



Sonar CoPilot

by SeeByte

AUTONOMOUS VEHICLE CONTROL



seebyte

Awareness Made Easy

VideoRay Sonar CoPilot Operator Manual



Copyright Notice

This material is copyright protected. No material may be reproduced or transmitted in any form or by any means for any purpose without expressed written consent of VideoRay LLC.

Copyright © 2015, VideoRay LLC - The Global Leader in Micro-ROV Technology



Table of Contents

- Copyright
- Table of Contents
- About this Document
- How to Get Help

Product Overview

- Quick Start Instructions
 - Safety First
 - System Components
 - Pre-Dive Preparations
 - Dive Operations
 - Post-Dive Operations
- Glossary

Equipment Guide

Software Guide

- Sonar Display
- Water Column Display
- Tracking Controls
- Toolbar
- Status

General Operations Guide

About this Document

This manual provides the following:

- an overview of the VideoRay Sonar CoPilot hardware unit configuration and connectivity;
- a general description and specification of VideoRay Sonar CoPilot pilot interface; and
- operating instructions for VideoRay Sonar CoPilot and equipment.

Target Audience

This manual is designed and developed for operators of the VideoRay Pro 4 MicroROV with a sonar who are required to operate the VideoRay remotely operated vehicle (ROV) systems using VideoRay Sonar CoPilot.

Document Conventions

Several symbols are used throughout this documentation to add emphasis and to assist in relocating important information. The following table describes these symbols and their uses.

SYMBOL	DESCRIPTION
	The Danger icon is used to indicate there is a potential risk of personal injury or death. Extra care should be taken to understand the risks, and all personnel should exercise caution. It may also be appropriate to warn others in the immediate vicinity.
	The Caution icon is used to indicate there is a potential risk of damage to the equipment or surrounding property. Personnel should receive training in the appropriate procedures before attempting to operate or maintain the equipment.
	The Note icon is used to emphasize a specific detail or point of information.
	The Tip icon is used to highlight a suggestion.

Quality Commitment

VideoRay strives to design, manufacture, deliver and support the highest quality products and services, including this documentation. We have made every effort to ensure that this documentation is accurate and provides you with the most up-to-date information. However, there is no substitute for experience and/or training, especially with respect to the real purpose for which you plan to use this equipment. We encourage you to explore options beyond the scope of these materials to expand your knowledge and skills necessary to support your application. In addition to this documentation, VideoRay offers training and technical support and hosts a general user discussion forum and user image gallery.

We also realize that collectively, users of our products spend considerably more time operating our systems than we do ourselves. Users also encounter more diverse operating environments across an extremely broad range of applications. We highly value this vast experience base, and if you have any questions or suggestions, please feel free to contact us by any of the following methods.

If you find anything wrong with this documentation, or have suggestions for improvements, each page contains a "Help us improve this document" feedback link in the left margin (you must be connected to the Internet).

Address

[VideoRay LLC](#)
212 East High Street
Pottstown, PA 19464
USA

Email

info@videoray.com General Information and Sales
support@videoray.com Technical Support

Telephone

+1 610-458-3000 Office

+1 610-458-3010 Fax

The information contained herein is deemed accurate at the time of printing and is subject to change without notice.

Online Manual

The full version of this manual is available in HTML or PDF formats for viewing or download from VideoRay's website at:
<http://www.videoray.com/support/manuals.html>.



How to Get Help

Help for your CoPilot Sonar product is available through several channels.

