VideoRay

PRO 4

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OPERATOR MANUAL

Version 1.03.01

Table of Contents

About this Documentation

The VideoRay Pro 4 has sophisticated features, but is easy to use and maintain once you learn its capabilities and the proper operating techniques. This documentation will guide you through your first dive and provide additional details to help you learn all aspects of its operation.

Document Organization

This documentation is organized into several guides.

- The **Quick Start Instructions** provide the basic steps to get you operational as quickly as possible while keeping you and the equipment safe.
- The **Equipment Guide** provides details about each component and its function.
- The **VideoRay Cockpit Guide** explains the software features and operation in detail.
- The **Operations Guide** provides tips on how to use the system most effectively.
- The **Maintenance Guide** provides procedures for routine maintenance, diagnostics and repair.
- The **Customization Guide** provides information about customizing the system to better meet your specific needs.
- The **Upgrader's Guide** provides comparative information for people who are familiar with the VideoRay Pro 3.

Document Navigation

You can navigate through the documentation to specific topics using the menu, or step through sequentially using the Next, Previous and Up tabs. The Next tab will step you from the current topic to the next topic at the same level unless the current topic has a sub-topic. If the current topic has a sub-topic, the Next tab will step you to the first sub-topic. The Previous tab works similarly, but in reverse sequence. The Up tab can be used to move from a sub-topic to its parent topic. Additionally, your current location within the document is shown at the top of each page under the external links. You can click on any level of the hierarchy to go that location.

Inline links are shown in blue bold font. Once you click on a link, the link text changes to a blue normal font.

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.

The Hand icon is used to indicate an interactive element of the page. When you hover your mouse over the hand icon, an image on the page will change to reflect the information in the text immediately prior to the hand icon. Try it here - hover your mouse over the following text and hand icon to turn the hand icon to the left blue: Interactive Text  .

Quality Commitment

VideoRay strives to design, manufacture and deliver 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 effective means to learn how to use your new Pro 4. 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.

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Pro 4 Overview

VideoRay is pleased to present the latest model in its top-of-the line professional series Micro-ROVs - the VideoRay Pro 4. The Pro 4 has entirely new internal electronics, including camera, LED lights, processor, and added sensors. With powerful brushless motors, the Pro 4 further extends VideoRay's position as the fastest and most powerful tether pulling vehicle. Additional improvements include deeper depth rating, hydrodynamic streamlining, and optimized ballast adjustment. Topside control is based on industry standard rugged computers, with new software that integrates several functions while dynamically reconfiguring for ease of use.

The Pro 4 submersible builds on VideoRay's strengths with more than twice the vertical thrust of the Pro 3, and 50% greater horizontal thrust. A depth rating of 300 meters (1000 feet) is standard. Improvements in the electronics allow for both greater total tether length up to 600 meters (2000 feet) and much better power transmission over longer tethers. Existing VideoRay tethers can be used with the Pro 4 - and different tether types can still be combined to meet different operational requirements. New sensors, including 3 axes compass and accelerometers and MEMS gyro improve navigational capabilities. The primary video camera features ultra low light and Wide Dynamic Range imaging capability, with a wide range of user controllable parameters for demanding imaging situations. Coupled with the very high intensity LED lighting, the images and video that can be captured are far clearer, particularly in difficult lighting conditions. A second camera can be rotated 270 degrees to provide lateral views as needed.

The topside control configuration replaces inflexible and limited switches and knobs with context-sensitive controls that go beyond simply controlling the submersible to controlling navigation, sonar, image and video capture, and other sensors and accessories in addition to the submersible. This "systems approach" significantly reduces operator workload and distraction caused by separate systems for sonar, navigation, video capture, and vehicle control.

The Pro 4 is part of an industry-wide initiative led by VideoRay (the largest volume ROV manufacturer in the world) to go beyond separate "point" technology solutions to a "systems" approach to solving underwater tasks. The Pro 4 series ROVs are packaged in configurations such as the PS (Port Security Configuration) and CD (Commercial Dive Configuration) designed to solve a specific or series of underwater tasks, with VideoRay providing comprehensive solutions across the many technologies involved. Users will be able to concentrate on their underwater missions, not which technology works together and how are the pieces fit together.

FAQ (Frequently Asked Questions)

New users typically have some pretty basic questions about the Pro 4. Before getting to the details, this section is provided to address the questions asked most frequently, without having to scan through the manual to find the answers.

1. **How hard is it to learn how to operate the Pro 4?**

   The Pro 4 is easy to learn to operate. In a few hours, user should be able to pilot the ROV confidently in clear, calm water and know enough about it to maintain it in good condition for years. However, mastering all the knowledge and developing the skills to be able to pilot the ROV in much more demanding situations with near zero visibility and swift current will require more experience. See the **Quick Start Instructions** for more information.

2. **How deep can the Pro 4 go?**

   The rated depth of the Pro 4 is 300 meters (1000 feet).

3. **How fast can the Pro 4 go?**

   The rated speed of the Pro 4 is 4.2 knots.

4. **In how much current can the Pro 4 operate?**

   While the logical answer seems to be that it can not operate in current faster than the vehicle can go in calm water, operational tactics can be used to operate in current that exceeds the maximum speed of the ROV. See the **Piloting in Current** section of the **Operations Guide** for more information.

5. **How much can you pick up with the Pro 4?**

   The Pro 4 manipulator closes with about 4.5 kilograms (10 pounds) of force, and the vehicle has limited vertical thrust. However, if you can grab a secure hold of an object, you can retrieve it by pulling on the tether. Items weighing up to 20 kilograms (80 pounds) in water have been successfully retrieved. See the **Tether** section in the **Equipment Guide** for more information.

6. **How much tether can you use with the Pro 4?**

   The maximum tether length is about 600 meters (2000 feet). Tether is like convention electrical extension cords and multiple sections can be plugged in together. See the **Tether** section in the **Equipment Guide** for more information.

7. **How do you adjust the buoyancy and trim of the Pro 4?**

   The buoyancy and trim can be adjusted by opening the skid pod and adding or removing the brass ballast weights. See the **Pre-Dive Preparations** section of the **Quick Start Instructions** for more information.

8. **Can you record pictures and video from the Pro 4?**

   Pictures and videos can be recorded in digital format on the computer. There is also an analog out connector for recording to standard analog devices that accept a composite video signal. See the **Images and Videos** section in the **Operations Guide** for more information.

9. **How much maintenance is required for the Pro 4?**

The Pro 4 is easy to maintain. There are very few consumable parts, and these have been designed to be as easy to replace as possible. Cleaning the vehicle after each use is one of the most important maintenance requirements. See the **Routine Maintenance** section of the **Maintenance Guide** for more information.

Quick Start Instructions

These Quick Start Instructions are streamlined to cover just the essentials of operating your Pro 4. They are provided to get you started as fast 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 the Pro 4.

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

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), and LIM (Line Insulation Monitor) 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 to ensure the safety of those around you as well as that of the equipment and nearby property.

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.

Control Panel

The control panel includes the system's power and communications modules, computer and hand controller, and serves as the operator's console and video display. Open the control panel and familiarize yourself with the components and primary controls on the hand controller. See the **Control Panel** and **Hand Controller** sections of the **Equipment Guide** for a complete description of all of the controls and connections.

See the **Control Panel** 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.

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.

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 warn 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

CAUTION 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

DANGER CAUTION 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 two circuit safety components.

- The GFCI (Ground Fault Circuit Interrupter) / Circuit Breaker
- LIM (Line Insulation Monitor) Test and Reset buttons can be found on the front right side of the control panel.

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 labeled with an embossed "T." 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.

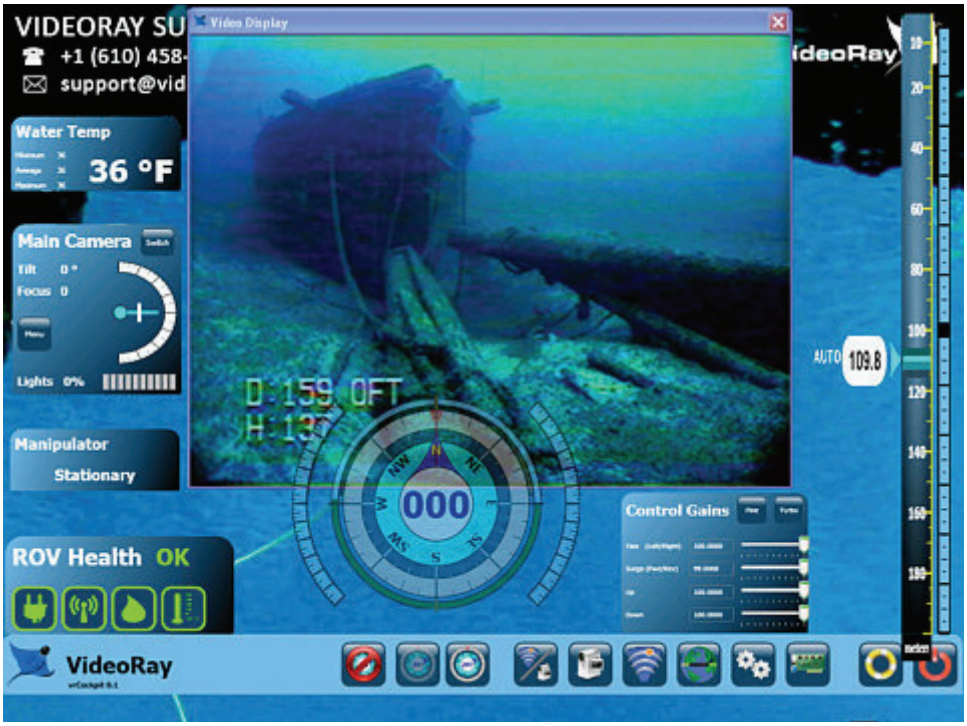
Test the Line Insulation Monitor (GFCI / Circuit Breaker switch and Power switch must both be set to On in order to perform this test.)

1. The yellow Alarm light should be off. If the yellow light is on, press and hold the black Reset button until the yellow Alarm light turns off.
2. To test the LIM, press and hold the red Test button until the yellow Alarm light turns on. This may take up to 10 seconds. Release the button when the yellow Alarm light turns on.
3. Press and hold the black Reset button to reset the LIM. The yellow Alarm light should turn off. Release the button when the yellow Alarm light turns off.

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.

Joystick
Depth Control knob
Lights Bright button
Lights Dim button
Camera Tilt Up button
Camera Tilt Down button
Camera Focus In button
Camera Focus Out button

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.

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.

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. 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 to buoyant or heavy, the vertical position may be hard to maintain or control.

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. Unhook the retaining o-ring on the end of the pod, and lift up on the pod. The weights can be added to or removed from the slots by hand. For most operations, the weights should be evenly distributed.


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

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 and then the GFCI / Circuit Breaker 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.

 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.

 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** and **Maintenance** guides. 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 in the **About this Documentation** section of the **Introduction**.

Equipment Guide

Understanding the features and capabilities of the Pro 4 equipment is essential to get the most value out of using the system. The sections within this Equipment Guide provide details about each of the components.

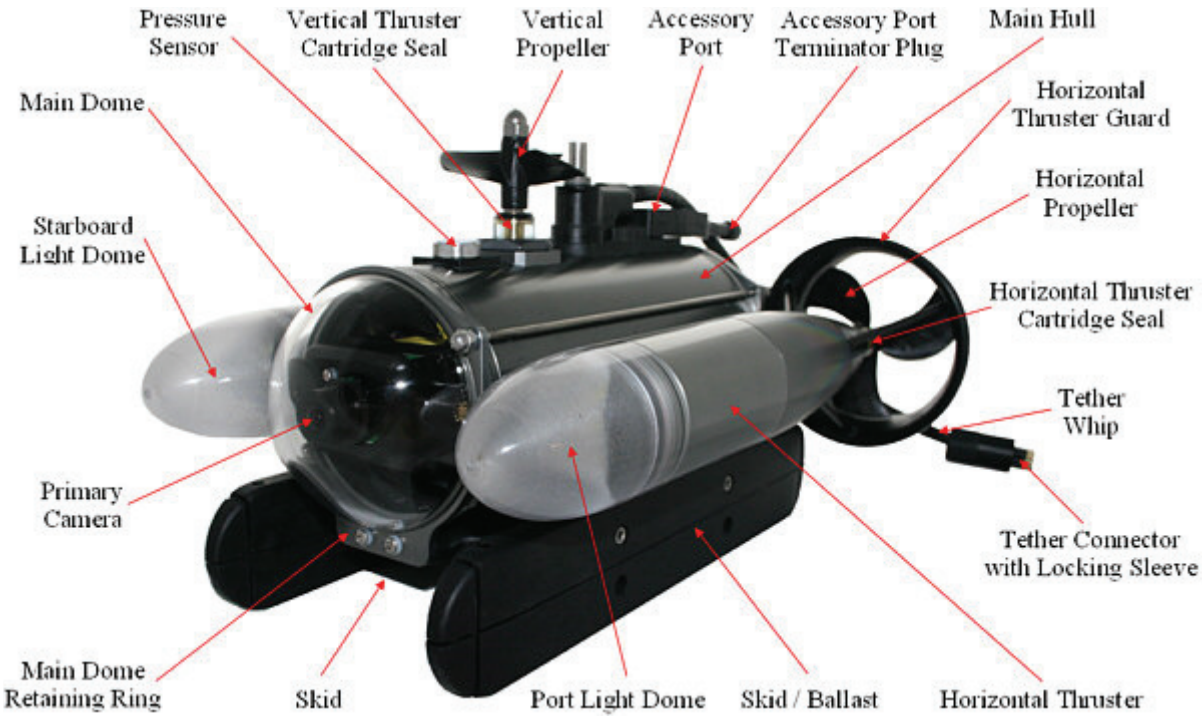
Topics in this Section

ROV

The Pro 4 ROV (Remotely Operated Vehicle) is depth rated to 300 meters (1000 feet).

Thrusters provide mobility and are controlled from the surface using the hand controller. The ROV carries cameras, lights and other sensors to the underwater locations being searched, explored or inspected.

The primary ROV components are illustrated below. Note that the yellow float block and clear vertical thrust splitter have been removed from the top of the ROV.



Connections

The ROV includes the following connections:

Connection	Type	Function
Tether Whip (View **Specifications**)	8 pin round male	Used to connect the ROV to the tether for power, communications, video and accessory support.
Accessory Port (Specifications listed below)	9 pin rectangular female	Provides power, communications and video. Can be used to connect accessories electrically to the ROV.

Accessory Port

The ROV accessory port provides power, access to the ROV communications bus and the APIC (Auxiliary Pair of Independent Conductors) to the surface. Most accessories, with the exception of the manipulator and cutter, use a stackable pass through connector that allows multiple accessories to be connected to the accessory port in parallel.

CAUTION The accessory port must be sealed with a terminated accessory connector or the accessory port terminator dummy plug. Failure to seal the accessory port may lead to loss of control of the ROV or damage to the components.

Accessory Port Specifications

Pin	Function
1	Video -
2	Video +
3	24 VDC + (30 Watts*)
4	Aux + (APIC) Connects to tether pin 4 and control panel AUX port pin 7
5	Power Common (Ground)
6	Aux - (APIC) Connects to tether pin 6 and control panel AUX port pin 8
7	RS-485 -/A
8	RS-485 +/B
9	12 VDC + (30 Watts*)

Buoyancy and Depth Control

The weight of the vehicle in water is offset by the air inside the hull and the float block on the top of the ROV. Ballast weights can be added or removed to achieve the desired buoyancy. Buoyancy can be affected by fresh or salt water and the buoyancy of any accessories that might be mounted on the ROV.

The depth of the Pro 4 is controlled by a vertical thruster. For the thruster to operate efficiently, the buoyancy of the ROV should be near neutral. This can be accomplished by adding or removing ballast weights that are stored in the skid pods on the bottom of the ROV. The skid pods are hinged at the rear and can be opened by unhooking the O-ring at the front. Turn the ROV over on its top to add or remove ballast. The ballast weights can be positioned within the skid pods to trim the ROV level, or pitched slightly up or down.

The procedures to adjust the buoyancy are described in the **Dive Operations** section of the **Quick Start Instructions**.

Propulsion

ROV Propulsion is provided by two horizontal thrusters and one vertical thruster that are controlled from the surface using the joystick and depth control knob on the hand controller. Each thruster motor turns a propeller to create the desired thrust.

Each thruster shaft is sealed with a cartridge seal to prevent water intrusion. These cartridge seals are filled with oil and will wear out over time. Worn cartridge seals need to be replaced. Inspection consists checking the amount of oil, and for any signs of contamination or other signs of wear. When the oil level is less than half of the volume of the cartridge seal, the seal should be replaced.

CAUTION Based on service records at VideoRay, the most frequent cause of ROV failure is the failure of the operator to inspect the thruster cartridge seals and replace them as necessary.

In additional to manual piloting, the VideoRay Cockpit control software provides two pilot assist modes, Auto Depth and Auto Heading. **Auto Depth** and **Auto Heading** are described in the **Operations Guide**.

The horizontal thrusters use counter rotating propellers to avoid torque induced roll while thrusting and for better performance. Additionally, VideoRay Cockpit includes variable control sensitivity and power management to further tune the performance of the thrusters.

DANGER CAUTION Avoid contact with the propellers or getting hair, clothing or other objects in the propellers.

Primary Camera

The ROV includes a primary camera in the front of the main hull, which can be tilted and focused from the surface using the hand controller. Panning the camera is accomplished by turning the ROV.

The camera has numerous features including the following highlights:

- Switchable between Color and Black and White
- Automatic White Balance
- Wide Dynamic Range
- Back Light Compensation
- Digital Slow Shutter
- 1 - 2.5X Zoom

These complete list of camera features and how to control them are described in the **Camera Menu** section of the **VideoRay Cockpit Guide**

The video circuit in the ROV is switchable between the primary camera and a video conductor pair on the ROV accessory port. This allows external cameras to be used as well, but only one camera can be viewed at a time when using this method.

 The ROV, control panel and tether, also support an APIC (Auxiliary Pair of Independent Conductors) that can be used to provide a second simultaneous video feed.

 The primary camera resides behind an acrylic dome. The dome should be cleaned with soap and water. Do not use products that contain alchohol, because this can create stress cracks in the dome.

 The front and rear domes are the same and can be interchanged. If the front dome is scratched, the rear dome can be moved to the front.

Primary Lights

The ROV uses two forward facing variable LED light modules that can be controlled from the surface using the hand controller. The lights produce 3,600 lumens. The beam pattern is optimized to minimize glare in the primary camera dome and provide maximum vertical coverage.

Sensors

In addition to the camera, the ROV includes several other sensors that provide feedback to the pilot about the ROV and the environment it is in.

ROV sensors include:

- **Pressure Sensor** - Indicates the depth of the ROV.
- **3 Axes Compass** - Indicates the heading of the ROV
- **3 Axes Accelerometers** - Indicates the attitude of the ROV
- **Water Temperature** - Indicates the water temperature of the water surrounding the ROV.
- **Internal Temperature** - Indicates the internal temperature of the ROV.
- **Internal Humidity** - Indicates the relative humidity of the air inside the ROV.

