication Cable is available as a replacement part, but is not usually recommended.

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