All Hours Self-Service / Crowd-Source Tools

Operator's Manuals and Standard Operating Procedures	www.videoray.com/support/manuals.html
Software Downloads	www.videoray.com/support/downloads.html
Frequently Asked Questions	www.rovfaq.com
ROV User Forum	www.rovinfo.com

Global Support

Email	support@videoray.com
Phone	+1 610-458-3000 (<i>select option 1</i>)
Skype	videoray.support (<i>by appointment</i>)
Remote Sessions	www.videoray.com/support/remote-support.html (<i>by appointment</i>)

Regional Support

VideoRay Authorized Service Centers and Dealers	www.videoray.com/dealer.html
---	--

Training

Operator Training	www.videoray.com/learn-more/training.html
Advanced Maintenance Training	www.videoray.com/learn-more/advanced-maintenance-courses.html

Operational Strategies and Tactics Support

If you need help understanding how to apply your system to a specific project, contact VideoRay or your local VideoRay dealer. We can provide guidance or help you find a certified consultant.

Product Overview

VideoRay Sonar CoPilot V1.1 provides the latest generation of SMART software tools in a simple to use, pilot-friendly form. Training using VideoRay Sonar CoPilot is painless and the intuitive tools help novice users tackle even the most complex operations.

Pilots normally control a VideoRay ROV using thruster inputs to follow a desired course and speed. Constant adjustments are required to correct the course and account for water current and tether drag. Using VideoRay Sonar CoPilot, operators are able to identify objects suitable for tracking and can then maintain a stable heading and range to the target as desired, without the concern of current and tether drag.

Pilots using the Pro 4 ROV equipped with VideoRay Sonar CoPilot will be able to:

- visualize current field of view as captured by the sonar;
- track and hold position relative to a selected target;
- alter the colormap of the interface to suit personal preference and current conditions;
- concentrate on the operations and not actual action of piloting.

2.1 Requirements

VideoRay Sonar CoPilot requires that the Pro 4 ROV is equipped with a BlueView P900 Sonar.

2.2 Dynamic Positioning System

A dynamic positioning (DP) system allows the ROV to automatically hold a requested position. A DP system mimics automatically what a pilot would do in adjusting the thrusters to keep the desired position.

VideoRay Sonar CoPilot enables object-relative station-keeping and approach; the system will maintain a constant range to target while keeping the target at the center of the sonar field of view. The user can then perform object-relative advances / retreats (reduce or increase range to target); or change depth/altitude while keeping a constant distance from the target.

2.3 VideoRay Sonar CoPilot Core Features

The core features of VideoRay Sonar CoPilot are:

- Pilot Interface: The VideoRay Sonar CoPilot pilot interface offers the visual aid of real-time monitoring of the sonar field of view. Its non-intrusive dark background enhances the display on screen and allows the user to extract vital real-time information for piloting.
- Sonar Target Tracking: VideoRay Sonar CoPilot allows the user to select and track a target using the simple Pilot Interface.
- Sonar Target relative vehicle control (see Tracking Module below).
- Compatibility: VideoRay Sonar CoPilot is compatible with the latest version of the BlueView P900 Sonar devices.

2.3.1 Tracking Module

The tracking module is a navigation tool that augments the operation of the dynamic positioning system. This tool works by using sonar input, analyzing the images produced by the sonar and identifying trackable targets within the sonar field of view. If a target has been selected, the user is able to reliably and safely move the vehicle relative to the target, provided it remains within the field of view of the sonar. The tracking module has applications in sub-sea operations, such as riser tracking, that allow the vehicle to easily maintain a constant visual of the selected target.

Quick Start Instructions

These Quick Start Instructions are streamlined to cover just the essentials of operating your CoPilot Sonar system. They are provided to get you started as quickly as possible, while keeping you and the equipment safe. They cover the equipment set up and basic operation, but are not intended to result in a comprehensive base of knowledge or set of operational and piloting skills. The remaining sections of this documentation should be referenced for a complete understanding of the features, capabilities, operating procedures and maintenance requirements of your CoPilot Sonar system.



While you will likely find the Pro 4 easy to pilot, we strongly recommend that your first dive be conducted in a controlled environment such as a small tank or pool. As you gain experience with your system and confidence in using it, you will be able to operate in more challenging conditions that might include low visibility, currents and potential hazards that could snag your tether or trap your ROV.