The information provided by these sensors is conveyed to the pilot via instruments in VideoRay Cockpit, and some items including the depth, compass heading and temperature can be overlaid on the video.

 The Depth and Temperature units are user selectable. See the **System Settings** tab of the **User Settings** for information on how to select the system of units.

 Do not put anything in the pressure sensor cavity or spray a strong stream of water into the pressure sensor cavity. Doing so may damage the pressure sensor.

Control Panel

The control panel provides power, communications and a video interface between the surface and the ROV through the tether. The computer, which runs VideoRay Cockpit software to control the ROV is housed in the control panel along with a second display monitor.

Control Panel Power Specifications

The VideoRay Pro 4 operates on typical residential power in the range of 100-240 Volts AC, 50,60 Hz. This can be provided from the land-based grid, a generator, or a battery with an inverter. The typical power requirements for operating from a generator or inverter are 600 Watts minimum. VideoRay supplies an inverter with the Pro 4. For sales to locations that do not support U.S. style power cords, VideoRay also provides universal IEC adapter cords with the inverter.

The system includes a GFCI (Ground Fault Circuit Interrupter) / Circuit Breaker to protect the operator.

There are two universal IEC power outlets on the back of the control panel. These outlets are protected by the GFCI. The GFCI must be on to use these outlets, but the control panel power switch does not need to be on.

The power in the tether is 74 Volts DC. This circuit is protected by a LIM (Line Insulation Monitor).

The procedures for testing the circuit safety components can be found in the **Pre-Dive Preparations** section of the **Quick Start Instructions**.

Display Monitor Tilt Arm

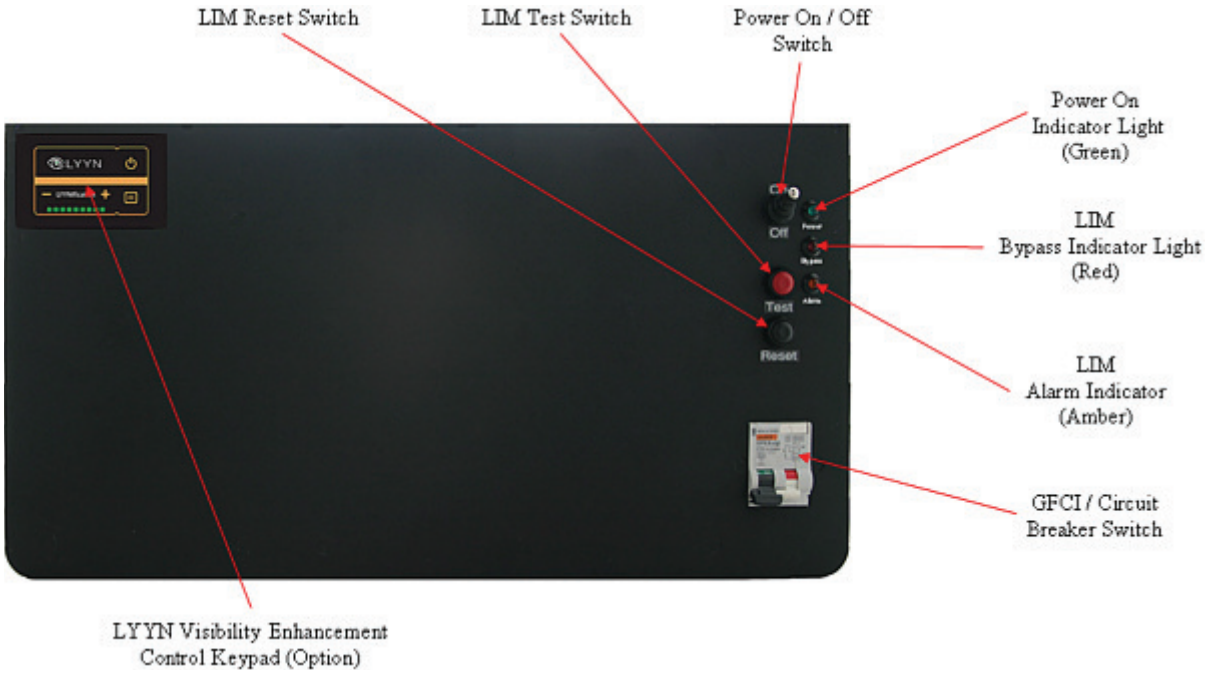
The Display Monitor Tilt Arm on the left side of the panel can be used to adjust the angle of the control panel lid, which houses the second monitor. To adjust the angle of the lid, loosen the locking collar, adjust the lid to the desired angle and tighten the locking collar.

CAUTION Make sure to loosen the display monitor tilt arm before closing the control panel lid, and be careful when closing the lid to avoid damaging the computer or monitor or pinching any cables.

CAUTION Do not block the fans. Blocking the fans can lead to overheating and component failure.

Switches and Connections

Control Panel Top



Control Panel Rear

The control panel includes the following switches:

Switch	Location	Function
GFCI/Circuit Breaker	Control panel top	Turns on the power outlets and enables the power switch.
Power	Control panel top	Turns the control panel on.
LIM Test	Control panel top	Test the LIM by simulating a fault and triggering the alarm state.
LIM Reset	Control panel top	Reset the LIM after a test or a fault has been detected and the alarm state has been triggered.
LIM Bypass	Control panel rear	If the LIM alarm state has been triggered, the LIM can be bypassed by enabling this switch.  If the LIM bypass switch is enabled, LIM protection is disabled. This situation can pose a risk to people handling the tether or in the water with the ROV. Do not use the LIM bypass switch unless you have examined the system to make sure it is safe, or are sure that people are not going to be exposed to a possible voltage leak in the tether or ROV.
AUX/Accessory Interface (Optional)	Control panel rear	Switches between the AUX connector and a dedicated accessory interface, such as an Ethernet connector, if one is included.

The control panel includes the following connections:

Connection	Type	Function
Power (100-240 Volts AC, 50, 60 Hz)	IEC male	Used to connect the control panel to a power source.
GFCI/Circuit Breaker Protected Power Outlets (2)	IEC female	Used to connect the computer and another device to the control panel to receive power.
Tether Whip (**Specifications**)	8 pin round female	Used to connect the control panel to the tether for power, communications, video and accessory support.
Monitor Power		Provides 12 Volts DC. Used to provide power to the monitor.
Analog Video Out	RCA female	Provides a composite video signal. Can be used to connect an analog video recording device.
USB PC	Type B female	Used to connect the control panel to the computer.
USB Accessories (3)	Type A male	Can be used to connect USB devices to the computer via the control panel.
AUX Port (Specifications listed below)	DB9 male	Provides access the APIC (Auxiliary Pair of Independent Conductors) in the tether. Can be used with ROV accessories that need to rely on the APIC for communications.
Ethernet (Optional)	RJ45 female	Can be used to connect the control panel to the computer for Ethernet based ROV accessories.
BlueView Pole Mount (Optional)		Used to connect the BlueView Pole Mount system to the control panel.

AUX Port Specifications

Connector Type - DB-9 Male.

Pin	Function
1	No connection
2	No connection
3	No connection
4	No connection
5	No connection
6	No connection
7	AUX + (Connects to tether pin 4 and ROV accessory port pin 4)
8	AUX - (Connects to tether pin 6 and ROV accessory port pin 6)
9	No Connection

The AUX Port provides access to the APIC. Some accessories use the AUX port directly and the topside device requires a female DB-9 connector. Some accessories can be built into the control panel. For control panels that have built-in accessories, there is a switch on the back of the control panel that determines whether the APIC is connected to the AUX port, or to the accessory components inside the control panel. The switch must be set to the proper position depending if you want to use an external device or built-in accessory. Set the switch to AUX if you want to use an external accessory device on the topside. Set the switch to the correct setting for any built-in accessory device that you want to use. For built-in accessories, there is either another dedicated connector (to connect to the laptop), or the accessory might use USB (to connect to the laptop), in which case a separate connector is not necessary. See the instructions that come with each accessory for more information.

Safety Circuits

The Control Panel includes two circuit safety components.

- GFCI (Ground Fault Circuit Interrupter) / Circuit Breaker
- LIM (Line Insulation Monitor)

See the **Pre-Dive Preparations** section of the **Quick Start Instructions** for information on testing these components.

GFCI (Ground Fault Circuit Interrupter) / Circuit Breaker

The GFCI / Circuit Breaker protects the operator from shock from the AC circuit of the power source, and protects the equipment from a current overload. The GFCI has two operating switches and a test button. To energize the control panel, both switches need to be turned on. If the GFCI detects a differential current between the supply and ground poles of the power source, it will trip, or open the circuit. If the circuit breaker detects a current greater than it's rating, it will trip. The test button can be used to simulate these conditions and pressing and holding the test button should cause the switches to open, or turn off. If the GFCI continues to trip, the system should be inspected for a fault before being used.

LIM (Line Insulation Monitor)

The LIM protects the operator from shock from the DC circuit of the tether. While the GFCI switches are part of the GFCI component and must be turned on to operate the control panel, the LIM switches are separate components and the LIM does not need to be turned on. The LIM switches include Reset and Test. When power is applied to the control panel, the LIM is active. The LIM operates on a principle similar to the GFCI and detects differential current. If the differential current exceeds a threshold, the LIM will trip. When the LIM trips, the yellow LIM Alarm LED will turn on. The LIM can be reset by pressing and holding the Reset button. The LIM may take several seconds to reset. The yellow LIM Alarm light should turn off. To test the LIM, press and hold the Test button. It may take several seconds to trip. If the LIM continues to trip, the system should be inspected for a fault before being used.

LIM Bypass

In some situations, the LIM may trip, but the system may in fact be safe to use. A common situation that may cause the LIM to trip is using an old tether that has some current leak at its connectors. The LIM is sensitive enough to detect this leak. If it is determined that the cause of the LIM tripping does not represent a potential hazard to the operator or people in the surrounding area, the LIM can be bypassed to continue operations. The LIM can be bypassed by engaging the LIM Bypass switch to the Bypass setting. The LIM Bypass switch is a locking switch and the stem of the switch must be pulled out to switch it. When the LIM is set in Bypass mode, the RED LIM Bypass LED will turn on indicating the system may be unsafe to operate.

Determining if the system is safe to operate in the LIM Bypass mode requires a trained and qualified technician. Do not operate the system in LIM Bypass mode unless you are trained and qualified and 100% certain that the situation is safe.

Computer

The computer provides the hardware and operating system platform for VideoRay Cockpit control software and image and video editing and production.

The computer system has been set up to use the "Administrator" account and there is no password assigned.

 For information about using the computer in general, see the instructions that came with it.

The computer is mounted to the control panel by a clamp. To remove the computer from the panel, loosen the yellow knob behind the computer until the computer can be pushed back enough to lift the front of the computer from the front clamp. Reverse the process to install the computer.

CAUTION When installing the computer, be sure to close the computer latch. The front clamp should be connected to the computer frame and should not be connected over the computer latch

 VideoRay does not recommend installing additional software on the computer unless you are familiar with the software and confident it will not interfere with VideoRay Cockpit or the computer's ports. Software that is packaged with VideoRay accessories has been tested and is approved for use.

The computer includes the following connections:

Connection	Type	Function
Power	Panasonic Power Supply	Used to connect the computer to a power source. The control panel includes two unswitched GFCI protected IEC female power outlets. One of these is available for dedicated use for the computer.
Ethernet	RJ45 female	Can be used to connect the computer to a network, or the control panel for Ethernet based accessories.
USB (Qty 2)	Type A female	Can be used to connect USB devices to the computer.
VGA Out	DB15 female	Provides a VGA video signal. Used to connect the computer to the monitor.
Serial Port	DB9 male	Can be used to connect the computer to RS-232 serial devices.

Computer specifications are subject to change without notice.

Monitor

The monitor provides a second display screen for the computer. The monitor has its own power switch, but is designed to automatically turn on when the control panel is turned on.

⚠ The monitor receives its power from the power supply in the control panel. When the control panel is off, the monitor will not turn on. If the computer is set to display on two screens, you will not be able to see applications or the mouse on the second screen. you will need to turn on the control panel to see applications and the mouse on the monitor.

The monitor supports several input sources, but the only input connections accessible are the VGA In, and on some systems the Analog Video In. The input source selection is controlled by the monitor menu. The monitor menu also controls the picture quality including brightness and contrast and other picture settings.

For better outdoor viewing in daylight, the Pro 4 includes a sun shade that mounts on the control panel case.

The monitor includes the following switches:

Switch	Icon	Function
Power		Turn the monitor On or Off. The system is designed to automatically turn on the monitor when you turn on the main power switch.
Menu		Enter the menu to adjust various settings.
Select		Confirm a menu selection. This button can also be used to select the monitor input source. Not all monitors support all input connections addressed by this button.
Menu Up / Previous		Move to the previous menu selection. This button is also used to decrease a menu selection.
Menu Down / Next		Move to the next menu selection. This button is also used to increase a menu selection.

The monitor includes the following connections:

Connection	Type	Function
Power	12 Volt DC	Used to connect the monitor to a power source. The control panel provides a matching 12 Volt DC connector.
VGA In	DB15 female	Used to connect the monitor to the computer.
Analog Video In	RCA composite female	Can be used to connect the monitor to the control panel analog video out or other analog video sources. ⚠ This connection may not be present on some models, or an RCA composite male cable may be permanently attached.

Monitor specifications are subject to change without notice.

Hand Controller

The hand controller is used to operate the VideoRay and its features.

The Standard Pro 4 Industrial Hand Controller joystick, button and knob mapping is shown below:

Help
Joystick
Depth Control knob
Lights Bright button
Lights Dim button
Camera Tilt Up button
Camera Tilt Down button
Camera Focus In button
Camera Focus Out button
Camera Switch
Snapshot
Video Record
Manipulator Open
Manipulator Close
Reserved

The hand controller functions are described in more detail in the next sections of this guide.

Hand Controller Connection

Connection	Type	Function
USB	Type A male	Used to connect the hand controller to a USB port on the control panel or the computer.

Hand Controller Support

Any Microsoft® Windows® compatible game controller can be used with the Pro 4, but each controller requires a configuration file to map the joystick, buttons and knobs to the ROV functions. VideoRay Cockpit currently includes two hand controller configuration files, the VideoRay standard industrial hand controller, and the Logitech® Cordless RumblePad™ 2. These controllers are auto detected on start-up. Other controller configuration files can be created for these or other controllers. See the **Hand Controller Customization** section of the **Customization Guide** for more information.

Help

The Help button opens this documentation on the computer.

Button Location and Label

Use

Press the Help button to open this documentation on the computer.

Joystick

The joystick is used to control the horizontal motion of the ROV.

Location

⚠ The Joystick does not have a label.

Use

Displace the joystick forward (away from you) to move the ROV forward. Displace the joystick rearward (toward you) to move the ROV backward. Displace the Joystick to the left to turn the ROV to its left. Displace the Joystick to the right to turn the ROV to its right. The greater the displacement from the center position, the faster it will move or turn in that direction.

The joystick can be moved in any direction to simultaneously turn while moving forward or backward.

CAUTION Do not run the horizontal thrusters in air for an extended period of time. Doing so may cause overheating and damage to the components.

Using the Joystick with Auto Heading

When Auto Heading is engaged, the system will try to maintain the heading of the ROV. You can displace the joystick forward and backward and the ROV will not yaw. If you displace the joystick to the right or the left, the ROV will yaw and when you center the joystick, the ROV will maintain the new heading. See the **Auto Heading** section of the **Operations Guide** for more information about using Auto Heading.

Joystick Third Axis

⚠ The Joystick also rotates about its central axis. By default, there are no functions assigned to this "third axis," but the controller can be customized to take advantage of this feature. For example, you can map this rotation so that rotating the joystick left or right causes the ROV to turn left or right. See the **Hand Controller** section of the **Customization Guide** for more information.

Depth Control

The Depth Control knob is used to make the ROV dive or surface by controlling the direction and amount of vertical thrust.

Knob Location and Label

Use

Rotate the Depth Control knob forward (counterclockwise) to dive. The greater the rotation from the center position, the faster it will dive. Rotate the Depth Control knob backward (clockwise) to surface. The greater the rotation from the center position, the faster it will surface.

CAUTION Do not run the vertical thruster in air for an extended period of time. Doing so may cause overheating and damage to the components.

Using the Depth Control Knob with Auto Depth

The label indicates the action of the ROV relative to the surface of the water. When the line on the Depth Control knob is rotated below the center line, the ROV will dive. When the line on the Depth Control knob is rotated above the center line of the label, the ROV will move towards the surface. When the line on the Depth Control knob is aligned with the center line of the label the action of the ROV will depend upon that status of Auto Depth.

If Auto Depth is Off and the Depth Control Knob is centered, there will be no vertical thrust (the ROV may drift vertically depending up its buoyancy and the presence of vertical currents). If Auto Depth is On and the Depth Control Knob is centered, the system will apply vertical thrust as necessary to maintain the current depth. You can rotate the Depth Control Know while Auto Depth is engaged and the ROV will surface or dive to a new depth. When you recenter the Depth Control Knob, the ROV will maintain the new depth.

See the **Auto Depth** section of the **Operations Guide** for more information about using Auto Depth.

⚠ The Depth Control knob has a center detent so that, by feel, you can tell when the knob is centered.

Camera Switch

The Camera Switch button toggles the video source from the primary camera to the auxiliary camera and back again.

Button Location and Label

Use

Press the Camera Switch button to switch from the primary camera to the auxiliary camera. Press the Camera Switch button again to switch back from the auxiliary camera to the primary camera.

⚠ Both the primary and auxiliary cameras use the same video pair in the tether and only one camera can be enabled at a time. To use multiple cameras simultaneously, one camera must be configured to use the APIC (Auxiliary Pair of Independent Conductors) in the tether, and a separate interface must be used on the AUX port on the control panel.

Camera Tilt

The Camera Tilt buttons control the vertical angle of the front camera.

Button Locations and Labels

Tilt Up

Tilt Down

Use

Press and hold the Tilt Up button to tilt the front camera up. Release the button when the camera has tilted to the desired setting or has reached the end of its range.

Press and hold the Tilt Down button to tilt the front camera down. Release the button when the camera has tilted to the desired setting or has reached the end of its range.

⚠ You should not continue to hold either tilt button when the camera has reached the end of its tilt range

⚠ The auxiliary camera has a fixed tilt. The camera tilt buttons do not affect the auxiliary camera even if it is the active camera.

Camera Focus

The Camera Focus buttons adjust the focus of the front camera.

Button Locations and Labels

Focus In

Forcus Out

Use

Press and hold the Camera Focus In button to adjust the camera focus for near objects. Release the button when the camera has focused to the desired setting or has reached the end of its range.

Press and hold the Camera Focus Out button to adjust the camera focus for far objects. Release the button when the camera has focused to the desired setting or has reached the end of its range.

⚠ You should not continue to hold either focus button when the camera has reached the end of its focus range

⚠ The auxiliary camera has a fixed focus. The camera focus buttons do not affect the auxiliary camera even if it is the active camera.

Lights

The Lights buttons control the intensity of the lights.

Button Locations and Labels

Lights Dim

Lights Bright

Use

Press the Lights Dim button to decrease the intensity of the lights. Press the Lights Bright button to increase the intensity of the lights.

