

Ocean Surveyor

Vessel-mount System Configuration and Sales Information - January 2009

General Product Information

The Ocean Surveyor (OS) product family is intended to provide long-range current profiling, when permanently mounted on larger ocean-going vessels.

- OS systems are capable of both Broadband processing, for high-precision measurement, and narrowband processing, for long range operation. Broadband and narrowband pings can be interleaved, for simultaneous operation.
- OS systems provide bottom-track reference for direct vessel speed measurement. Vessel speed can be output from the system computer to an optional, Remote Speed Log Display.
- The patented OS phased-array technology creates 4 acoustic beams, simultaneously, from a single, compact transducer. The small size of the phased-array transducer allows a lower frequency OS to replace an older, Teledyne RD Instruments (RDI) VM transducer which has physically separate beams, without requiring a larger acoustic well in the vessel hull. This allows an existing Teledyne RDI client to easily upgrade to a longer-range system.
- The OS system provides a pulse output, and can accept a trigger input, for ping synchronization with an external device.
- Several vessels have been outfitted with both an OS38, for long range in deep-water applications, and an OS150, for good resolution in shallow-water applications. A single computer can operate both OS systems, simultaneously, using the included VMDAS software.
- Proper installation is a critical factor in the realization of optimal system performance. ALL systems should be considered as a package, including the acoustic window and commissioning service, and either including or specifying an acceptable computer system. Optimal system performance may also critically depend upon the quality of data input from non-Teledyne RDI sources, such as vessel heading and navigation data.

Following are specific answers to common questions on details for the Ocean Surveyor product family.

Frequently Asked Questions

What should be considered for a complete OS 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 OS system should ALWAYS be considered as part of a complete package, to insure the best results.

The total package should consist of:

- The OS model appropriate for the user application
- Extra Transducer cable, if required for the vessel installation
- The recommended computer system, or equivalent
- 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, navigation)

What is included in the System Hardware?

The product hardware consists of (3) major pieces; the Transducer, Transducer Cable, and Electronics Chassis.

- The product selection consists of (3) fixed-frequency models: 38kHz, 75kHz and 150kHz.
- The OS transducer is a round, flat-faced, 32x32 (or 36 x 36) element phased-array. The Transducers are frequency-specific; they cannot be interchanged. Transducer cases are naval bronze. The Transducer housings are (nominally) depth-rated to 200m. NO high-pressure option is available. The vessel-mount Transducer DOES NOT contain heading or tilt sensors. External (vessel) heading data MUST be input to the OS system Electronics Chassis or OS system computer, from a customer-supplied device.
- The Transducer cable is not frequency-specific. The STANDARD Transducer Cable is supplied in a 30m length, with both connectors installed as straight, molded connectors. The wet-end connector can be 90 degree angle, if so specified with the order. The dry-end (Chassis) connector may be delivered unattached, for ease of cable installation, and may be supplied in an angled configuration, if so specified with the order. 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 30m. An older BBVM transducer cable cannot be used with the OS.
- The Electronics Chassis are frequency-specific; they cannot be interchanged. Chassis are 19" rack-mount, NOT weather resistant, sealed or waterproof. The Chassis accepts 85VAC to 250VAC, 45-65Hz input power.
- Electronics Chassis are configured to accept analog Gyro heading input. 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, instead of analog Gyro signal to the Chassis.
- A standard 10m Gyro Interface Cable is also supplied. Specify if a longer cable is required.

What System Software is provided?

Teledyne RDI Windows-based software is supplied with the OS 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 OS?

Teledyne RDI recommends the use of a commercial PC as the most economical approach to providing OS 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 OS 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.

Can the customer use their existing computer system to support the OS?

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 OS computer?

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

What is the Remote Speed Log Display?

The Remote Speed Log Display accessory enables the user to take advantage of the OS system's precise velocity measurements, to also function as an aid for vessel navigation. The VMDAS software allows output of vessel speed log data through a dedicated serial port on the OS system computer. This data appears on the serial port in NMEA 0183 format. The data consists of vessel speed (forward & starboard velocity), vessel heading, and water depth. This speed log output data capability can be used by displaying the data on the (optional) Remote Speed Log Display product, available as an OS accessory (see the price list). This touch-screen display can be mounted remotely from the OS system (ie: on the bridge). The display can be configured from the front panel to show the speed log data in various formats, and can also display the calculated distance traveled.