Topics in this Section

- [Safety First](#)
- [System Components](#)
- [Pre-Dive Preparations](#)
- [Dive Operations](#)
- [Post-Dive Operations](#)

Safety First

DANGER **CAUTION** Operating electrical devices in and near the water can be dangerous. There is always a risk of drowning or electrocution in such an environment. Reduce these risks by using common sense and observing safety regulations and recommended safe practices including the following:

- Never handle power cords while in contact with water or allow power cord connectors or the control panel to enter the water. The only components that can safely be placed in water are the submersible, any onboard accessories and tether, and only after making sure the connections are secure.
- Always test the GFCI (Ground Fault Circuit Interrupter) before beginning operations. Follow the procedures described later in these Quick Start Instructions.
- Have proper safety equipment, such as PFDs (Personal Flotation Devices), on hand and make sure you know how to use them before you need them.
- Keep fingers, hair, loose clothing and other objects away from VideoRay's propellers.

- Be aware of and follow any legal ordinances or regulations in your area regarding operation of vessels and underwater equipment in the water.
- Monitor weather and sea conditions and heed any warnings or alerts.



Before setting up for or commencing any dive, it is a good practice to make sure there are no hazards to people or the equipment on land or in the water. If there are other people in the water nearby, you should advise them that you are going to be operating the ROV. As the owner/operator, it is your responsibility to ensure the safety of those around you as well as that of the equipment and nearby property.

How Safe Is Safe Enough?

Addressing all aspects of safety while working in a water environment is beyond the scope of this documentation. VideoRay encourages you to participate in safety training appropriate for your industry and applications, including such topics as vessel operations, first aid, survival and other relevant topics.

Introduction to the System Components

Unpack the system and familiarize yourself with the components.



ROV

The ROV, or Remotely Operated Vehicle, carries the cameras, lights and sensors or accessories to the underwater places you want to observe. Thrusters provide mobility and these systems are controlled from the surface using the control panel and hand controller.

See the [ROV](#) section of the [Equipment Guide](#) for more information.

Hand Controller

The hand controller is used to pilot the VideoRay and operate other features like the lights, camera controls and manipulator. The hand controller is pre-programmed, but can be customized to meet specific user or operational needs.

See the [Hand Controller](#) section of the [Equipment Guide](#) for more information.

Tether / TDS (Tether Deployment System)

The tether connects the ROV to the control panel. It delivers power and control signals to the ROV, and returns video and sensor data (optional) from the ROV to the surface. Some systems come with a TDS (Tether Deployment System), that makes the work of managing the tether easier. The tether is also often referred to as the umbilical.

See the [Tether](#) section of the [Equipment Guide](#) for more information.



Some items shown are optional and not included with all models.

Additional Items

Additional items may be supplied with your system including tools, spare parts and some accessories. If included, these items are described in other sections of this documentation.

Pre-Dive Preparations



Select a safe and preferably level area to set up the control panel. See the [On-site Operations](#) section of the [Project Management Guide](#) for more information about site selection and set up.

The pre-dive preparations consist of three parts, a visual inspection before setting up the system, setting up the system including making connections, and power on tests of the system's safety circuits and primary functions.

VideoRay Cockpit includes an online interactive Pre-Dive checklist. See the [Pre-Dive Checklist](#) section of the [VideoRay Cockpit Guide](#)

Conduct a Visual Inspection

Assuming this is your first time using the VideoRay, everything should be in proper working order and ready to go, but it is good practice to perform a pre-dive inspection before every dive, even your first. If any problems are noticed, refer to the [Diagnostics and Repair](#) section of the [Maintenance Guide](#) and take appropriate corrective action, or contact VideoRay for assistance before commencing the dive.