You can press and hold the Lights buttons to force the lights to continue to decrease or increase their intensity until they reach the desired setting or the end of their range.

CAUTION Do not leave the lights on for an extended period of time. Doing so may cause overheating and damage to the components.

The auxiliary camera has a fixed lights. The Lights buttons do not affect the auxiliary camera lights even if it is the active camera.

Snapshot

The Snapshot button saves a still image from the active camera.

Button Location and Label

Use

Press the Snapshot button to capture a still image from the active camera.

The number of snapshots captured during a session is displayed in the Video Window title bar. For more information, see the **Video Window** section of the **VideoRay Cockpit Guide**.

Snapshots are saved as .JPG formatted files in the "My Documents\VideoRay\Imagery\" folder. They are automatically named by date and time. For more information, see the **Snapshots** section of the **Operations Guide**.

You can capture a snapshot will recording video.

Video Record

The Video Record button toggles the video record feature for the active camera.

Button Location and Label

Use

Press the Video Record button to start recording a video from the active camera. Press the Video Record button again to stop recording a video from the active camera.

When the recording is active, the word "Active" is displayed in the video window title bar and a red circle flashes in the upper left corner of the video window. This circle is not recorded. The number of video recordings captured during a session is also displayed in the Video Window title bar. For more information, see the **Video Window** section of the **VideoRay Cockpit Guide**.

Video Recordings are saved as Windows® .WMV (Windows Media Video) formatted files in the "My Documents\VideoRay\Imagery\" folder. They are automatically named by date and time. For more information, see the **Video Recording** section of the **Operations Guide**

You can capture a snapshot will recording video.

Manipulator

The Manipulator buttons open or close the manipulator.

Button Locations and Labels

Manipulator Open

Manipulator Close

Use

Press and hold the Manipulator Open button to open the manipulator jaws. Release the button when the jaws have opened to the desired setting or have reached the end of their range.

Press and hold the Manipulator Close button to close the manipulator jaws. Release the button when the jaws have closed to the desired setting or have reached the end of their range.

⚠ You should not continue to hold either manipulator button when the jaws have reached the end of their range, but you can momentarily press the close button a few times to tighten the grip after the jaws have secured an object.

Tether

Tether connects the ROV to the surface and provides power, communications, video and an APIC (Auxiliary Pair of Independent Conductors) for accessory use. The tether consists of conductors, a Kevlar® strength member, flotation (for Neutral and Performance tethers) and an outer jacket. It is available in three types: Negative, Neutral and Performance (often called PPT). Neutral and Performance are neutrally buoyant in fresh water because they have a specially designed foam jacket.

While larger conductors provide the best power transmission capacity, they lead to thicker tethers, which results in higher drag. Negative tether has the largest conductors (best power transmission capacity), followed by Neutral, and then Performance. Negative and Performance tether have the smallest diameter (least drag), while Neutral tether has the largest diameter.

The tether connectors are wet mateable and can be connected while they are wet. One of the pins in the connector is offset. To connect the tether to the ROV, control panel or another tether, align the offset pin of the connectors and press the two connectors together until the base surface of each connector are touching each other. Then, connect the tether locking sleeves by screwing them together to secure the connection.

CAUTION For the ROV and tether to tether connections, there is a strain relief system that consists of a cable and carabineer. The strain relief system should be used to avoid separation and loss of the ROV.

The strain relief carabineer can get hooked on something underwater and cause the ROV to become trapped. To avoid this possibility, tape over the carabineer with electrical or duct tape.

Tether Specifications

Strength - while the Kevlar is rated at 450 kilograms (1000 pounds), the connectors are rated 80 kilograms (175 pounds).

CAUTION These values are breaking strength. The tether should not be subjected to a working strength greater than one half of the breaking strength. The ROV and tether are equipped with a strain relief cable and connectors, which are rated at 136 kilograms (300 pounds). The strain relief cable should be used to avoid separation of the tether connectors and loss of the ROV.

Tethers can be connected in series like conventional power extension cords. The maximum tether length is limited by the ability of the tether to transmit power and data signals. The maximum tether length of the Pro 4 is about 600 meters (2,000 feet).

Tether Diameter

Type	Diameter
Negative	7.925 mm (0.312 inches)
Neutral	11.17 mm (0.44 inches)
Performance	8.18 mm (0.322 inches)

Tether Conductor Pin Configuration

Pin	Function
1	Video -
2	Video +

3	74 VDC +
4	Aux + (APIC)
5	Ground
6	Aux - (APIC)
7	RS-485 +/B
8	RS-485 -/A

CAUTION Always secure the tether connectors using the locking sleeves and strain relief system to avoid separation and loss of the ROV.

CAUTION The tether connectors should be kept clean to avoid abrasion and corrosion on the electrical contacts and damage to the rubber insulation. Tether connectors should not be lubricated with grease. Grease will attract dirt and lead to abrasion and corrosion. VideoRay recommends lubricating the tether connectors with pure silicone spray.

TDS (Tether Deployment System)

The TDS (Tether Deployment System) consists of a tether reel within a case. This system allows the tether to be managed neatly, and helps avoid tether tangles.

The TDS comes in two sizes: standard and extended capacity. Both have the same exterior physical dimensions, but the extra capacity TDS can store more tether.

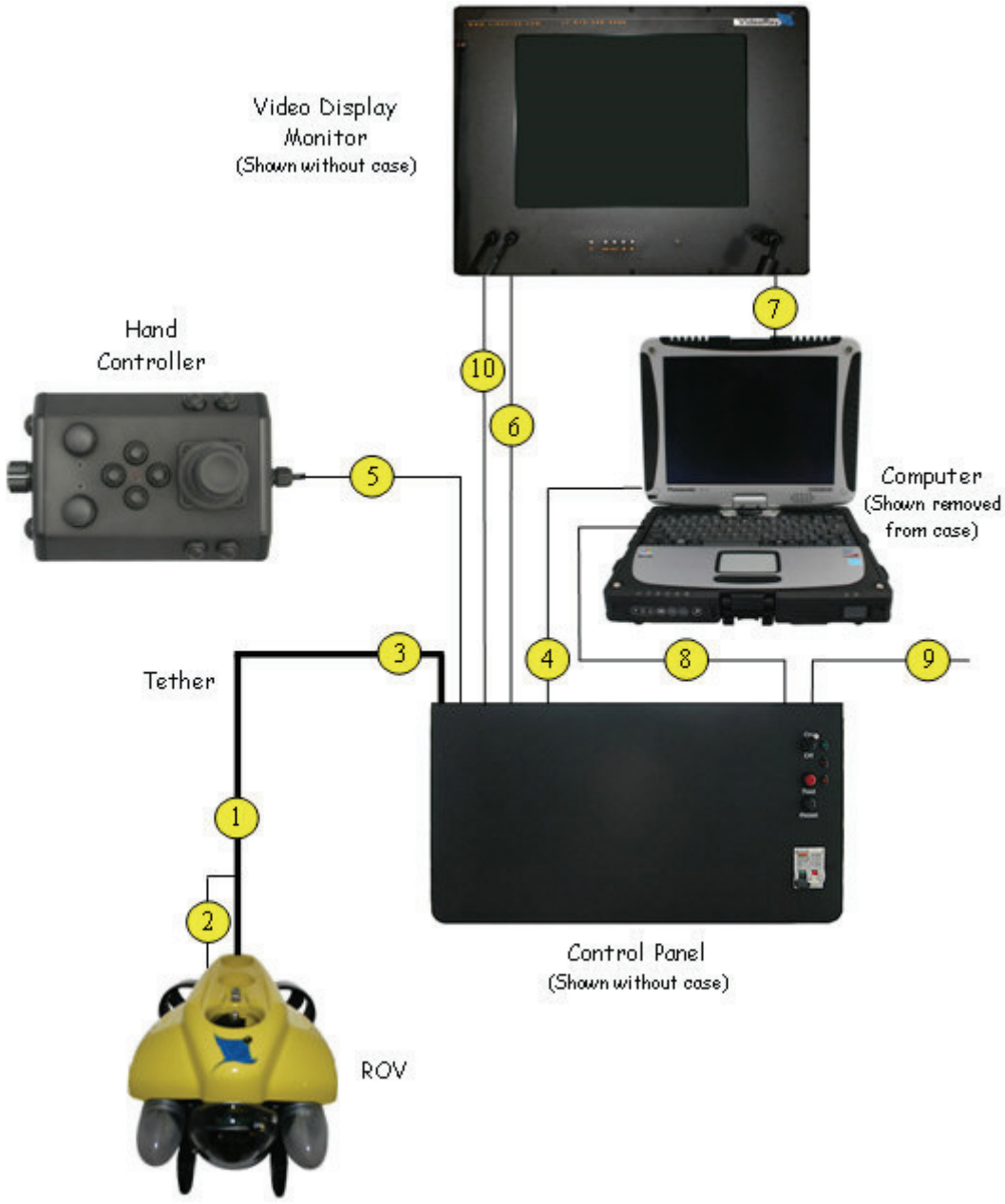
The handle is removable and can be stored in the case.

CAUTION The TDS is not water proof. Keep the TDS clean, but do not spray the slip ring at the end of the spool opposite from the handle. Doing so may force dirt into the slip ring and damage its components or lead to corrosion.

⚠ Wind the tether on the TDS neatly to store the maximum amount of tether. The standard TDS can hold one 76 meter (250 feet) negative tether, one 76 meter (250 feet) neutral tether and one 40 meter (130 feet) PPT. The extended capacity TDS can store up to 300 meter (1000 feet) of negative tether.

Connections Summary

Connections Summary - see the descriptions below the figure for each numbered connection.



1. The male tether connector on the ROV is connected to the female connector on the tether.
2. The ROV strain relief cable is connected to the strain relief webbing on the tether.
3. The male tether connector is connected to the female tether connector on the control panel.
4. The USB connection on the computer is connected to the USB PC connection on the control panel using the supplied USB cable.
5. The hand controller is connected to one of the three USB ports on the control panel.

6. The male monitor power connector on the monitor is connected to the female monitor power connector on the control panel.

7. The female VGA Out connector on the computer is connected to the female VGA In connector on the monitor using the supplied VGA cable.

8. The computer power cord is connected from the computer power cord receptacle to one of the GFCI protected IEC outlets on the control panel using the supplied country specific adapter cable.

9. The control panel power cord is connected from the control panel IEC power cord receptacle to a suitable power source (100-240 Volts DC, 50, 60 Hz)using the supplied country specific power cord.

10. Optional -VGA use is preferred. The RCA composite female Analog Video In connection on the monitor can be connected to the RCA composite female Analog Video Out connector on the control panel or another video source using the supplied cable. Some models may have a permanently attached RCA composite male cable, or may not have this connection at all.

    a. The control panel Analog Video Out can be connected to an external composite analog video display or recording device.

    b. The monitor Analog Video In cable can be connected to a composite analog video source.

Accessories

Numerous accessories can be used with the Pro 4 to extend its capabilities and range of performance. These accessories allow the Pro 4 to support a wider variety of applications. Visit the **VideoRay** website to find the latest information about accessories and their availability.

Accessories generally fall into one of the following categories:

- **Imagery Support and Enhancement**
  - **VideoRay Auxiliary Camera**
  - **VideoRay High Definition Camera**
  - **LYYN® Visibility Enhancement System**
- **Intervention**
  - **VideoRay Manipulator**
  - **VideoRay Cutter**
  - **VideoRay Ship Hull Inspection Stabilizer**
- **Sonar Systems**
  - **BlueView® Technologies Imaging Sonars**
  - **Tritech International Imaging Sonar**
  - **Tritech International Scanning Sonar**
- **Position Tracking Systems**
  - **Desert Star Systems Pilot™**
  - **Desert Star Systems AquaMap™ Seafloor**
  - **Desert Star Systems AquaMap ShipHull**
  - **KCF Technologies Smart Tether**
  - **Tritech International Micron Nav**
- **Other Sensors**
  - **VideoRay Radiation Sensor**
  - **Tritech International Micron Echo Sounder**
  - **Buckley's CP Probe**
  - **Cygnus Ultrasonic Thickness Gauge**
  - **YSI Water Sampling Equipment**
- **Tether**
  - Performance Tether
  - Neutral Tether
  - Negative Tether
  - TDS (Tether Deployment System)
  - Extended Capacity TDS (Tether Deployment System)
- **Topside Support**
  - Operations support items including tables and chairs
  - Power sources including generators and inverters
  - Video display and recording devices
  - Tools and spare parts
  - Software

Accessories are supported via an accessory port on ROV that includes power and an interface to the APIC (Auxiliary Pair of Independent Conductors). The tether includes an APIC for dedicated communications to the topside, where the conductors can be accessed at the AUX connector on the control panel. The ROV communications bus is also exposed on the accessory port of the ROV allowing a direct interface between VideoRay Cockpit software and the accessory.

Most accessories, with the exception of the manipulator and cutter, use a stackable pass through connector that allows multiple accessories to be connected in parallel.

CAUTION The accessory port must be sealed with a terminated accessory connector or the accessory port terminator dummy plug. Failure to seal the accessory port may lead to loss of control of the ROV or damage to the components.

The specifications for the ROV accessory port can be found in the **Accessory Port** section of the **Equipment Guide**

The specifications for the control panel AUX port can be found in the **AUX Port** section of the **Equipment Guide**

Accessories - Imagery

VideoRay supports external **auxiliary lights** to provide better illumination in some situations.

A second **auxiliary camera** can be mounted on the VideoRay to provide images in angles that otherwise would be difficult using just the Primary camera. The auxiliary camera can be mounted so the image direction is lateral, to the rear or vertical.

When the highest quality underwater imagery is desired, a **high definition camera** can be mounted on the VideoRay. Obviously, the water visibility has to be quite good to be able to use the high definition camera effectively.

ROV are often operated in water conditions with limited visibility. Several accessories have been designed and engineered to support this need.

The **LYYN Visibility Enhancement Systems** provide real time video image clarification in cloudy or turbid water.

When the water conditions are too poor to support the required range of visibility, sonar can be used to "See" beyond the visible range. See the section on **sonar accessories** for more information.

VideoRay Auxiliary Lights

Auxiliary lights with variable intensity control can be mounted on the Pro 4 and directed in the desired direction.

Available Q2 2010.

VideoRay Auxiliary Camera

A second auxiliary camera can be mounted on the Pro 4 and directed laterally, toward the rear or vertically up or down.

The VideoRay Pro 4 supports to video circuits that can be switched between the primary camera and the second auxiliary camera. When one camera is active, the other camera cannot be viewed.

Two simultaneous video signals can be supported if the APIC (Auxiliary Pair of Independent Conductors) in the tether is used for the second video signal.

VideoRay High Definition Camera

VideoRay has developed a High Definition camera capability that houses the camera in a second hull that can be mounted below the main hull. This system has been used on several projects, but is currently in the prototype stage. Contact VideoRay if you are interested in High Definition underwater imagery.

Available for hire only at this time.

LYYN Visibility Enhancement Systems

The LYYN visibility enhancement systems provide real time image clarification allowing you to see more details and further in water with limited visibility. They can be used to process the video directly from the Pro 4, or with any external composite video source.

LYYN Hawk™

The LYYN Hawk board can be built into the control panel to eliminate the need to carry additional components or connect cables.

LYYN T38™

The LYYN T38 is a self contained version of the Lyyn Hawk system.

 See the **LYYN website** or the instructions that came with the system for more information.

Accessories - Intervention

While Micro-ROVs like the Pro 4 do not have the intervention capabilities of work class ROVs, the Pro 4 does support several mechanical devices including a **manipulator, cutter** and a **ship hull inspection stabilizer** that extend the range of capabilities of the system beyond the realm of video only inspection class vehicles.

VideoRay Manipulator

The VideoRay Manipulator allows the Pro 4 to retrieve items. The manipulator will support up to 34 kilograms (75 pounds). The jaws open as wide as 50 mm (2 inches) and can be used with a smooth face or pointed screws for a better grip. The manipulator jaws can be rotated while the ROV is on the surface to open and close horizontally, vertically or at any angle in between.

VideoRay Cutter

The VideoRay Cutter can be used to cut rope, soft metal cables and other items up to 12 mm (0.5 inch) thick. The cutter blade can be rotated while the ROV is on the surface to cut horizontally, vertically or any angle in between.

VideoRay Hull Inspection Stabilizer

The VideoRay Hull Inspection Stabilizer mounts to the float block and can be used to stabilize the ROV against a ship's hull or other smooth surface. Through suction induced by the vertical thruster (thrust up), the ROV can be held securely against the surface or track along the surface even in surge or current. This device greatly enhances the ROV pilot's ability to maintain position on a hull and greatly improves the ease with which a visual inspection of a hull can be conducted and the quality of the results.

Accessories - Sonar

When long range vision is needed in water with low visibility, sonar can be used to "see" beyond the range of visibility. Sonar stands for **SO**und **NA**vigation and **R**anging and uses sound echos to create an image of the surrounding environment. VideoRay supports the **Tritech SeaSprite**, a scanning sonar that operates similar to a traditional radar screen, and multibeam sonars from **BlueView** and **Tritech** that create images similar to a medical ultrasound.

BlueView Imaging Sonars and Accessories

BlueView Technologies provides multibeam imaging sonars and a pole mount device with remote pan and tilt capabilities.

BlueView sonars mount under the ROV and the topside interface can be built into the control panel, eliminating the need to carry additional components or connect cables. BlueView's ProViewer software can be launched from within VideoRay Cockpit.

The fast image update allows the ROV pilot to navigate using the sonar image.

P450-45 Multibeam Imaging Sonar

P900 Series Multibeam Imaging Sonars

DF900-2250 Multibeam Imaging Sonar

BV-3100 Pole Mount

See the **BlueView website** or the instructions that came with the system for more information.

Tritech Sonars

Tritech offers two different types of sonars. Both systems' topside components can be built into the control panel to eliminate the need to carry additional components or connect cables.

Gemini Multibeam Imaging Sonar

The Gemini imaging sonar creates an image similar to a medical ultrasound. The fast image update allows the ROV pilot to navigate using the sonar image.

SeaSprite Scanning Sonar

The SeaSprite scanning sonar creates images using the traditional circular sweep.

⚠ See the **Tritech website** or the instructions that came with the system for more information.

Accessories - Position Tracking and Navigation

Underwater searches and surveys often require that the precise position of the ROV be known so that observations can be geo-referenced or the position can be relocated on a future. VideoRay supports several acoustic and tether based position tracking systems from **Desert Star**, **KCF Technologies** and **Tritech**.

Desert Star Acoustic Position Tracking Systems

Desert Star offers several versions of acoustic position tracking systems. These systems include baseline stations that are deployed from a dock or a vessel and an ROV mobile station that is attached to the ROV.

Pilot™

The Desert Star Pilot system offers the tracking capability of a USBL system and the survey-grade accuracy of a long baseline system in one compact package.

AquaMap™ Seafloor

AquaMap Seafloor offers robust performance in harbors, on shallow reefs and in the deep oceans alike. ROV pilots can pinpoint their location and fix objects within tens of centimeters. Seafloor includes GPS integration, image annotation, chart overlay and real-time export to mapping applications.