What affects the performance of the OS system?

The Ocean Surveyor 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 OS 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 Transducer 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 transducer. 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 transducer is not at all practical for the OS38, and there are serious considerations even for smaller transducers. 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. Stem, and over-the-side mounts, are considered non-standard by Teledyne RDI. 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.

Why does the OS need an Acoustic Window?

Like any vessel-mounted acoustic system, the performance of the Ocean Surveyor is sensitive to acoustic noise. For best performance, the transducer is mounted in its own well, recessed in the vessel hull, with an opening slightly larger than the transducer. An Acoustic Window, mounted across the well opening, is required to isolate the transducer face from flow noise, as the vessel moves through the water. The Acoustic Window is a polycarbonate material (*other materials will have differing acoustic properties that will affect ADCP performance*). The thickness of the window must be selected depending on the required structural strength of the window for a particular well design, and the range loss for a particular frequency system. A thick window provides strength, but causes more signal loss than a thin window, resulting in loss of profiling range.

The Acoustic Window material is available in flat sheets, in either 4.0 foot x 4.0 foot, or 2.0 foot x 2.0 foot sizes, to be cut to size by the shipyard at the time of installation. Specify thickness and sheet size desired.

- 38kHz OS, recommended window thickness 1.5" (38mm)
- 75kHz OS, recommended window thickness 0.75" (19mm)
- 150kHz OS, recommended window thickness 0.375" (10mm)

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 OS Installation Guide for details.

Are there special considerations for icebreakers?

The installation of an OS on an icebreaker requires considering two particular issues; strength of the acoustic window, and use of antifreeze in the seachest.

Acoustic window material

- Either Polycarbonate or LDPE can be used, but acoustic and physical properties differ.
- LDPE is stronger. Polycarbonate is more brittle.
- Maximum available material thickness is 2.0 inches.
- Acoustically, the materials behave similarly for a 1.5 inch thickness at 38 kHz (each with ~3 decibels of two way transmission loss at 38 kHz). At 2 inches, the LDPE is slightly worse (~ 4 decibels), but the polycarbonate hits a notch in the spectrum with a two inch thickness and definitely should not be used.

Two US icebreakers (the Gould and the Palmer), retrofitted with OS38s, used 1.5 inch thick polycarbonate. Naval architects specified a five inch thickness of our standard Zelux - W (polycarbonate) window to accomplish the strength requirements, which led to two immediate difficulties:

- There is no manufacturer of Zelux W capable of manufacturing a window of sufficient diameter for an OS38 well covering at this thickness from a single sheet. The general practice would be to manufacture two sheets and join them, which introduces significant unknowns in both strength and transmission characteristics.
- A five inch thick window was going to reduce the transmission range to something on the order of 200 m.

The solution chosen was to use a standard 1.5 inch thick polycarbonate window material (which can be made in a single sheet by Westlake Plastics, among others). Since this material did not meet the theoretical strength requirements, the well structure was designed to have sufficient water-tight integrity should the window break.

Antifreeze

A mixture of no more than 40% Propylene Glycol is recommended, should antifreeze be desired to be used in the seachest. Ethylene Glycol must not be used, as it is incompatible with the urethane used in the OS transducer.

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 OS acoustic well. The Ocean Surveyor 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 Ocean Surveyor, cannot constitute a basis for failure of Ocean Surveyor 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 OS 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 OS system, without commissioning, a computer, or window material. 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 OS system.

What is the Factory Warranty?

Teledyne RDI a one-year, standard, limited warranty on the Ocean Surveyor. 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?

No individual, board-level, spare parts are available for OS systems. The Electronics Chassis is recommended as a spare part, for those clients who routinely order spares as a line item in a capital equipment procurement program. Transducer Cables are available as replacement parts, but are not usually recommended as spare parts. Transducers are the high-value part of the OS system. Transducers are available as replacement parts, only with the return of the old transducer. Transducers are not offered as spare parts.

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