1. Inspect the ROV and other system components to make sure there are no visible signs of damage or loose or worn parts. Also check for water inside the ROV hull by holding it with the front facing downward and look for signs of water in the main dome or light domes.
2. Check the horizontal thrusters to make sure that the shafts are not bent and the propellers are free to spin and are not fouled, loose or binding on the thruster guards. Check the thruster cartridge seals - they are filled with oil and there should be no signs of leaking or contamination. A small air bubble in a thruster cartridge seal is acceptable. See the [Maintenance Guide](#) for [warnings, replacement criteria, examples and replacement procedures](#).
3. Check the vertical thruster to make sure the shaft is not bent and the propeller is not fouled or loose or binding on the float block. Also, check the thruster cartridge seal following the same guidelines used to check the horizontal thruster cartridge seals. Make sure the accessory port at the rear of the ROV is sealed with either a connector from an attached accessory or an accessory port terminator plug. Removal of the float block by loosening the retaining screw may facilitate this process.

Make the Connections



Connecting or disconnecting cables while the system is powered on is not recommended.

Most of the cables have been connected at the factory. See the appropriate sections of the [Equipment Guide](#) for detailed information about each of the connections.

You will typically need to connect only the hand controller, tether and power cord.

1. Connect the hand controller to one of the USB ports on the back of the control panel or directly to one of the USB ports on the computer.
2. Connect the female end of the tether connector to the ROV. The connectors have one pin that is offset towards the center of the connector. Make sure the connectors are clean, align the pins, and push the connectors together - do not twist the connectors. Secure the locking collar by screwing the halves together, and connect the strain relief cable from the ROV to the braided strap on the tether.
3. Connect the male end of the tether to the control panel. When not in use, keep the tether connectors clean and protected for the best performance and reliability.
4. Plug the control panel power cord into a conventional power source (100-240 Volts AC, 50,60 Hz). Power can be supplied through a land-based power outlet, generator or battery and inverter. See the [Control Panel](#) section of the [Equipment Guide](#) for power source requirements.

Power On Tests



If the system does not pass any of the following tests, it should not be used until the problem is identified and corrected. See the [Diagnostics and Repair](#) section of the [Maintenance Guide](#) for more information.

The VideoRay Pro 4 includes circuit safety component.

- The GFCI (Ground Fault Circuit Interrupter) / Circuit Breaker

Testing the Circuit Safety Components

Test the GFCI / Circuit Breaker switch (The system must be connected to a working power source to perform this test.)

1. Set the GFCI / Circuit Breaker switch to the On position.
2. Press the test switch on the GFCI. The GFCI / Circuit Breaker switch should turn off.
3. Set the GFCI / Circuit Breaker switch to the On position.

Set the Power switch to the On position. The green Power On indicator light should turn on. If the green Power On indicator light is not on, make sure the system is connected to a working power source and the GFCI / Circuit Breaker switch is turned on.

Starting VideoRay Cockpit Control Software

Make sure the system is connected to a working power source and the GFCI / Circuit Breaker and Power switches are turned on.

1. Turn on the computer and wait for the system to complete the boot up process.
2. After the computer has started, start VideoRay Cockpit using the desktop icon, or by selecting it from the Start->All Programs->VideoRay menu.
3. When VideoRay Cockpit starts, you will see the [Video Window](#), the [Control Instruments](#) and the [Control Bar](#). For now, you will only need to focus on the video window. See the [VideoRay Cockpit Guide](#) for details about using VideoRay Cockpit.



VideoRay Cockpit screen with simulated video image - your image will likely be different.

Testing the System's Functions

The next step is to ensure that the essential features of the ROV are functioning properly. Use the hand controller to perform the following tests. See the [Hand Controller](#) section of the [Equipment Guide](#) for more information about using the hand controller.



Test the thrusters

CAUTION For the next two steps, do not operate horizontal thrusters out of water for more than 30 seconds to avoid overheating or premature wear of the cartridge seals.