AquaMap™ ShipHull

Deployed in minutes on any vessel, AquaMap ShipHull "paints" a trace of the ROV's path on a computer image of the hull. When the hull is painted, the job is done.

 See the **Desert Star website** or the instructions that came with the system for more information.

KCF Smart Tether Position Tracking and Navigation System

The KCF Smart Tether is a complete position tracking and navigation system that requires zero additional deployment time because it is part of the tether. Using nodes spaced along the tether, the system can calculate the location of the ROV to within several feet. In addition to tracking the ROV, the Smart Tether can also provide the location of the tether. Both visual and sonar coverage can be charted and exported to mapping applications.

 See the **KCF Technologies website** or the instructions that came with the system for more information.

<

Tritech Micron Nav Position Tracking System

The Tritech Micron Nav position tracking system is a USBL (Ultra Short Baseline) acoustic tracking systems that offers quick deployment of one USBL station and a mobile station mounted on the ROV. The system offers a variety of tracking modes and support GPS integration.

See the **Tritech website** or the instructions that came with the system for more information.

Accessories - Sensors

VideoRay supports a variety of sensors and measurement devices. These systems extend the range of capabilities of the Pro 4 to broaden its scope of applicability to a wide variety of applications in numerous industries.

Tritech Micron Echo Sounder

The Tritech Micron Echo Sounder can be used as an altimeter to measure the height off of the seafloor, or for distance measurements to other distant subsea objects

⚠ See the **Tritech website** or the instructions that came with the system for more information.

VideoRay Radiation Sensor

The radiation sensor mounts to the bottom of the Pro 4 and can read, plot, and trigger an alarm upon the detection of radiation. The system is very sensitive to Gamma radiation and high energy X-Rays. The sensor is not designed to detect Alpha or Beta particles because these particles will not penetrate the pressure housing. Gamma Sensitivity 10 Kev. Cesium Calibration Tube calibrated to Cesium 137 +/- 5% (MIL-STD-45662).

Buckley's CP Probe

The Buckley's CP (Cathodic Protection) probe can be used to assess and monitor corrosion inhibiting systems. The probe mounts on the ROV. The probe is available in both contact and proximity versions. A calibration cell is also available.

See the **Buckley's website** or the instructions that came with the system for more information.

Cygnus Instruments Ultrasonic Thickness Gauge

The Cygnus Instruments ultrasonic thickness gauge can be used to measure metal thickness even through coatings. The probe does not need to touch the surface under test, as measurements can be taken through 5 mm (0.2 inch) of water. Readings are not influenced by the probe orientation.

⚠ See the **Cygnus Instruments website** or the instructions that came with the system for more information.

YSI Water Sampling Equipment

The YSI 600XL sonde measures several water quality parameters including:

- Temperature
- Conductivity
- Salinity
- Specific Conductance
- Depth or Shallow Vented Level
- pH
- ORP
- TDS
- Optical Dissolved Oxygen

⚠ See the **YSI website** or the instructions that came with the system for more information.

Accessories - Topside

Several topside accessories are included with the Pro 4.

Power Inverter

The inverter can be used with a deep cycle marine battery to provide several hours of operating time in remote locations where other power sources may not be available.

Sun Shade

The sun shade can be attached directly to the control panel lid and provides shade for the computer and monitor to make it easier to see the displays when working in bright light. See the label on the sun shade for installation instructions.

Compass

A hand held compass is included to assist with orientation at the operations site.

Tool Kit

A basic tool kit is provided in order to perform routine maintenance and field repairs. The tool kit also includes some spare parts including ballast weights, propellers, O-rings and other items.

Additional Recommended Accessories

Users will typically add a variety of items to support their on-site logistics needs. These items are optional and not provided with the base Pro 4 system. See the **General Logistics** section of the **Operations Guide** for recommendations and more information.

Model Specific Features

VideoRay Pro 4s are packaged for specific industries and applications. These configurations bundle appropriate tether and accessory combinations that are suitable for the typical jobs that would likely be encountered. The configurations are generally available with different levels of capabilities for a range of budgets.

The following model designations are currently available:

- Commercial Diving
  - **VideoRay Pro 4 CD 300SE**
  - **VideoRay Pro 4 CD 300XT**
- Port Security
  - **VideoRay Pro 4 PS 300SE**
  - **VideoRay Pro 4 PS 300XL**
- Law Enforcement, Search and Rescue and First Responders
  - **VideoRay Pro 4 SAR 300SE**
  - **VideoRay Pro 4 SAR 300XL**
  - **VideoRay Pro 4 SAR 300XT**
- Crime Scene Investigation
  - **VideoRay Pro 4 CSI 300XT**
- Oil and Gas
  - **VideoRay Pro 4 OG 300SE**
  - **VideoRay Pro 4 OG 300XL**
  - **VideoRay Pro 4 OG 300XT**
- Potable Water Tanks and Pipelines
  - **VideoRay Pro 4 PW 300se**
- Science and Research
  - **VideoRay Pro 4 SCI 300SE**
  - **VideoRay Pro 4 SCI 300XL**

Pro 4 CD 300SE

The Pro 4 CD 300SE includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**

Pro 4 CD 300XT

The Pro 4 CD 300XT includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **Tritech International Scanning Sonar**
- **Tritech International Micron Nav**

Pro 4 PS 300SE

The Pro 4 PS 300SE includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **VideoRay Hull Inspection Stabilizer**
- **LYYN Hawk Visibility Enhancement System**

Pro 4 PS 300XL

The Pro 4 PS 300XL includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **VideoRay Hull Inspection Stabilizer**
- **LYYN Hawk Visibility Enhancement System**
- **BlueView Technologies Imaging Sonar**
- **KCF Technology Smart Tether Position Tracking and Navigation System**

Pro 4 SAR 300SE

The Pro 4 SAR 300SE includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **KCF Technology Smart Tether Position Tracking and Navigation System**

Pro 4 SAR 300XL

The Pro 4 SAR 300XL includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **BlueView Technologies Imaging Sonar**
- **KCF Technology Smart Tether Position Tracking and Navigation System**

Pro 4 SAR 300XT

The Pro 4 SAR 300XT includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **Tritech International Imaging Sonar**
- **Tritech International Micron Nav**

Pro 4 CSI 300XT

The Pro 4 CSI 300XT includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **Tritech International Scanning Sonar**
- **Tritech International Micron Nav**
- **Tritech International Echo Sounder**

Pro 4 OG 300SE

The Pro 4 OG 300SE includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**

Pro 4 OG 300XL

The Pro 4 OG 300XL includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **BlueView Technologies Imaging Sonar**
- **KCF Technology Smart Tether Position Tracking and Navigation System**

Pro 4 OG 300XT

The Pro 4 OG 300XT includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **Tritech International Scanning Sonar**
- **Tritech International Micron Nav**

Pro 4 PW 300SE

The Pro 4 PW 300SE includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**

Pro 4 SCI 300SE

The Pro 4 SCI 300SE includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**

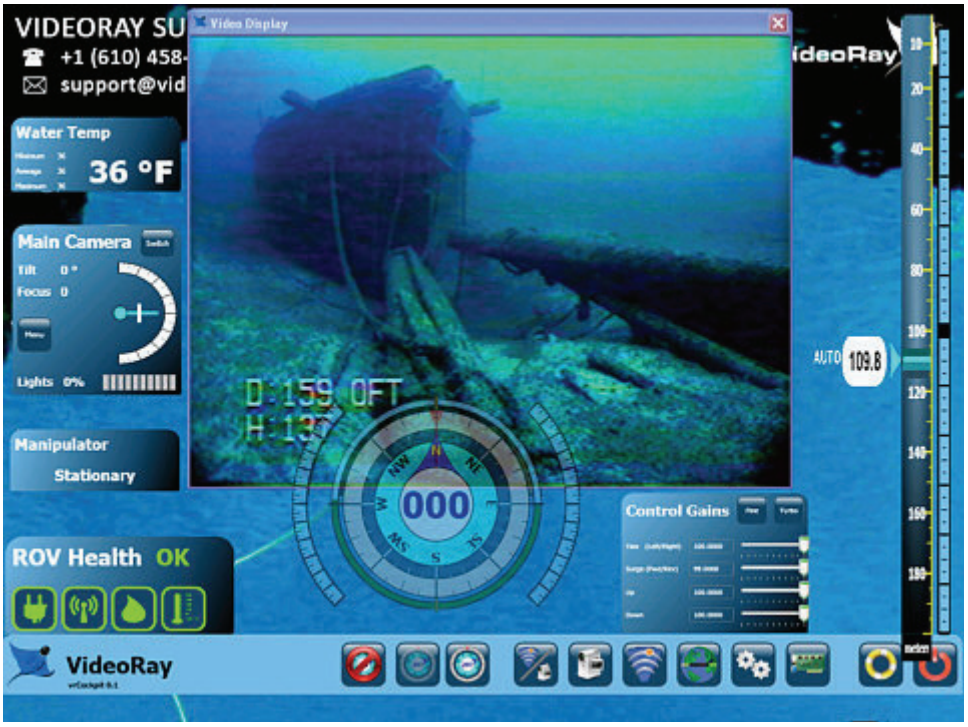
Pro 4 SCI 300XT

The Pro 4 SCI 300XT includes the following accessories:

- **VideoRay Auxiliary Camera**
- **VideoRay Manipulator**
- **LYYN Hawk Visibility Enhancement System**
- **Tritech International Scanning Sonar**
- **Tritech International Micron Nav**
- **Tritech International Echo Sounder**

VideoRay Cockpit Guide

VideoRay Cockpit is the Pro 4's control software. It communicates your control inputs to the ROV, and provides feedback from the ROV's video and sensor systems. VideoRay Cockpit consists of a Video Window, the Control Instruments and the Control Bar. Each of these items will be described in more detail in the following sections.



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

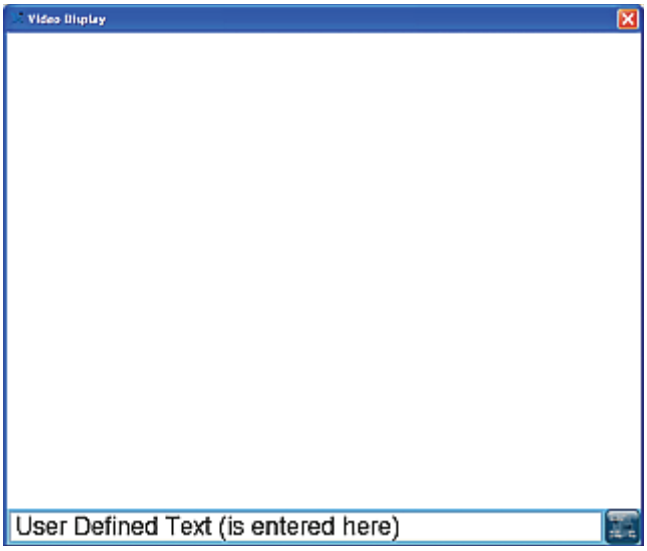
VideoRay Cockpit can be started using the desktop icon, or by selecting it from the Start->All Programs->VideoRay menu.

Topics in this Section

- **Video Window**
- **Instruments**
- **Control Bar**
- **Software Updates**

Video Window

The video window consists of three parts: The Title Bar, the Video Display Area and the Text Overlay Controls.



The title bar displays the number of snapshots and video recordings captured during the current session, as well as the word "Active" when video is being recorded. These numbers are not retained when you close VideoRay Cockpit. If there are no snapshots or recordings, no information is displayed.

The video display area displays the video from the active camera and a red flashing dot when video is being recorded. The video display area can also include text overlay.

The text overlay controls enable the display of the date, time, ROV sensor data and user defined text to be overlaid on the video image.

Video Text Overlay

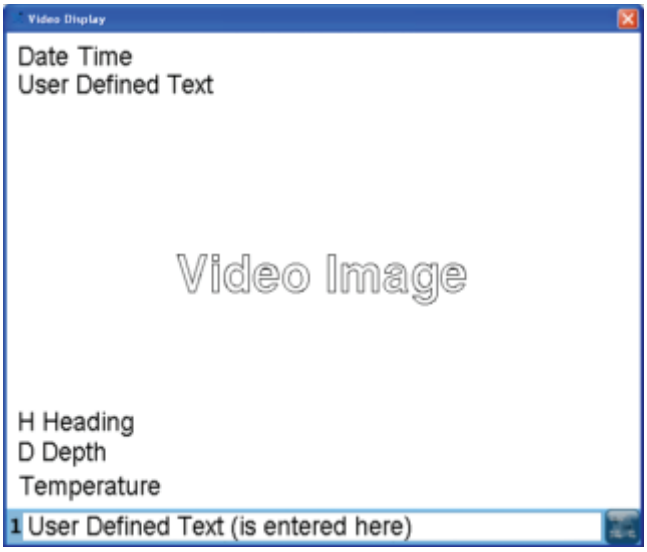
VideoRay Cockpit allows text to be overlaid over the video image. This text will be recorded along with the video in snapshots and video recordings. The text overlay information includes:

- Date[1]
- Time[1]
- User Defined Text (up to 8 lines)
- ROV Heading
- ROV Depth[2]
- Water Temperature[2]

1. The Windows® date/time settings are used to format the display of the Date and Time.
2. The units for the ROV Depth and Water Temperature are defined in the **System Settings** tab of the **User Settings**.

Text Overlay Locations

The positions of these text overlay items are as indicated in the image below. Only the first line of user defined text is shown - additional lines will display below this line. The Heading is preceded by the letter "H," and the Depth is preceded by the letter "D." The depth and temperature units are based on the System of Measure selection in the **User Settings** window.



Controlling the Text Overlay

Each line of user defined text can be entered in the text key-in area at the bottom of the video window. The number at the left of the key-in area indicates which line of text is currently available for editing. Use the Up and Down arrow keys on the keyboard to scroll through the lines.

To enter user defined text, enter the desired text and press the enter key. To delete user defined text character by character, use the Delete key or Backspace key. To delete all of the user defined text for the active line, press the Escape key. To delete the all of the user defined text for all lines, press the Shift + Escape keys.

Lines can be entered in any order or lines can be skipped.

The text overlay can be toggled on of off by pressing the Text Overlay toggle button in the lower right of the video window. Currently, all items are toggled on or off together.

For indexing and cataloging purposes, you may want to have the text overlay displayed when you start recording a video, but then turn it off after a few seconds so it does not detract from the video image.

Instruments

In addition to controlling the Pro 4 and displaying video, VideoRay Cockpit provides numerous feedback and control instruments. These instruments float on the desktop and can be moved, resized, turned on or off or made transparent. You can also restore their sizes and positions to their default locations.

VideoRay Cockpit Instruments Highlighted in Yellow

Moving Instruments

To move an instrument, click on a background area of the instrument with the left mouse button and drag it to the desired location. Some instruments have indicators, buttons or key-in fields. Do not click on these items when trying to move an instrument.

Resizing Instruments

To resize an instrument, hover the mouse over the instrument, and then move the cursor toward a border. When the cursor reaches the border, the border will highlight. Click on the highlighted boarder with the left mouse button and drag it to the desired size. You can resize the instrument by clicking anywhere on the highlighted border. You do not need to drag the border from a corner.

Toggling Instruments between Opaque and Transparent Individually

To make an instrument transparent, double click on it with the right mouse button. To restore an instrument to opaque, double click on it again with the right mouse button.

Closing Instruments

To close an instrument, hover the mouse over the instrument, and then move the cursor toward a border. When the cursor reaches the border, the border will highlight and an "X" will appear in the upper right. Click

on the "X" to close the instrument. See the section below and the **User Settings** and **Instrument Display** sections for more information about how close and restore instruments.

Additional Control Methods

In addition to the operations above that work directly on individual elements, there are other methods to control instruments individually or as a group.

User Settings

The Instruments tab within User Settings allows you to turn instruments on or off individually. The Instruments tab also has a button to restore all of the instruments to their default sizes and locations. See the **User Settings** Section of the **VideoRay Cockpit Guide**.

Control Bar Tools

The Control Bar has three tools that allow you to turn off the display of all instruments, make them all transparent, or make them all opaque. See the **Instrument Display Control** Section of the **VideoRay Cockpit Guide**.

Instruments Display Control Hierarchy

Some settings methods take precedence over other settings methods.

- The User Settings Off setting for an individual instrument overrides the Control Bar Opaque and Transparent settings for all instruments.
- The Control Bar Off setting for all instruments overrides the User Settings On setting for an individual instrument.
- Whether applied through the Control Bar or individually, the Transparent and Opaque settings will override the current state of the instrument.

ROV Health Indicator

The ROV Health Indicator provides status information for several key operational parameters, including the power management system, power, communications, internal humidity and internal temperature.

Display

Power Management Status Indicator
Power Status Indicator
Communications Status Indicator
Humidity Status Indicator
Temperature Status Indicator

Use

The status indicators are green if the status is okay, but change to red if a problem is detected.

Sample ROV Health Instrument indicating a communications fault.

If a problem is detected, corrective action should be taken. See the **Diagnostics and Repair** section of the **Maintenance Guide** for more information.

The size and display of the ROV Health Indicator can be adjusted. See the **Instruments** section of this guide for more information.

Control Sensitivity

The Control Sensitivity Instrument allows you to adjust how responsive the ROV is to joystick and depth control inputs.

The sensitivity is determined by the values of control gains, which range from 1% to 100%. The control input applied by the operator is multiplied by the gain before being sent to the ROV as a command to drive the thrusters. A gain setting of 100% and maximum control input will result in the thrusters operating at full available power. If the gain is reduced, the same maximum control input will result in correspondingly less thruster power. Lower gain settings allow the operator to have more precise control over the vehicle at the expense not having the maximum power available. For example, new users may find it easier to pilot the ROV using lower gain settings until they get used to the handling characteristics of the vehicle.

The gain settings can be adjusted at any time according to the piloting requirements.

Display

Text Input Mode

Visual Input Mode

Use

You can independently control the sensitivity of the following control parameters:

- Surge (forward and backward motion, usually mapped to the joystick forward and back motion)
- Yaw (turning motion usually mapped to the joystick left and right motion)
- Vertical Up (usually mapped to the depth control knob)
- Vertical Down (usually mapped to the depth control knob)

The Pro 4 is a very responsive vehicle. New users may find it easier to learn how to pilot the ROV by decreasing the Yaw gain.

There are two ways to set the sensitivity, numerically or visually. In addition you can save three favorite settings for recall.

Adjusting the Sensitivity Numerically

To adjust the control sensitivity numerically, click on the number (#) button in the lower right hand corner of the control sensitivity instrument. The left hand side of the instrument will list the control parameters and display input fields for the gains. You can enter a number from 1 to 100 in each of the input fields. You can also move the slider above the text input area to decrease or increase all of the numbers uniformly. Moving the slider to the left decreases the gains and moving it to the right increases gains.

Adjusting the Sensitivity Visually

To adjust the control sensitivity visually, click on the graph button in the lower right hand corner of the control sensitivity instrument. The left hand side of the instrument will display a vertical bar on the left for Vertical Up and Down gains, and a polar grid area on the right for the Surge and Yaw gains. The green shaded region in both areas gives a visual indication of the gain settings. Left click and drag the vertical bar to set the Vertical gain symmetrically for up and down. Right click and drag to set the up and down gain independently. The top of the bar is for Vertical Up thrust and the bottom for Vertical Down thrust. Likewise, left click and drag in the polar region to set the Surge gain (indicated by the top and bottom values) and Yaw gain (indicated by the left and right values). When you left click and drag, the gains are adjusted symmetrically as indicated by the circular green shaded area. Right click and drag in the polar region to adjust the Surge independent of the Yaw. The top and bottom of the polar area are for Surge and the left and right are for Yaw. You can also move the slider above the graph area to decrease or increase all of the gain settings uniformly. Moving the slider to the left decreases the gains and moving it to the right increases the gains.

For the surge and Yaw, when clicking and dragging with the left button, the gains are set to the radius of the circle at the point of release. When clicking and dragging with the right button, the gains are set to the major and minor axes radii of an ellipse. The point of release defines a bounding rectangle of the ellipse.


The forward gain cannot be set independently of the reverse gain, and the left gain cannot be set independently of the right gain.

Saving Favorite Settings for Recall

The Control Sensitivity Instrument also has three buttons for quickly setting the gains to preset or saved values. By default, "Fine" sets the all of the gains to 50%, and "Turbo" and "Custom" set all of the gains to 100%. Click on a button to activate the gain settings associated with it. The border of the button will turn blue to indicate its settings are active. If you make manual changes to the gains, the border will turn yellow to indicate the gains no longer match its stored settings. You can change the saved values for any of the buttons. To program a button with new values, manually adjust the gain settings to the desired values. Click and hold on the desired button until the border around the button turns blue. The current settings will be associated with that button and can be recalled at any time by clicking on the button. Repeat this process to associate new gain settings with any button at any time.

Sizing the Control Sensitivity Instrument

The size and display of the Control Sensitivity can be adjusted. See the **Instruments** section of this guide for more information.

Compass and Attitude Indicator

The Compass Instrument displays a variety of information, including the heading of the ROV, the Auto Heading status, an artificial horizon to indicate the attitude of the ROV, and the horizontal thruster settings. The Compass Instrument is also used to engage and set Auto Heading.

Display

Compass Rose
Auto Heading Control/Indicator
Artificial Horizon
Thruster Settings Indicators

Use

The central portion of the Compass displays the heading of the ROV. It uses a "heading up" display so that the heading of the ROV is always displayed under the reference indicator at the top center of the compass dial. For example, if the ROV is heading NW, the North arrow will be rotated to the right. The heading in degrees clockwise from North is also listed at the center of the dial.

The Auto Heading control/indicator is around the perimeter of the Compass. Auto Heading can be used to make the ROV maintain its current heading, or turn to a user specified heading. See the **Auto Heading** section of the **Operations Guide** for details on using Auto Heading.

The blue and green ring around the Compass/Auto Heading is the Artificial Horizon. It indicates the attitude of the ROV. The horizon is represented by the horizontal interface line between the top blue section (sky) and the bottom green section (earth). When the ROV pitches down to a nose low attitude, the amount of green increases and the interface line moves up within the circle. The reverse is true when the ROV pitches up. When the ROV rolls to the starboard (right), the interface line rotates to the left indicating that the starboard side is closer to the sea floor. The reverse is true when the ROV rolls to the port (left).

The outer bands on the left and right of the Compass are the horizontal thrusters settings indicators. The left side displays the port thruster setting, and the right side displays the starboard thruster setting. When there is no thrust applied, these indicators become transparent. When thrust is applied a green shaded section appears within the bands. The length of the green shading from the horizontal centerline indicates the amount of user input applied for that thruster. Forward thrust is indicated by a green shading above the horizontal centerline. Reverse thrust is indicated by a green shading below the horizontal centerline.

The size and display of the Compass can be adjusted for more information. See the **Instruments** section of this guide for more information.

⚠ The feedback of the thrusters settings is based upon the status of the hand controller input, not the thruster action.

Depth Gauge

The Depth Gauge displays the depth of the ROV and the Auto Depth status. The Depth Gauge is also used to engage and set Auto Depth.

Display

Depth Indicator Flag
Thruster Setting Indicator
Auto Depth Control/Indicator

Use

The depth of the ROV is indicated as a number in the flag, which moves along the scale proportionally to the depth. As the ROV moves deeper, the flag moves down the scale. As the ROV moves towards the surface, the flag moves up the scale.

The vertical thruster setting indicator is on the right side of the Depth Gauge. When there is no thrust applied, this indicator becomes transparent. When thrust is applied, a green shaded section appears within the indicator. The length of the green shading from the horizontal centerline indicates the amount of user input applied for the vertical thruster. Vertical up thrust (to move the vehicle towards the surface) is indicated by a green shading above the horizontal centerline. Vertical down thrust is indicated by a green shading below the horizontal centerline.

The Auto Depth control/indicator is to the left of the Depth flag. Auto Depth can be used to make the ROV hover at the current depth or surface or dive to a user specified depth. See the **Auto Depth** section of the **Operations Guide** for details on using Auto Depth.

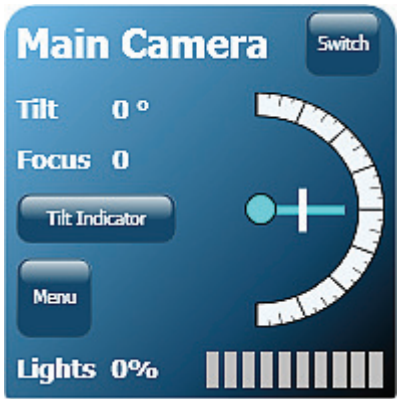
The size and display of the Depth Gauge can be adjusted. See the **Instruments** section of this guide for more information.

⚠ The feedback of the thruster setting is based upon the status of the hand controller input, not the thruster action.

Camera and Lights Indicator

The Camera and Lights Indicator displays information about the ROV's camera and the lights. The Camera and Lights Indicator Instrument is also used to activate the camera menu and the camera selection.

Display



Tilt Indicator Mode

Camera Menu Mode

Use

The Camera and Lights Indicator provides feedback on the camera tilt position, camera focus and intensity of the lights.

The Camera Tilt angle relative to the horizontal centerline of the ROV is indicated by the light blue pointer and curved scale, and the tilt angle is also displayed as a number. The tilt indicator pointer rotates about the central circle to represent the tilt position of the camera. The tilt angle is displayed as positive number when the camera tilted about the horizontal, and negative when the camera is tilted below the horizontal.

The Camera Focus position is indicated by the white line, and the focus position is also displayed as a number. When the focus changes from near to far, the focus line moves from the center of the tilt indicator to the outside end of the tilt indicator. The focus position number ranges from 0 for full near focus to 100 for full far focus. The scale is not a linear indication of the focus distance. It is a measure of the focus motor position.

The Camera Switch button can be used to select whether the front or auxiliary camera is active. Click the Camera Switch button to switch from the front camera to the auxiliary camera. Click the Camera Select button again to switch back from the auxiliary camera to the front camera. The title of the Camera Indicator changes to reflect which camera is active

The Camera Menu button can be used to activate the camera menu to make adjustments to the camera settings. See the **Camera Menu** section of this guide for more information.

The Camera Tilt Indicator button can be used to activate the camera tilt and focus indicator after using the camera menu.

The Lights Indicator provides feedback on the intensity of the lights as a bar scale and a number. As the lights intensity increases more bars light up. The range of the lights indicator number is from 0% for Off to 100% for full On.

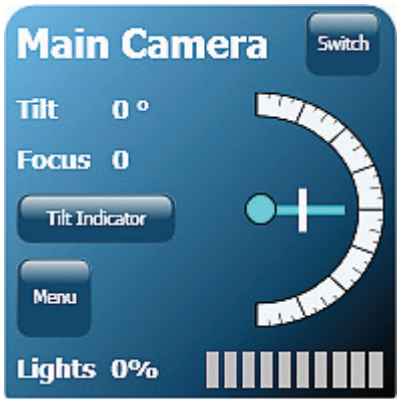
The size and display of the Camera and Lights Indicator can be adjusted. See the **Instruments** section of this guide for more information.

 The feedback is based upon the status of the hand controller input, not the camera action or light intensity.

Camera Menu Operation and Default Settings

The VideoRay Pro 4 camera includes sophisticated features that can be used to enhance the image quality in various lighting conditions. These features are controlled through the camera menu system.

The camera menu can be accessed by clicking on the Menu button on the VideoRay Cockpit camera instrument. This will display the menu as text overlaid on the video window. Each menu item represents a sub-menu where settings can be adjusted.



Tilt Indicator Mode

Camera Menu Navigation

After clicking on the Menu button, the camera menu displays in the video window and the camera instrument displays menu navigation buttons. Click on the up and down arrow buttons to navigate from one sub-menu to the next. Once the desired sub-menu is highlighted, activate the sub-menu by clicking on the left or right arrow buttons. You can also use the keyboard arrow keys to navigate the menu.

Camera Menu Navigation Mode


Keyboard Arrow Keys

Within a sub-menu, use the up and down buttons or keys to navigate from one feature to the next. Features can be changed by using the left or right buttons or keys. To exit a sub-menu, navigate to the Return sub-menu item and activate it using the left or right buttons or keys. To exit the main menu, navigate to the Exit menu item and activate it using the left or right buttons or keys.

⚠ Be aware that VideoRay Pro 4 does not use the same defaults as the camera manufacturer's Factory

Default settings. For VideoRay Pro 4 the Lens Type must be set to "ELC," and the DSS must be set to "1X." To quickly restore the camera to the recommended **VideoRay Pro 4 camera menu default settings**, first restore the factory default settings, and then change the Lens Type to "ELC" in the Lens sub-menu, and change the DSS setting to "1X" in the Exposure sub-menu.

Default Settings

The default settings for the VideoRay Pro 4 are listed below. In the Setting column, an underlined value means the setting must be used, "N/A" means the setting is not available for use with the Pro 4, and "User" means the user can select their preference for this setting. In some cases, user settings are only available in certain modes. For example, in the White Balance sub-menu, RED CONT is not available unless the White Balance Mode is set to USER.

SUB-MENU	SUB-MENU ITEM	SETTING	DESCRIPTION
LENS	**LENS TYPE**	**ELC**	This is the correct Lens Type setting for the VideoRay Pro 4. The other settings do not apply to VideoRay.
	LEVEL	**8**	Set the brightness of the image. Lower numbers result in a darker image. Higher numbers result in a brighter image.
EXPOSURE	**SHUTTER**	N/A	This setting does not apply to the ELC Lens Type recommended for VideoRay.
	FLICKERLESS	**OFF**	Some lighting situations may cause the camera image to flicker or pulse. If this situation happens, setting the Flickerless mode to On should resolve the problem.
	AGC Automatic Gain Control	**MID**	Lower gain results in a more detailed image, but may not perform will in low light. Higher gain results in brighter image but may introduce video noise.
	DSS Digital Slow Shutter	**1X**	Digital Slow Shutter allows the camera to collect light over several frames. The number indicates how many frames are used to create an image. Higher numbers can provide better images in low light, but introduce a delay in the video image update rate and may not be practical for piloting. Higher numbers can work well when the VideoRay is stable, and in low light situations this feature may provide better visual penetration than increasing the brightness of the lights. If the light level is sufficient, the Digital Slow Shutter will not be employed. If the Digital Slow Shutter is active and the scene being observed changes from dark to light, the video image will turn white while the camera adjusts. The higher the Digital Slow Shutter setting, the longer it will take for the image to return to normal.
WHITE BALANCE	**WB MODE** White Balance Mode	**ATW** Automatic White Balance	White Balance ensures that white areas of an image are not tinted and provides natural color images.
	RED CONT	User	Set the amount of red gain. Range = 0 to 255. Available only when White Balance Mode is set to USER.
	BLUE CONT	User	Set the amount of blue gain. Range = 0 to 255. Available only when White Balance Mode is set to USER.

	PUSH AUTO	User	Set the White Balance based on the current scene and lighting. For best results, the scene should be white or contain as much white as possible. Available only when White Balance Mode is set to Push Lock.
WDR Wide Dynamic Range	**WDR MODE** Wide Dynamic Range Mode	**OFF**	Wide Dynamic Range can be used to improve the image quality of a scene that includes light and dark areas. In images without Wide Dynamic Range, either the light areas are too light when the exposure is set for the dark areas, or the dark areas are too dark when the exposure is set for the light areas. Wide Dynamic Range creates underexposed and overexposed frames of each image and combines them to provide good contrast and detail in both the light and dark areas. In some lighting conditions, Wide Dynamic Range may make the image looked washed out or pale. In these situations, turning Wide Dynamic Range off may provide a better image.
	WDR LEVEL Wide Dynamic Range Level	**8**	Lower numbers result in the underexposed image being favored, which provides more detail in the light areas, but less detail in the dark areas. Higher numbers result in the overexposed image being favored, which provides more detail in the dark areas, but less detail in the dark areas.
	BLC Back Light Compensation	**OFF**	Back Light Compensation overexposes the image to provide more detail in the dark areas when the scene includes a bright area. Back Light Compensation is not available if the Wide Dynamic Range is set to On or Auto.
	BLC ZONE Back Light Compensation Zone	**CENTER**	Set the Back Light Compensation Zone of the image. The Back Light Compensation Zone is the dark area of the image where more detail is desired.
	BLC LEVEL Back Light Compensation Level	**4**	The Back Light Compensation Level is the amount of overexposure applied. Higher numbers will show more detail in dark areas.
DAY & NIGHT	**D&N MODE** Day and Night Mode	**COLOR**	The Day & Night Mode sets whether the camera image is color, black and white, or the camera automatically switches between these two modes depending upon the lighting situation. When the Day & Night Mode is set to Auto, the image will be color unless the light decreases below a threshold. The camera will switch to black and white when the light decreases below the threshold. The camera will switch to color when the light increases above the threshold.
	LEVEL	N/A	This setting is not used for the VideoRay Pro 4
	DWELL TIME	N/A	This setting is not used for the VideoRay Pro 4
IMAGE	**REVERSE**	**NORMAL**	Reverse the image horizontally, vertically or both.
	SHARPNESS	**10**	Lower numbers may produce images that look blurry. Higher numbers may produce images that look grainy.
	FREEZE	**OFF**	Freeze the image. Freeze is not recommended for use with the VideoRay Pro 4.
	D-ZOOM	**1.0X**	Set the zoom magnification. Zoom is not supported when the Wide Dynamic Range Mode is set to On or Auto.

SPECIAL	**CAM TITLE** Camera Title	User	Set the camera title, which can be displayed on-screen.
	LANGUAGE	**ENGLISH**	Select the camera menu language.
	SYNC	**INT**	Set the Sync mode. The VideoRay Pro 4 does not support an external Sync.
	COMM ADJ Communications Adjust	User	Set the Camera ID, which can be displayed on-screen and communications baud rate.
	PRIVACY	User	Privacy Zones allows portions of the image to be blacked out.
	MOTION DET Motion Detect	User	Motion Detection allows the camera to react to motion in the scene.
	DISPLAY	User	Display provides controls to make the Camera ID, Camera Title and Motion Detection indicators visible on the image or not.

Camera Sub-menu: LENS

MENU ITEM	DESCRIPTION
LENS TYPE	Set the Lens Type. The Lens Type defines the type of iris. • **ELC** - This is the correct Lens Type setting for the VideoRay Pro 4. • DC - This Lens Type is not recommended for the VideoRay Pro 4. • VIDEO - This Lens Type is not recommended for the VideoRay Pro 4.
LEVEL	Set the brightness of the image. Lower numbers result in a darker image. Higher numbers result in a brighter image. • **0** • **1** • **2** • **3** • **4** • **5** • **6** • **7** • **8** • **9** • **10** • **11** • **12** • **13** • **14** • **15**
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the main menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera Sub-menu: EXPOSURE

MENU ITEM	DESCRIPTION
SHUTTER	Set the Shutter speed. This setting is not used when the Lens Type is set to ELC, and therefore does not apply to the VideoRay Pro 4. • 1/60 (1/50 for PAL format cameras) • 1/100 (1/120 for PAL format cameras) • 1/250 • 1/500 • 1/1000 • 1/2000 • 1/4000 • 1/10000 • 1/100000
FLICKERLESS	Set the Flickerless mode On or Off. Some lighting situations may cause the camera image to flicker or pulse. If this situation happens, setting the Flickerless mode to On should resolve the problem. • **ON** - Set the Flickerless Mode On • **OFF** - Set the Flickerless Mode Off
AGC Automatic Gain Control	Set the Automatic Gain Control. Lower gain results in a more detailed image, but may not perform will in low light. Higher gain results in brighter image but may introduce video noise. • **LOW** - Set the AGC to Low. • **MID** - Set the AGC to Medium. • **HIGH** - Set the AGC to High.
DSS Digital Slow Shutter	Digital Slow Shutter allows the camera to collect light over several frames. The number indicates how many frames are used to create an image. Higher numbers can provide better images in low light, but introduce a delay in the video image update rate and may not be practical for piloting. Higher numbers can work well when the VideoRay is stable, and in low light situations this feature may provide better visual penetration than increasing the brightness of the lights. • **1X** • **5X** • **10X** • **20X** • **40X** • **80X** • **160X** • **320X** • **500X** If the light level is sufficient, the Digital Slow Shutter will not be employed. If the Digital Slow Shutter is active and the scene being observed changes from dark to light, the video image will turn white while the camera adjusts. The higher the Digital Slow Shutter setting, the longer it will take for the image to return to normal.

INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the main menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera Sub-menu: WHITE BALANCE

MENU ITEM	DESCRIPTION
WB MODE White Balance Mode	Set the camera White Balance Mode. White Balance ensures that white areas of an image are not tinted and provides natural color images. • **ATW** - Auto White Balance in the range of 2,500K to 11,000K. • **PUSH** - Auto White Balance with a broader range than the ATW mode. • **PUSH LOCK** - Allow the user to set the White Balance (see Push Auto below) • **USER** - Set Red and Blue levels manually
RED CONT	Set the amount of red gain. Range = **0** to **255**. Available only when White Balance Mode is set to USER.
BLUE CONT	Set the amount of blue gain. Range = **0** to **255**. Available only when White Balance Mode is set to USER.
PUSH AUTO	Set the White Balance based on the current scene and lighting. For best results, the scene should be white or contain as much white as possible. Available only when White Balance Mode is set to Push Lock.
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the main menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera Sub-menu: WDR (Wide Dynamic Range)

MENU ITEM	DESCRIPTION
WDR MODE Wide Dynamic Range Mode	Wide Dynamic Range - Set the Wide Dynamic Range mode. Wide Dynamic Range can be used to improve the image quality of a scene that includes light and dark areas. In images without Wide Dynamic Range, either the light areas are too light when the exposure is set for the dark areas, or the dark areas are too dark when the exposure is set for the light areas. Wide Dynamic Range creates underexposed and overexposed frames of each image and combines them to provide good contrast and detail in both the light and dark areas. • **AUTO** - The camera will turn Wide Dynamic Range On or Off based on the lighting conditions of the scene. • **ON** - Turn Wide Dynamic Range On. • **OFF** - Turn on Wide Dynamic Range Off. When the Wide Dynamic Range is On, the Back Light Compensation and Zoom are disabled.
WDR LEVEL Wide Dynamic Range Level	Set the Wide Dynamic Range to favor the underexposed or overexposed image. Lower numbers result in the underexposed image being favored, which provides more detail in the light areas, but less detail in the dark areas. Higher numbers result in the overexposed image being favored, which provides more detail in the dark areas, but less detail in the dark areas. • **1** • **2** • **3** • **4** • **5** • **6** • **7** • **8** • **9** • **10** • **11** • **12** • **13** • **14** • **15** • **16**
BLC Back Light Compensation	Set Back Light Compensation mode On or Off. Back Light Compensation overexposes the image to provide more detail in the dark areas when the scene includes a bright area. • **ON** - Turn Back Light Compensation On • **OFF** - Turn Back Light Compensation Off. Back Light Compensation is not available if the Wide Dynamic Range is set to On or Auto.