1. Gently move the joystick forward and backward and left and right - the horizontal thruster motors should turn the propellers. Release the joystick - it will return to center on its own, and the propellers will stop turning.
2. Rotate the Depth Control knob - the vertical thruster motor should turn the propeller. Return the Depth Control knob to center to cease the vertical propeller rotation.

Test the lights

CAUTION For the next two steps, do not leave the lights on bright for more than 30 seconds while the ROV is out of water to avoid overheating.

1. Press and hold the Lights Bright button to increase the intensity of the lights - the lights should get brighter.
2. Press and hold the Lights Dim button to dim the lights - the lights should dim.

Test the camera functions

1. Press and hold the Camera Tilt Up button - the camera should tilt up smoothly through its entire range.
2. Press and hold the Camera Tilt Down button - the camera should tilt down smoothly through its entire range.
3. Press and hold the Camera Focus In button - the camera should focus in smoothly through its entire range.
4. Press and hold the Camera Focus Out button - the camera should focus out smoothly through its entire range.

 If a manipulator or other accessories are attached, these items should be checked at this time.

Good Advice

The time to catch small problems before they become big problems is during the pre-dive inspection.

CAUTION The thruster cartridge seals are designed to prevent water intrusion along the thruster shafts. Based on service records at VideoRay, the most frequent repair (as well as the most expensive) is the failure of the operator to inspect the thruster cartridge seals and replace them as necessary.

View example [cartridge seals](#)

Dive Operations

After all of the pre-dive checks and tests have been completed successfully, you are almost ready to commence the dive. But, there is one more issue to address that could affect the performance of the ROV. The ROV is designed to be operated in a near neutrally buoyant configuration, so the last step before launching your VideoRay is to check the buoyancy, and adjust the ballast if necessary. For most operations, the buoyancy is optimal when the top of the float block is even with the water surface and the ROV is level. If the ROV is too buoyant or too heavy, the vertical position may be hard to maintain or control.

 Buoyancy will need to be adjusted for use in fresh water versus salt water and depending upon whether accessories are used with the ROV.

Buoyancy Check and Adjustment

To determine if the buoyancy is correct, lower the ROV and at least 3 meters (10 feet) of tether into the water. You can lower the ROV by the tether - it will not hurt the tether because there is Kevlar in it. Observe the ROV in the water - it should not be floating too high or sink. It should also be floating level and not tipped to one side or pitched up or down. If the ROV floats too high, you will need to add some ballast weights. If the ROV sinks, you will need to remove some ballast weights. If the ROV is not floating level, you can change the locations of the weights.

The buoyancy can be adjusted by opening the skid pods and adding or removing the supplied ballast weights. To open the skid pods, turn the ROV upside down. Press on the buttons on the sides of the pod, and lift up on the pod shell. The weights can be added to or removed from the slots by hand. For most operations, the weights should be evenly distributed.

Commence the Dive

Once the buoyancy has been adjusted the ROV is ready to launch. Lower it into the water and operate the controls to maneuver it.

- Start with the ROV on the surface and push the joystick forward slightly to make the ROV move forward. Move the joystick to the left or right to make it turn left or right. Get a feel for how agile the ROV is.
- Observe the video display as well as the ROV to become acquainted with the camera's wide angle lens and its affect on depth perception underwater.
- Once you feel comfortable with the horizontal maneuverability of the ROV, rotate the depth control knob to dive the ROV. Tilt the camera down as you dive so you can see towards the bottom. Rotate the depth control knob to bring the ROV back to the surface. Tilt the camera up as you surface so you can see towards the surface.
- Change the lights settings, and adjust the camera focus. If you have a manipulator, tilt the camera down so you can see it and open and close the jaws.
- As you get familiar with maneuvering the ROV, you can start to observe some of the on-screen displays including the depth, heading, camera settings and other data.

For your first dives, practice until you are comfortable operating the controls without looking at them and you are able to control the ROV with some precision.



See the [Hand Controller](#) section of the [Equipment Guide](#) for complete information about using the hand controller and see the [Piloting](#) section of the [Operations Guide](#) for more advanced tips on piloting the Pro 4.

Post-Dive Operations

At the conclusion of your dive, retrieve the VideoRay and power down the system by closing VideoRay Cockpit, shutting down the computer and turning off the Power switch. Make sure the ROV is secure before disconnecting the tether. After disconnecting the tether, keep the tether connectors clean and do not let them drag on the ground.

Proper maintenance of your VideoRay system ensures a long service life and that it will be ready to operate when you are. After each dive, you should visually inspect the system for damage that might have occurred during your operation.

VideoRay Cockpit includes an online interactive Post Dive checklist. See the [Post Dive Checklist](#) section of the [VideoRay Cockpit Guide](#)

 Keeping the ROV clean is one of the most important aspects of good preventative maintenance practices, especially after using it in salt water. If you use your ROV in salt water, or water with contaminants, you should first rinse it, and then soak it in clean fresh water for at least one-half hour. After cleaning the ROV and tether, they should be allowed to air dry before being put away for storage.

CAUTION Failure to properly maintain the ROV by thoroughly cleaning it after use may dramatically reduce its service life.

Debriefing

Congratulations! You are well on your way to becoming an accomplished micro-ROV operator, but there are still many things to learn and skills to master. Continue learning about the system by reviewing the additional sections of this documentation

and, most importantly, practice, practice, practice.

If you encountered any difficulties or have any questions, review these Quick Start Instructions and the other documentation that came with your system, including the [Equipment Guide](#) and [Maintenance Manual](#). If you still have difficulty or questions, contact VideoRay. Your success is our success, and we are here to help you get the most out of your VideoRay.



VideoRay contact information is available on the [About this Documentation](#) page.

Ready to learn more?

To accelerate your learning and receive recognition for your knowledge and skills, VideoRay offers in-person classes and online training as well as the Micro-ROV User Certificate program. Training can be delivered at your site and customized to your needs. To learn more about these opportunities, click on the training link above to visit the [VideoRay Educational Resources](#) website.



Glossary



Equipment Guide

CoPilot Sonar operates on Pro 4 ROV systems equipped with BlueView P Series sonars. For more information about these systems, see the [Pro 4 Operator's Manual](#) and the [BlueView Sonar Operator's Manual](#).

Software Guide

Sonar Display

sonar position range color

6 - Water Column Display

The water column display allows the user to view the area above and below the ROV in the water column. The ROV remains in the center of the display at all times.

Since there is no altitude sensor on the BV equipped VideoRay, the height above seabed cannot be shown. The sea surface icon is displayed in blue. The current depth is represented by an arrow the same color as the ROV.



Figure 12 - Water Column Display

⚠ The Joystick indicator above the water column display will flash yellow if the depth control is not in the center or neutral position. In this situation, the automatic depth control is disabled. Returning the depth control to the center or neutral position will restore automatic depth control.

6.1 Alarm Panel

The alarm panel is displayed across the bottom of the pilot interface. It displays the current status of each software component that allows VideoRay Sonar CoPilot to run smoothly.

If a software component fails, its name is illuminated in the alarm panel situated along the bottom of the pilot interface.

In normal operation, the bar illustrated below should have no alarms illuminated; when a failure is detected the appropriate alarm will be indicated in RED.



Figure 13 - Alarm Panel

CAUTION If any alarm is activated, the CoPilot system will automatically switch back to MANUAL, and display the warning "DP Standby"; the pilot must take immediate control of ROV from this point.

water zoom joystick

Tracking Controls

tracking controls Range Stop Manual Go to target size target type

Toolbar

target type sonar toggle record snapshot User settings sonar color

Status

status standby nav inposition joystick sonar i/o gyro depth navigation sonar



General Operations Guide

sonar interpretation target selection target relative motion