BLC ZONE
Back Light Compensation Zone

Set the Back Light Compensation Zone of the image. The Back Light Compensation Zone is the dark area of the image where more detail is desired.

- **TOP** - Set the Back Light Compensation Zone to the top 1/3 area of the image.
- **LEFT** - Set the Back Light Compensation Zone to the mid-left area of the image.
- **CENTER** - Set the Back Light Compensation Zone to the central area of the image.
- **RIGHT** - Set the Back Light Compensation Zone to the mid-right area of the image.
- **BOTTOM** - Set the Back Light Compensation Zone to the bottom 1/3 area of the image.

BLC LEVEL
Back Light Compensation Level

Set the Back Light Compensation Level. The Back Light Compensation Level is the amount of overexposure applied. Higher numbers will show more detail in dark areas.

- **1**
- **2**
- **3**
- **4**
- **5**
- **6**
- **7**
- **8**
- **9**
- **10**
- **11**
- **12**
- **13**
- **14**
- **15**

INITIAL

Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.

RETURN

Return to the main menu.

VideoRay defaults are underlined.

Camera Sub-menu: DAY & NIGHT

MENU ITEM	DESCRIPTION
D&N Mode Day & Night Mode	The Day & Night Mode sets whether the camera image is color, black and white, or the camera automatically switches between these two modes depending upon the lighting situation. When the Day & Night Mode is set to Auto, the image will be color unless the light decreases below a threshold. The camera will switch to black and white when the light decreases below the threshold. The camera will switch to color when the light increases above the threshold. • **COLOR** - Set the image to color. • **B/W** - Set the image to black and white. • **AUTO** - Allow the camera to select color or black and white depending upon the lighting situation. • EXT - Use an external input for Day & Night Mode control. This mode is not recommended for the Pro 4.
LEVEL	For use with an external photocell. This mode is not available for the Pro 4.
DWELL TIME	For use with an external photocell. This mode is not available for the Pro 4.
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the main menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera Sub-menu: IMAGE

MENU ITEM	DESCRIPTION
REVERSE	Reverse the image horizontally, vertically or both. Reverse is not recommended for use with the VideoRay Pro 4. • **Normal** - Use the normal image. • **H** - Reverse the image horizontally. • **V** - Reverse the image vertically. • **H/V** - Reverse the image horizontally and vertically.
SHARPNESS	Set the sharpness of the image. Lower numbers may produce images that look blurry. Higher numbers may produce images that look grainy. • **0** • **1** • **2** • **3** • **4** • **5** • **6** • **7** • **8** • **9** • **10** • **11** • **12** • **13** • **14** • **15**
FREEZE	Freeze the image. Freeze is not recommended for use with the VideoRay Pro 4. • **ON** - Freeze the image. • **OFF** - Show normal video motion.
D-ZOOM Digital Zoom	Set the zoom magnification. • **1.0X** • **1.5X** • **2X** • **2.5X** Zoom is not supported when the Wide Dynamic Range Mode is set to On or Auto.
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the main menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera Sub-menu: SPECIAL

MENU ITEM	DESCRIPTION
CAM Title Camera Title	Set the camera title, which can be displayed on-screen. Click on the menu item for more information.
LANGUAGE	Select the camera menu language. • **ENGLISH** • **CHINESE** • **RUSSIAN** • **SPANISH** • **GERMAN**
SYNC	Set the Sync mode. • **INT** - Use the internal sync. • AUTO - Use an External sync if available, otherwise use the internal sync. The VideoRay Pro 4 does not support an external sync.
COMM ADJ Communications Adjust	Set the Camera ID, which can be displayed on-screen and communications baud rate. Click on the menu item for more information.
PRIVACY	Set the Privacy Zones. Privacy Zones allows portions of the image to be blacked out. Click on the menu item for more information.
MOTION DET Motion Detection	Enable Motion Detection. Motion Detection allows the camera to react to motion in the scene. Click on the menu item for more information.
DISPLAY	Display provides controls to make the Camera ID, Camera Title and Motion Detection indicators visible on the image or not. Click on the menu item for more information.
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the main menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera->SPECIAL Sub-menu: CAM TITLE

MENU ITEM	DESCRIPTION
CAM TITLE Camera Title	Set the Camera Title. The Camera Title can contain up to 10 characters, which can be displayed over the image. Use the arrow buttons or keys to highlight the desired character, and then click on the menu button two times to select that character. See the **DISPLAY** sub-menu for information on how to display the Camera Title once it has been set. The VideoRay Cockpit software provides advanced video overlay text features. The Camera Title function is therefore not recommended for use with the VideoRay Pro 4.
LOCATION	Set the location of the Camera Title on the image. Use the arrow buttons or keys to adjust the location of the title. Click on the menu button two times to set the location.
RETURN	Return to the Special sub-menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera->SPECIAL Sub-menu: COMM ADJ

MENU ITEM	DESCRIPTION
CAM ID	Set the Camera ID. The Camera ID can be set to a number from **0** to **255**. The Camera ID can be displayed over the image. See the **DISPLAY** sub-menu for information on how to display the Camera ID once it has been set.
BAUDRATE	Set the baud rate for serial communications to the camera. This feature is not supported by the VideoRay Pro 4. • 2,400 • 4,800 • 9,600 • 19,200
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the Special sub-menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera->SPECIAL Sub-menu: PRIVACY

MENU ITEM	DESCRIPTION
ZONE	Select the Privacy Zone. The Privacy Zone is a blacked out region of the screen. The camera supports up to 8 zones, and each zone's size and location can be controlled separately. • **0** • **1** • **2** • **3** • **4** • **5** • **6** • **7**
MASK	Set each Privacy Zone to be On or Off. For each zone selected above, the display of that area can be blacked out or not. • **ON** - Set the selected Privacy Zone display On. • **OFF** - Set the selected Privacy Zone display Off.
POSITION	Set the location and size of each Privacy Zone. Click on the menu item for more information.
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the Special sub-menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera->SPECIAL->PRIVACY Sub-menu: POSITION

MENU ITEM	DESCRIPTION
LOCATION	Set the location of the selected Privacy Zone on the image. Click on the menu button two times and then use the arrow buttons or keys to adjust the location. Click on the menu button two times to set the location.
WIDTH/HEIGHT	Set the width and height of the selected Privacy Zone on the image. Click on the menu button two times and then use the arrow buttons or keys to adjust the width and height. Click on the menu button two times to set the width and height.
RETURN	Return to the Privacy sub-menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera->SPECIAL Sub-menu: MOTION DET

MENU ITEM	DESCRIPTION
MOTION MODE	Set the Motion Detection feature On or Off. When motion is detected, the camera will flash a white square in the area where the motion is detected. See the **DISPLAY** sub-menu for information on how to display the motion indicator once it has been set to On. • **ON** - Set the Motion Detection feature On. • **OFF** - Set the Motion Detection feature Off.
ZONE	Set the Motion Detection Zone. The Motion Detection Zone is an area of the image where motion is to be detected. • **TOP** - Set the Motion Detection Zone to the top 1/3 of the image. • **BOTTOM** - Set the Motion Detection Zone to the bottom 1/3 of the image. • **CENTER** - Set the Motion Detection Zone to the central area of the image. • **LEFT** - Set the Motion Detection Zone to the mid-left area of the image. • **RIGHT** - Set the Motion Detection Zone to the mid-right area of the image. • **WHOLE** - Set the Motion Detection Zone to the whole image.
LEVEL	Set the sensitivity of the Motion Detection. Lower numbers will be less sensitive to motion and it will take more motion to trigger the detection. • **0** • **1** • **2** • **3** • **4** • **5**
INITIAL	Reset this sub-menu to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the Special sub-menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera->SPECIAL Sub-menu: DISPLAY

MENU ITEM	DESCRIPTION
CAM ID	Set the Camera ID to display on the screen or not. See the **COMM ADJ** sub-menu for more information on how to set the Camera ID. • **ON** - Set the Camera ID display On. • **OFF** - Set the Camera ID display Off.
CAM TITLE	Set the Camera Title to display on the screen or not. See the **CAM TITLE** sub-menu for more information on how to set the Camera Title. • **ON** - Set the Camera Title display On. • **OFF** - Set the Camera Title display Off.
MOTION	Set the Motion Detection feature to indicate motion on the screen or not. See the **MOTION** sub-menu for more information on how to set the Motion Detection mode to On. • **ON** - Set the Motion Detection display feature On. • **OFF** - Set the Motion Detection display feature Off.
INITIAL	Reset this sub-menu only to the factory default state. VideoRay uses optimized camera menu settings and the factory default settings should not be used. If you want to reset this sub-menu to the VideoRay optimized settings, use the recommended settings described for this sub-menu.
RETURN	Return to the Special sub-menu.

Settings in **bold** are available for use with the VideoRay Pro 4. VideoRay defaults are underlined.

Camera Sub-menu: FACTORY DEFAULT

The Factory Default menu item restores the camera settings to the initial values as configured at the factory. This menu item does not have any settings and does not open a sub-menu.


Be aware that VideoRay Pro 4 does not use the same defaults as the camera manufacturer's Factory Default settings. For VideoRay Pro 4 the Lens Type must be set to "ELC," and the DSS must be set to "1X." To quickly restore the camera to the recommended **VideoRay Pro 4 camera menu default settings**, first restore the factory default settings, and then change the Lens Type to "ELC" in the Lens sub-menu, and change the DSS setting to "1X" in the Exposure sub-menu.

Camera Sub-menu: EXIT

The Exit menu item closes the camera menu. This menu item does not have any settings and does not open a sub-menu.

Water Temperature Indicator

The Temperature Indicator displays the water temperature.

Display

Use

The Temperature indicators displays the current water temperature, as well as the minimum, average and maximum temperatures encountered during the current session. If you stop VideoRay Cockpit, the minimum, average and maximum values are reset.

The size and display of the Temperature Indicator can be adjusted. See the **Instruments** section of this guide for more information.

The Pro 4 has several temperature sensors including internal temperature sensors to monitor the health of the ROV. These other temperature sensors can be monitored in the Engine Room. See the **Engine Room** section of the **VideoRay Cockpit Guide**.

Manipulator Status Indicator

The Manipulator Status Indicator provides feedback on whether the manipulator is opening, closing or stationary.

Display

Use

When the manipulator is opening or closing, the display is animated to indicate the action.

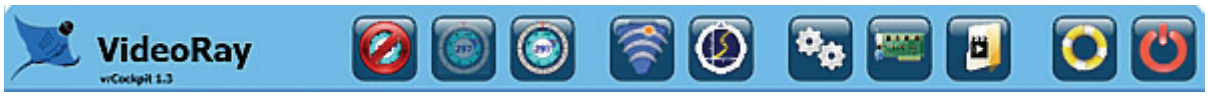
The size and display of the Manipulator Status Indicator can be adjusted. See the **Instruments** section of this guide for more information.

⚠ The feedback is based upon the status of the hand controller input, not the manipulator action.

Control Bar

The Control Bar can be used to launch help and integrated applications, control various settings and close VideoRay Cockpit.

Display



Use

The control bar is displayed at the bottom of the primary monitor. It contains a series of buttons. Moving from right to left, the buttons are as follows:

- **Close VideoRay Cockpit**
- **Open Help**
- **Open the VideoRay Data Folder**
- **Open the Engine Room**
- **Open the User Settings**
- **Launch KCF Smart Tether Software**
- **Launch BlueView ProViewer Software**
- **Set Instruments Opaque**
- **Set Instruments Transparent**
- **Set Instruments Off**

Each of these controls will be described in the following sections.

The version number of the software is displayed in the lower left of the control bar. Only the primary version number is displayed. Hover your mouse over the version number for the full version and build number.

Close

 Close

The Close button can be used to close, or stop, VideoRay Cockpit.

You can also click on the traditional Windows® Close button in the upper right hand corner of the video window to stop VideoRay Cockpit.

The Close button does not turn off power to the ROV or control panel.

Windows is a registered trademark of Microsoft.

Help

Help

The Help button opens this documentation in a browser window.

Open the VideoRay Data Folder

Open the VideoRay Data Folder

The Open VideoRay Data Folder button opens the folder that contains VideoRay data including digitally recorded images and videos.

Images and videos recorded via the analog Video Out connection will not be stored on the computer. When using an analog recording device, check the manufacturer's instructions for details.

Sensor accessories may store their data in other locations. Check the manufacturer's instructions for details.

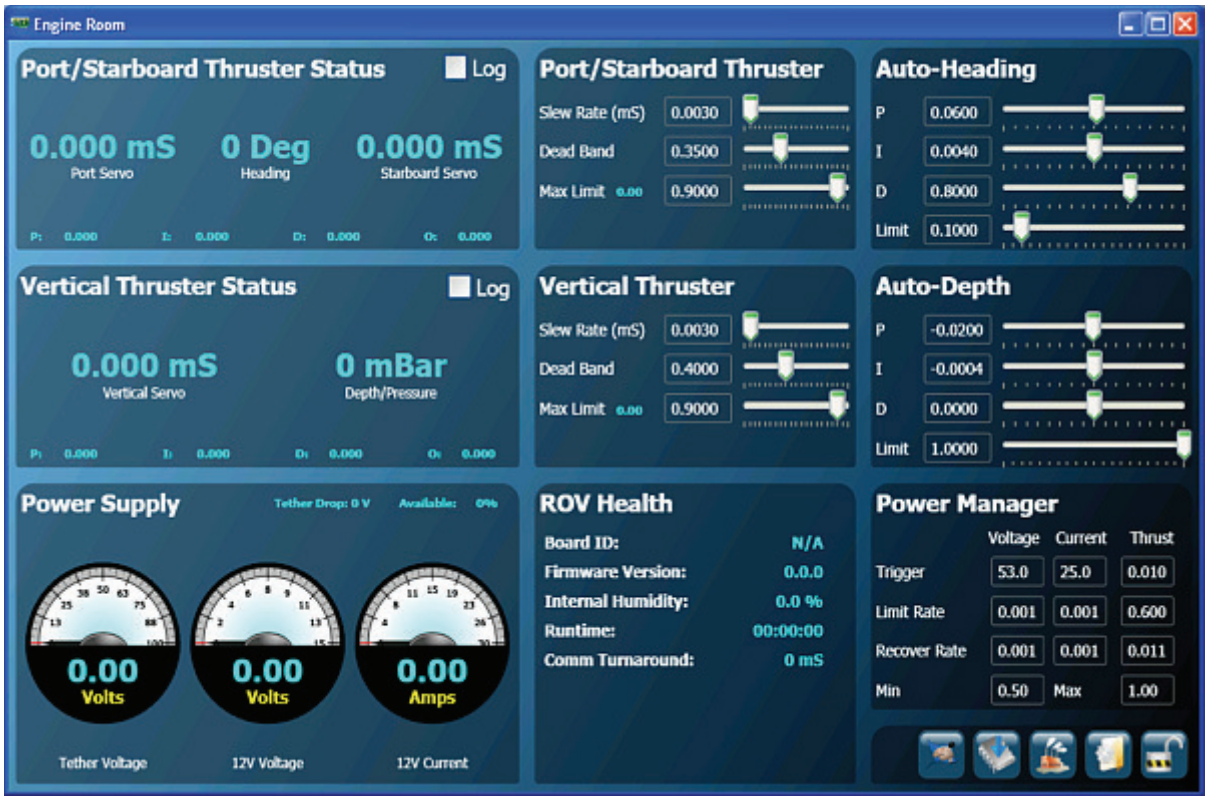
Engine Room

Engine Room

The Engine Room button opens the engine room window. The engine room provides diagnostics information, firmware management and advanced systems tuning.

Status Information

Power Management



Status Information

The left hand side of the Engine Room window provides status information including thruster status, raw compass and pressure readings and power supply status. There is also a display of the firmware version, internal humidity, system run time and communications timing.

Systems Tuning

The Systems Tuning section of the Engine Room allows you to fine tune the performance of the ROV.

⚠ The systems tuning section of the engine room contains settings for advanced users. Untrained operators should not modify the systems tuning parameters without guidance from a trained individual. Modifying the systems tuning parameters without training can result in a erratic or non-functioning ROV.

The systems tuning parameters are stored on the ROV. When you start VideoRay Cockpit, these settings are read from the ROV and the fields in the systems tuning windows are updated with these values. If no ROV is attached, the factory default settings are used.

The systems tuning parameters can be changed. When you change a value, it becomes active, but it does not overwrite the values stored on the ROV. If you turn off the ROV without storing the new values on it, the old values will remain on the ROV and will be reloaded the next time you start VideoRay Cockpit with that ROV attached. In order for your changes to the systems tuning parameters be saved for future sessions, you need to store the settings on the ROV.

⚠ Different ROVs may have different systems tuning parameters stored on them. If you move an ROV to another control panel, the systems tuning parameters will follow the ROV. If you use a different ROV, and its systems tuning parameters have been modified, the ROV's performance may be different from what you expect. You can always restore the factory default systems tuning parameters, but there is no way to restore customized settings once they have been overwritten. It is therefore recommended that if you have custom settings, you may want to write them down so they can be restored in the event restoring the factory defaults or other changes.

Modifying the Systems Tuning Parameters

To modify the systems tuning parameters, you must first unlock the systems tuning panel. Unlock the systems tuning panel by clicking on the Lock toggle. This will turn the locked icon into the unlocked icon and activate the systems tuning panel. You can then modify the settings.

Lock toggle showing the locked and unlocked states

To confirm the input you have entered in the current field, you must press either the tab or enter key, or click on another field. If you do not confirm the entry, it will not be accepted when you click on the Store Settings on the ROV button or Lock toggle.

The settings will become active when they are confirmed, but only for the current session.

Store Settings

Store Settings on the ROV (or simply: Store Settings)

To store the systems tuning parameters on the ROV for future sessions, click on the Store Settings on the ROV button.

When you are finished modifying the systems tuning parameters, click on the Lock toggle to lock the power management panel and avoid inadvertently changing a setting.

Restoring the Factory Default Systems Tuning Parameters

To restore the factory default values for the systems tuning parameters, click on the Restore to Factory Defaults button.

Restore to Factory Defaults

You must click on the Store Settings button if you want the factory defaults to be stored on the ROV for future sessions.

Open the VideoRay Cockpit Configuration Folder

Open the VideoRay Cockpit Configuration Folder

VideoRay Cockpit stores operating information in various configuration files. These files can be accessed by clicking on the Open the VideoRay Cockpit Configuration Folder button.

VideoRay Update

The remaining button in this section is used to update the firmware in the ROV.

VideoRay Update

See the **Software Updates** section of this guide for more information about VideoRay Update.

User Settings

User Settings

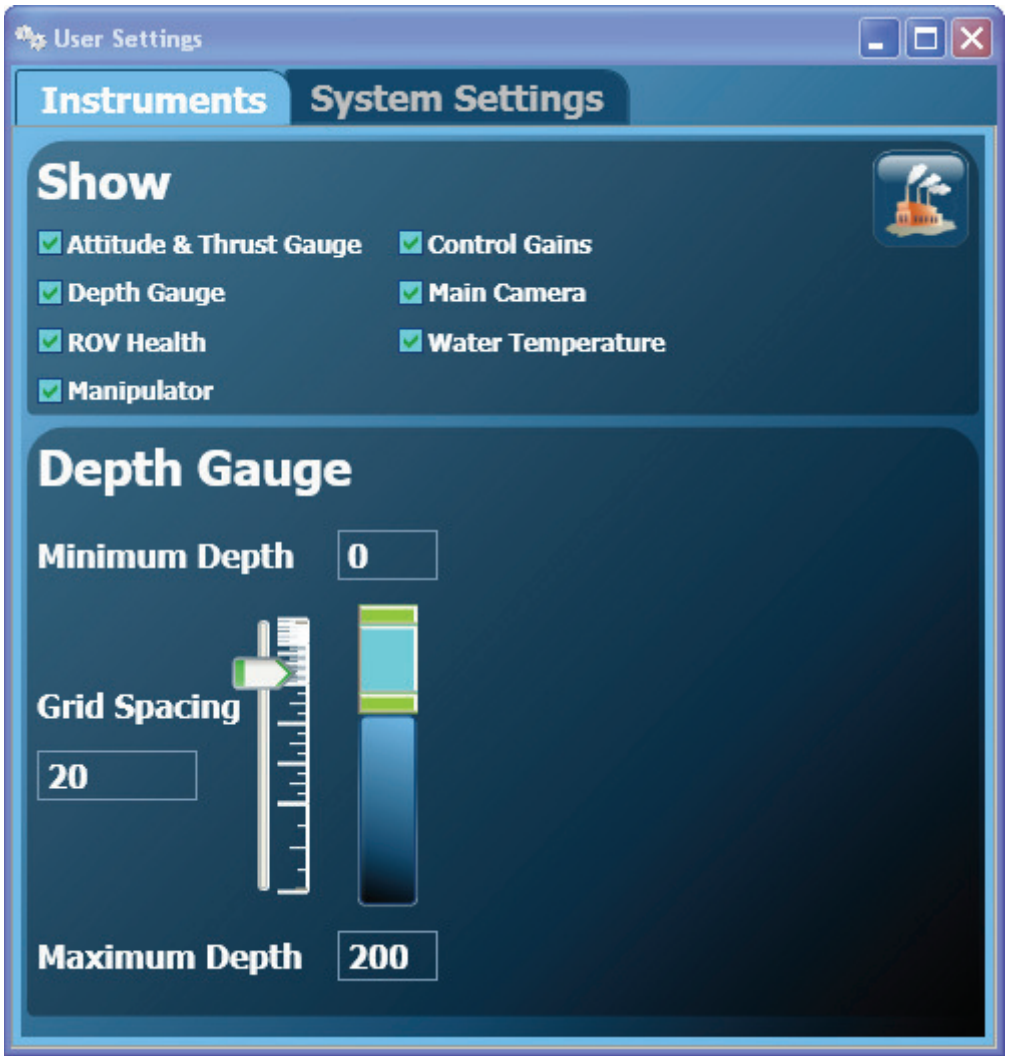
The User Settings button opens the User Settings window. Within the User Settings, users can control the instruments display, set the zero depth and select the systems of units for display.

The following settings are available:

- **Instrument Settings**
- **System Settings**

Instruments Settings

The Instruments Settings tab allows you to control the display properties of the instruments.



Instrument Display

The top portion of the Instruments Settings allows you to turn On or Off the display of instruments individually. Check the box next to the instrument to turn On its display. Uncheck the box next to the instrument to turn Off its display.

⚠ Instruments that are turned On individually will turn Off when using the Control Bar Off setting.

⚠ Instruments that are turned Off individually will not turn On when using the Control Bar Transparent or Opaques settings.

Depth Gauge Scale

There is also a button in the top portion of the Instruments Settings that restores all instruments to their default size and location.

The lower portion of the Instrument Settings allows you to adjust the depth gauge scale. You can set the minimum depth, the maximum depth and the grid spacing displayed on the depth gauge. These properties can be set by entering values or by clicking with the left mouse button and dragging the sliders. You can drag the grid slider to adjust the grid spacing. You can drag the top green bar to set the minimum depth, you can drag the bottom green bar to set the maximum depth, or you can drag the blue bar to change both ends of the range simultaneously

 The Depth scale values can not be set to less than 0, or greater than 1000, and the grid spacing cannot be set to less than 1 or greater than 100.

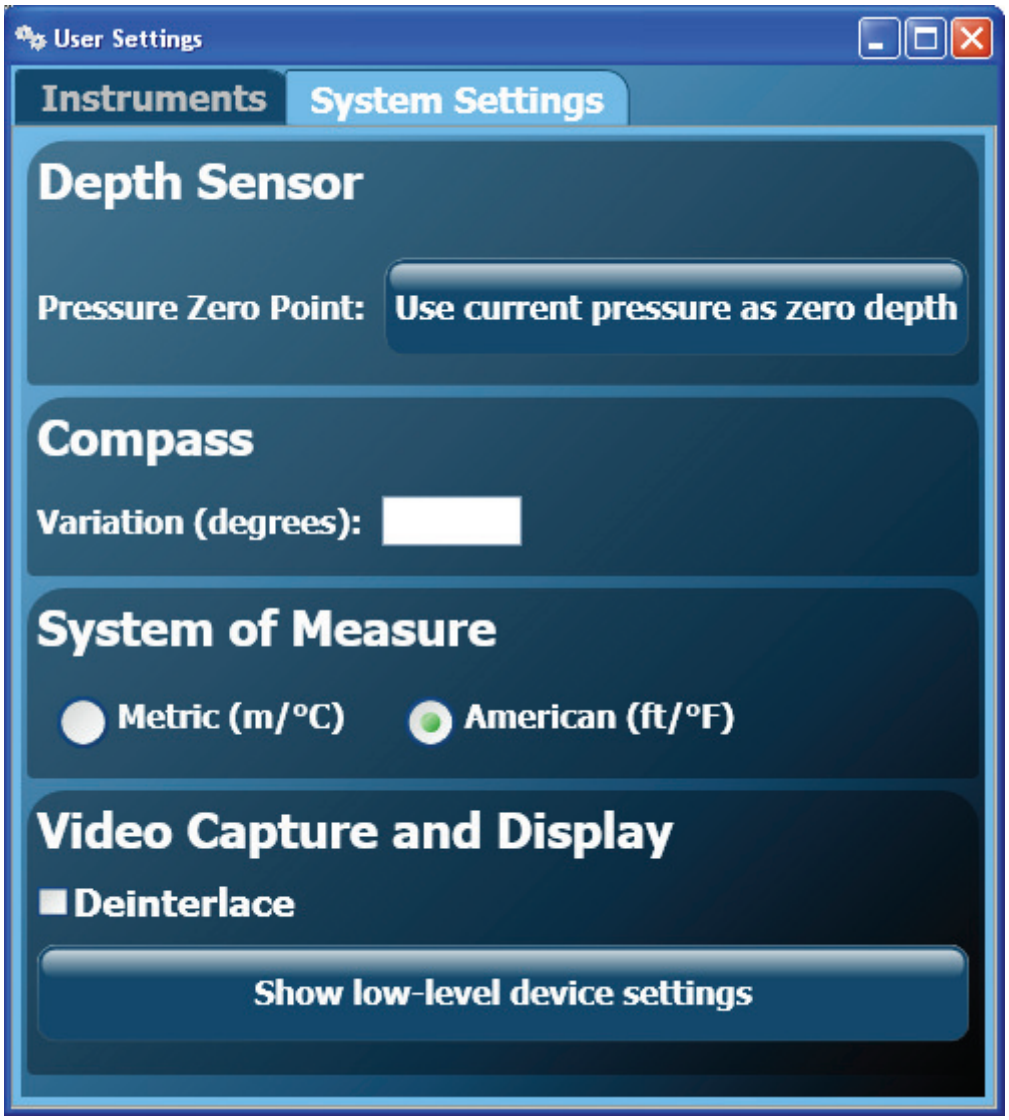
 If the ROV surfaces or dives outside of the range defined for the depth gauge, the depth flag will stop at the end of the gauge, but the depth number will continue to update to provide an accurate indication of the depth of the ROV.

Restoring Factory Defaults

The factory default settings for instruments can be restored by clicking on the Restore Factory Defaults button in the upper right hand corner of the Instruments Settings window.

System Settings

The System Settings tab allows you to reset the depth gauge to zero and select the systems of units.



Depth Sensor

The Pro 4 depth gauge is calibrated at the factory and does not need calibration. The Pro 4 will automatically zero the depth on start up as long as the pressure is below an internally defined threshold. This will allow the system to take into account differences in barometric pressures from one project to the next. The system will not zero the depth on start up if the pressure is above the threshold. This will allow you to turn the system off and then back on while the ROV is submerged without affecting the depth reading. If you want to manually zero the depth, you can do so by clicking on the "Use current pressure as zero depth" button.

The ability to zero the depth can help if you are working in a tidal area and want to get the elevation of the ROV. The elevation, as determined by the depth, will vary by the height of the tide. By placing the ROV at a known elevation (below the water line) and setting the zero depth, the depth can be used to determine a consistent indication of the elevation regardless of the height of the tide.

Compass

The ROV compass system is designed to display headings relative to Magnetic North. You can enter a local compass variation to account for magnetic declination. The declination is considered positive when the Magnetic North is East of True North.

 The value you enter is numerically added to the heading from the ROV. For example, if you are in an area with a declination of 15 degrees West, the ROV heading will read +15 degrees when the ROV is facing True North (assuming no variation has been entered). You should therefore enter -15 for the variation, which would result in a correct True North reading of 0 when the ROV is pointed True North.

 The declination is saved from session to session. Be sure to clear it or change it at the start of each session if necessary.

 You can enter a compass variation to facilitate easier navigation with respect to a fixed reference such as a dock. If you know the heading of the dock, you can enter the negative of that heading as a variation and the compass will indicate North when you are aligned with the dock. East would indicate a course that is toward the right, either perpendicularly towards or away from the dock depending if you were on the left or right respectively.

System of Measure

You can select the units used for display, choosing between either Metric or American. Click on the radio button preceding the desired system of units.

Video Capture and Display

The camera has a sophisticated menu system to adjust various settings to achieve the optimal quality image under a variety of conditions. Likewise, the video capture system has similar settings to adjust how the image is converted from analog to digital. You can enable or disable deinterlacing and you can adjust the brightness, contrast and sharpness of the image.

 The camera menu will affect the image display on both the analog Video Out and computer. The Video Capture and Display settings only affect the digital image displayed and recorded on the computer.

Companion Applications

BlueView Technologies ProViewer

KCF Technologies Smart Tether

Several companion applications can be launched from the control bar. Currently, the applications that are supported include the KCF Smart Tether software and the BlueView ProViewer software.

Companion application launch buttons will display if the associated software is installed on the computer. If the application is not installed, the application launch button for that application will not display.

Instrument Display

All Instruments Off

All Instruments Transparent

All Instruments Opaque

There are three buttons on the control bar to manage the display properties of instruments. You can turn off all instruments, make them all transparent, or make them all opaque. These buttons work on all instruments as a group.

All Instruments Off - Turns off the display of all instruments.

All Instruments Transparent - Turns the display of all instruments transparent. Instruments that are turned off in the User Settings will not be turned on.

All Instruments Opaque - Turns the display of all instruments opaque. Instruments that are turned off in the User Settings will not be turned on.

Application Integration

VideoRay Cockpit supports unprecedented application integration through new software and hardware interfaces.

Virtual COM Ports

For data communications with other applications, VideoRay Cockpit software includes a virtual COM port driver. As an example of how this technology works, VideoRay Cockpit is integrated with the KCF Smart Tether. Both programs need to access their respective hardware, but the KCF Smart Tether nodes and the ROV share a common communications bus. This presents a problem because only one software application at a time can access the physical port to which the bus is attached. In order to solve this problem, VideoRay Cockpit handles the communications with both hardware systems and passes information it receives from the tether nodes to a virtual COM port. The KCF Smart Tether opens a companion virtual Port where it receives this data. As you may have noticed, virtual COM ports are defined in pairs. Typically one application writes to a port, and the other application reads from the companion port. The virtual COM port driver supports multiple port pairs.

A second example is the Desert Star ShipHull system. Traditionally, this system used the APIC (Auxiliary Pair of Independent Conductors) in the tether, and the software "talked" directly to the mobile station. This meant that other devices that require the APIC could not be used simultaneously with ShipHull. In the Pro 4, the mobile station can be connected to the ROV communications bus rather than the APIC (see below for hardware configuration details), and VideoRay cockpit can pass the data from the mobile station to the Shiphull software using a pair of virtual COM ports. Using this arrangement, ShipHull can now be used simultaneously with accessories such as sonar or a radiation sensor.

Other possible uses of virtual COM ports include having VideoRay Cockpit make the heading, depth, temperature and/or other parameters available for another software application to read in real time.

Default Virtual COM Port Assignments

COM Port Pair	Purpose
15 - 16	Ports assigned for VideoRay Cockpit to communicate with KCF Smart Tether
17 - 18	Ports assigned for VideoRay Cockpit to communicate with Desert Star ShipHull
19 - 20	Ports assigned for VideoRay Cockpit to communicate with the VideoRay PAM
31 - 32	Ports assigned for VideoRay Cockpit to communicate with a generic external application for real-time serial data transfer

Additional port pairs may be defined in the future.

In each case in the table above, VideoRay Cockpit is configured to communicate with the lower numbered port and the other software application configured to communicate with the higher numbered port.

PAM - a New Hardware Interface

Up until now, the only accessory that could be controlled by VideoRay was the manipulator. Other accessories needed to use the APIC and have a topside software application to control the accessory or read data from it. Essentially the only real integration was that the device was mounted on the ROV. In order to expand the possibilities, VideoRay is in the process of creating a PAM (Protocol Adapter and Multiplexer) module. The PAM module is a hardware interface that support servo motor controllers and serial communications. The PAM will allow devices like the radiation sensor, which required the APIC and its own software application, to be connected to a PAM, and communicate directly with VideoRay Cockpit. Besides freeing up the APIC for another device, this arrangement allows VideoRay Cockpit to offer a radiation

sensor instrument. The instrument can be configurable with control over and the display and alarms, and even turning the sensor on or off. In addition, and perhaps more importantly, with VideoRay Cockpit managing the data from the radiation sensor, it can be displayed in the video text overlay and/or recorded as part of a comprehensive collection of synchronized video and sensor data.

A generic PAM is still in the prototype and testing stage, but a PAM designed to work specifically with the Desert Star ShipHull is available now allowing the ShipHull system to be used with other accessories where required.

SDK (Software Developer's Kit)

Accessory developers, programmers and "Do-it-your-selfers" will be able to exploit the capabilities of the virtual COM ports and PAM easily through the VideoRay Cockpit SDK. See the **SDK** section of the **Customization Guide** for more information. Additional information about the SDK can also be found online at: **http://download.videoray.com/developer/**

VideoRay Cockpit Installation

VideoRay Cockpit is installed at the factory on new Pro 4 systems. VideoRay Cockpit does not need to be installed unless the software has been deleted, or the software is being installed on a new computer.

VideoRay installation software components are stored on the computer in the C:\VideoRay folder, and is also available online at: **http://download.videoray.com/**.

The VideoRay Pro 4 control panel requires the installation of a serial communications hardware driver and a video capture hardware driver on the computer. These hardware drivers can be found on the local machine or online in the above referenced areas.

In addition, the VideoRay Cockpit application requires the following prerequisite software: .Net Framework 3.5, DirectX and SlimDX. There are two versions of the installation package. One package has the prerequisites included, and one does not. If the software is being installed on a computer for the first time, the package with the prerequisites must be used. If VideoRay Cockpit has been installed previously, the package without the prerequisites can be used.

The installation package with the prerequisites is 26 times larger and takes much more time to install than the version without the prerequisites. If you are downloading software and do not need the prerequisites, use the installation package that does not include the prerequisites.

First Time Installation

If the computer has never had VideoRay Cockpit installed, the hardware drivers and the full installation package are required. It is recommended that these be downloaded from the Internet to ensure that you have the latest version.

The drivers and application installation packages should be copied to the computer on which VideoRay Cockpit is to be installed. Once copied, unzip each package and run the setup program. Follow the prompts to complete the installation of the topside software.

Once the topside software is installed, the firmware and systems tuning parameters on the ROV will need to be updated. Continue the installation process by following steps 5 - 7 in the **Software Updates** section of this guide.

Subsequent Installations

If the computer has already had a version of VideoRay Cockpit installed, the installation procedures are the same as those required to install an update. See the **Software Updates** section of this guide for the installation procedures.

Software Updates

Software updates provide new features and capabilities. Updates are available using the Downloads link at the top of any page of this documentation.

The VideoRay Cockpit software consists of two parts, a topside control program that includes the user interface, and ROV firmware that communicates with the topside and manages the ROV systems and sensors. The topside software update process is similar to most other conventional software applications. There are special procedures to update the ROV firmware. The ROV firmware update process is described below. In addition, the systems tuning parameters are stored on the ROV. When updating VideoRay Cockpit, the ROV should be updated with any new default systems tuning parameters that might be included with the update. If there are new systems tuning parameters included with the update, and you do not store these on the ROV, then ROV will continue to use the old settings and its performance may not be optimal. The systems tuning parameters are different from the firmware and the procedures to store them on the ROV are also describe below.

Software Update Process

The basic steps for the update process are as follows:

1. Check for updates
2. Download the update
3. Unzip the update
4. Install the topside software
5. Update the firmware
6. Load the factory default systems tuning parameters
7. Store the systems tuning parameters on the ROV

1. Check for Updates

To check for updates, verify the current version number. The version number can be found in the left hand corner of the VideoRay Cockpit Control Bar below the VideoRay logo. Use the Download link at the top of the page to access VideoRay's download center and ascertain if newer software is available. Update packages will be named Setup_vrCockpit_v**x_x_x**.zip, where the **x_x_x** is the version number.

2. Download the Update

If newer software is available, download the update package and save it in c:\installs\videoray\vrcockpit\. C:\installs has been set up to store all installation packages on the local machine in case a product needs to be reinstalled.

3. Unzip the Update

Unzip the update package.

4. Install the Topside Software

The installation program will be named Setup_vrCockpit_v**x_x_x**.msi, where the **x_x_x** is the version number. Run the installation program. This will update the software on the computer, but not update the firmware or systems tuning parameters.

5. Update the Firmware

To update the firmware, connect the ROV as usual, but make sure that no accessories are connected to the ROV's accessory port. Turn on the power and run VideoRay Cockpit. When VideoRay Cockpit is running and connected to the ROV, click on the Engine Room button on the Control Bar to activate the Engine Room. From within the Engine Room, click on the VideoRay Update button.

VideoRay Update button

This will start the VideoRay Update software. The software should automatically locate the most up-to-date version of the firmware, and its version number will be displayed in the VideoRay Update Window.

* The version may be different from the one shown here.

If you wish to install another version of the firmware, click on the Open button and navigate to find the desired version.

Once the desired version is loaded and displayed, click on the Reset button. This will install the firmware.

In some situations, such as when PC Pilot firmware is installed on the ROV, the firmware will not update unless the ROV power is cycled. To install the firmware in this case, first remove any accessories attached to the ROV accessory port. Follow the steps above up to the point of clicking on the Reset button, but do not click on the Reset button. Click on the Hot Plug button to enable the ROV power to be cycled, and then disconnect the ROV from the tether and reconnect it. The firmware installation process should begin automatically once the tether is reconnected.

6. Load the Factory Default Systems Tuning Parameters

With VideoRay Cockpit running, click on the Engine Room button. Unlock the systems tuning parameters by clicking on the lock toggle. Click on the Restore Factory Defaults button.

Restore to Factory Defaults button

7. Store the Systems Tuning Parameters on the ROV

Click on the Store Settings on the ROV button. See the **Systems Tuning** section of the Engine Room for more information about systems tuning parameters.

Store Settings button

Operations Guide

This Operations Guide is provided to go beyond the Equipment and VideoRay Cockpit Guides to describe not just how the Pro 4 works, but how to work with the Pro 4. There are numerous topics and tips that are outside of the scope of conventional system documentation that focuses on the hardware and software. You will find recommendations and best practices, but you are also encouraged to use your best judgment and apply all of the information in this documentation and your experiences to your specific applications.

In addition to this guide, there are other sources of information about ROV operations that you might consider. These include training, support and user forums. There are links to these resources at the top of each page. The Community Link at the top of the page provides access to **http://www.rovinfo.com**, which is a great resource to meet other VideoRay and ROV operators and exchange information and tips with them.

Topics in this Section

Project Management

While the differences between conducting a recreational dive, an inspection of an offshore well riser, and a drowning victim recovery are quite dramatic, each of these dive missions usually consist of the following phases:

1. Establish the need, objectives and acceptable outcomes of the mission
2. Plan the mission
3. Prepare for the mission
4. Execute the mission
5. Conclude the mission

Of course, how critical a successful outcome is deemed and how much lead time and how many resources are available will dictate how much effort can or will be afforded to each phase.

The essential knowledge and skills required for a consistent ability to "get the job done" go well beyond just being able to set up and pilot an ROV. In this section, the following topics will be discussed to help broaden your understanding of the scope of practical ROV applications.

- **Mission Planning**
- **General Logistics**
- **On-site Operations**
- **Project Completion**

Mission Planning

Once the basic objectives for an ROV mission have been established, there are several additional, and critical, requirements that need to be identified before rushing off to the dive site. Each of these additional requirements can be defined by developing a list of questions and thinking through the answers. Some of the answers may lead to more questions. With the information gathered by answering the questions, appropriate decisions can be made and your plan developed.

Below is a representative list of requirements and corresponding questions. This list is not comprehensive, and is only intended to serve as a guide for you to develop your own list of appropriate requirements and questions.

- **Define the safety requirements**
  - How many PFDs are needed?
  - Are there any known hazards in the operating area?
    - Is the water contaminated or potentially contaminated?
- **Define the ROV equipment requirements**
  - How much tether will you need?
    - How deep do you plan to dive?
    - How far is the dive target from the set up location?
  - Are accessories needed?
    - What is the water visibility?
    - Will you need to retrieve anything?
- **Define the additional equipment requirements**
  - What are the site conditions?
    - Will you have power available or need to supply your own?
    - Will you need insect repellent?
  - What will the weather be?
    - Will you need to bring extra clothes or rain gear?
    - Will you need to bring sun screen?
  - How long do you expect the mission to last?
    - Will you need to bring food?
    - Will you need extra staff for multiple shifts?
- **Define the time-frame requirements**
  - How long do you think it will take to accomplish your goals?
  - How long do you have to accomplish your goals?
  - Are there any schedule constraints?
- **Define the staff skill requirements**
  - Will you need extra staff to transport the equipment?
  - Will you need someone to liaise with the public on-site?
- **Define the transportation requirements**
  - Will you be operating from the shore or a vessel?
  - How much equipment and how many people will you bring?
- **Define any unique requirements**

- Is the area of operation under any jurisdiction that requires you to get a permit for access or ROV operations?

General Logistics

In addition to the ROV system and its accessories, you will typically need to provide other equipment to support your mission. The first items on your list should be those required for safety of the crew, such as personal flotation devices and a first aid kit. Depending upon your specific requirements that should have been identified in the planning phase, recommended equipment might also include:

- Items for personal comfort including appropriate clothing, chairs, tables, pop-up tents for shade
- Tools and spare parts to make field repairs
- Items to document the mission including topside cameras
- Short and long range communications equipment including cell phones and/or two-way radios
- Lights for night time operations
- Code "A" flag (similar to the "Diver Below" flag) to indicate to those around you that the ROV is deployed and they should exercise caution when entering your area

VideoRay Power Requirements

The VideoRay Pro 4 operates on 100-240 Volts AC, 50,60 Hz. This can be provided from the land-based grid, a generator, or a battery with an inverter. See the **Control Panel Power Requirements** section of the **Equipment Guide** for more information about the power requirements and suitable power sources.

Transportation

Land or water transportation will likely be required and you will need to ensure that you have enough space for your crew and equipment. You may also want to bring maps or charts of the operating area, and you should try to ascertain access points and plan your route accordingly. Carts to transport equipment while at the site may be helpful if the terrain is accommodating.

Site-specific Requirements

Often, river or shoreline sites have steep banks. For these locations, you might want to bring rappelling equipment or at a minimum some ropes to assist in climbing or transporting equipment up and down.

Sea sickness remedies for vessel operations can make the difference between a successful mission and an aborted attempt.

On-site Operations

On-site operations can be hectic and demanding. The following information can help maintain order and productivity.

Site Selection and System Set Up

The following recommendations should be considered when selecting a site and setting up the equipment:

- Select a level site if possible
- Orient the panel for best visibility (avoid glare), and piloting reference (directions on the screen match real world directions)
- Watch for tripping hazards from the tether or power cord
- When operating from a vessel, make sure the system is physically secure in case of rough seas
- Watch for tether pinch points hazards around docks or chaffing hazards around rocks or coral

The ROV Team, Their Roles and Responsibilities

While one person can operate a VideoRay, having multiple people participate can be valuable or may even be required in some situations. The following roles and responsibilities are suggested to assist in developing an efficient and effective ROV team.

Role	Responsibility and Tips
Pilot	Pilots are responsible for operating the ROV in a safe manner while navigating the ROV to achieve the mission objectives. Pilots should wear dark colored shirts to avoid brightly colored glare in the monitor.
Tether Handler	The tether handler, also affectionately called the "Tether Monkey," supports the pilot by managing the tether, including: making sure the right amount is deployed, keeping it away from surface hazards like a propeller, keeping loose tether on the surface neat and communicating with the pilot. The Tether handler should wear gloves to assist in gripping the tether, to keep their hands warm and dry, or for protection when operating in contaminated water.
Accessory Operator	On some missions the pilot must focus intently on navigating the ROV. Trying to have the pilot operate an accessory at the same time may be counter productive. Having an accessory operator will reduce the burden on the pilot and
Supervisor	The supervisor should manage the team, and make sure the objectives of the project are being met. On long duration missions, supervisors should consider rotating shifts or rotating roles to keep the crew at peak performance levels. Supervisors are often called upon to log the operations to maintain a record of the dive.
Technician	Technicians maintain the equipment and repair it as necessary. They should also maintain maintenance and repair logs. Technicians can also serve as equipment and logistics managers.

Project Completion

On-site, the system should be cleaned as best as possible and stowed for transport. Be careful when closing lids to avoid pinching any cables or damaging the video display components of the computer or the control panel.

Upon return to the home base, other tasks that should be considered before stowing the equipment include:

- Clean and inspect the equipment.
- Make any necessary repairs so system is ready to go next time.
- Complete any operations and maintenance logs.
- Produce and deliver the project deliverables.

Project Deliverables

Often, the completion of a project means delivering a product, such as images or videos of an inspection, or retrieval of an item. These can be delivered as isolated products or as part of a formal report. See the **Images and Videos** section of the **Operations Guide** for more information about still image and video post-processing and production.

Tether Management

Choosing the right tether and managing it can have a very significant impact on the outcome of an ROV dive.

Tether is available in neutral or negative buoyancy. Negative tether sinks but has larger conductors, which means longer lengths can be used without affecting the power available at the ROV. Neutral tether is neutral in fresh water (slightly buoyant in salt water), but has thinner conductors. Neutral tether is available in standard diameter and performance diameter (also called PPT), which is thinner. Thinner tether has less drag, but also has smaller conductors and less power transmission capacity. Selecting the right tether is a balancing act between performance and handling characteristics.

General Tether Use Recommendations

- Make sure tether connections are secure.
- Use the shortest amount of tether required to operate in the target area.
- Use Performance or Neutral tether at the ROV and if more tether is needed use Negative at the control panel.
- Only deploy what is needed - too little will affect piloting - too much may result in snags, tangles or propeller cuts.

Tether Storage

Tether should be stored on a TDS or coiled using an over/under or figure eight technique. Coiling the tether in one direction will result in twists that are hard to remove.

Piloting

Piloting a VideoRay is generally easy in clear, calm water and can be learned quickly. Real world operations are generally more challenging and demanding. Pilots should be comfortable in clear calm water before attempting more challenging conditions. Unless you work in a controlled environment, such as tanks, you are likely to encounter low visibility, current, deep conditions, or even all three. Each of these takes special techniques or accessories.

The following suggestions will help you advance your piloting skills.

- Use a light touch on the controls. The VideoRay is very agile and if you apply too much control input, you will tend to over steer or over shoot your objectives. This will often require reverse control input to compensate, which is inefficient.
- You should learn to operate the ROV by watching it on the surface and by watching only the video display. Expert pilots will often navigate on the surface to the desired area of operations before descending, but once the ROV is underwater, they may not be able to see it from the surface and must rely on the video from the ROV.
- Start out by practicing simple maneuvers like going in a straight line and making 90 degree turns.
- Also work on simple vertical maneuvers by following a line or piling. Tilt your camera down when diving and tilt it up when surfacing to see where you are going.
- Notice that when the ROV is on the surface and the camera is tilted up, you should be able to see above the waterline. This capability can be used to reference navigate using surface landmarks, like the sun, buildings, trees or vessels.
- While you can operate the VideoRay by yourself, it is a good idea to have another person help manage the tether - if you have too little tether in the water, you will have a hard time piloting the ROV, and too much tether can lead to tangles.

Auto Depth

Auto Depth can be used to maintain an existing depth, or surface or dive to a specified depth. Auto Depth is designed to be as seamless as possible so that you can pilot without having to constantly engage and disengage it when alternating between hovering and changing depths.

How Auto Depth Works

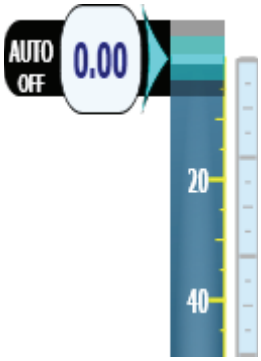
When Auto Depth is engaged, the ROV will automatically respond to changes in depth (measured by the pressure sensor) by applying vertical thrust to maintain the current depth (pressure). If the Auto Depth Indicator is moved to a new depth, the ROV will automatically respond by applying vertical thrust until the depth of the ROV matches the depth indicated by the Auto Depth Indicator.


See the **Depth Gauge** section in the **VideoRay Cockpit Guide** for information about the Depth Gauge.

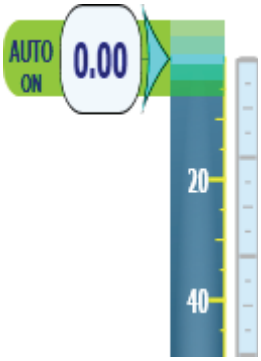
Using Auto Depth to Hover

To hover at the current depth, center the **depth control knob** and click and drag the Auto Depth Indicator on the **depth gauge** to the current depth. The Auto Depth Indicator should change from black to green and the text from "Auto Off" to "Auto On." The ROV will hover at the current depth. To move to a new depth while Auto Depth is engaged, rotate the Depth control knob to apply thrust in the desired direction. You do not need to disengage Auto Depth, and when you center the Depth control knob, Auto Depth will take over and maintain the new depth.

Auto Depth Indicator Display



Auto Depth Off

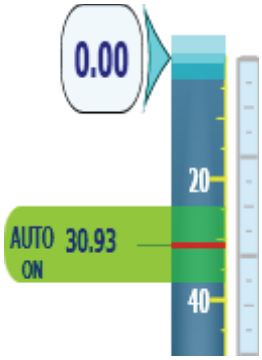


Auto Depth Engaged

Using Auto Depth to Automatically Surface or Dive to a Specified Depth

To surface or dive the ROV to a specified depth, center the depth control knob and click and drag the Auto Depth Indicator to the desired depth. The Auto Depth Indicator should change from black to green and the text from "Auto Off" to "Auto On." The ROV will surface or dive to the depth. You can override the Auto Depth manually by using the Depth control knob to pilot the ROV. When you recenter the knob, Auto Depth will take over and surface or dive to the specified depth.

Using Auto Depth to Dive to a Specified Depth



Disengaging Auto Depth

While the depth control knob is rotated from its centered position, Auto Depth will temporarily suspend itself until the depth control knob is centered again. The Auto Depth indicator will change from green to black and display the word "Manual" to indicate that the depth is being controlled manually.

To disengage Auto Depth completely, click on the Auto Depth Indicator. It will turn from green to black when the Auto Depth is disengaged.

For most operations, you can engage Auto Depth and leave it engaged, because it will hold the ROV at the depth you want, but you can manually override Auto Depth to move to a new depth without having to disengage it.

Auto Heading

Auto Heading can be used to maintain an existing Heading, or turn the ROV to a specified Heading. Auto Heading is designed to be as seamless as possible so that you can pilot without having to constantly engage and disengage it when alternating between holding a course and changing directions.

How Auto Heading Works

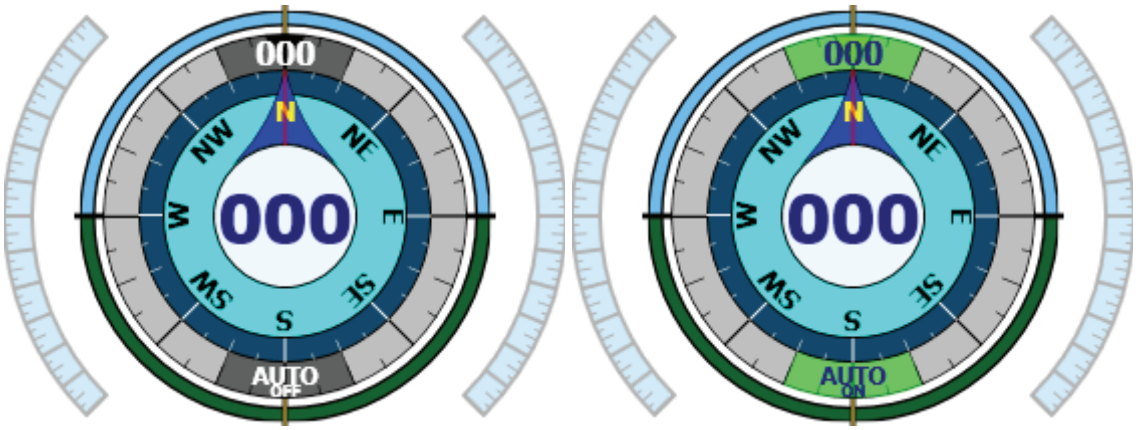
When Auto Heading is engaged, the ROV will automatically respond to changes in heading (measured by the compass) by applying horizontal thrust to maintain the current heading. If the Auto Heading Indicator is moved to a new heading, the ROV will automatically respond by applying horizontal thrust until the heading of the ROV matches the heading indicated by the Auto Heading Indicator.


See the **Compass** section in the **VideoRay Cockpit Guide** for information about the Compass.

Using Auto Heading to Hold a Heading

To hold the current Heading, center the **joystick** and click and drag the Auto Heading Indicator on the **Compass** to the current heading. The Auto Heading Indicator should change from gray to green and the text from "Auto Off" to "Auto On." The ROV will hold the current heading. You can apply forward or backward thrust to move in the direction of the heading. To turn to a new heading while Auto Heading is engaged, displace the joystick laterally to apply thrust in the desired direction. You do not need to disengage Auto Heading, and when you center the joystick, Auto Heading will take over and maintain the new heading.

Auto Heading Indicator Display



Auto Heading Off | Auto Heading Engaged

Using Auto Heading to Automatically Turn to a Heading

To rotate the ROV to a specified heading, center the joystick and click and drag the Auto Heading Indicator to the desired heading. The Auto Heading Indicator should change from black to green and the text from "Auto Off" to "Auto On." The ROV will turn to the heading. Note that the heading to which you want to turn is displayed in the Auto Heading Indicator at the top of the compass. You can override the Auto Heading to pilot the ROV manually by used the joystick. When you center the joystick, Auto Heading will take over and turn the ROV to the specified heading.

Using Auto Heading to Turn to a Specified Heading

Disengaging Auto Heading

While the joystick is displaced laterally from its center position, Auto Heading will temporarily suspend itself until the joystick is centered again. The Auto Heading indicator will change from green to gray and display the word "Manual" to indicate that the heading is being controlled manually.

To disengage Auto Heading completely, click on the Auto Heading Indicator. The Auto Heading Indicator turns from green to gray when Auto Heading is disengaged.

For most operations, you can engage Auto Heading and leave it engaged, because it will hold the ROV at the heading you want, but you can manually override Auto Heading to turn to a new heading without having to disengage it.

Piloting in Low Visibility

When piloting in low visibility, there are several techniques that can be used to help you navigate to your objective or find and observe your target.

- Rather than navigate underwater to the target, navigate on the surface to a point above the target and try to drop down on the target. If you can operate above the target in a vessel, you can drop a weighted line and follow the line to the bottom.
- Do not always assume more light will help - you may find that you can pick up shadows of objects from ambient light alone.
- Switch the primary camera to Black and White mode. The Black and White mode has a lower lux rating.
- Use the **DSS mode** of the primary camera to enhance the video image in low light situations. This method will reduce the frame rate, so it may not work while moving, but if you can set the ROV on the bottom or against a hull, you will be able to see in near darkness.

Depending on the objectives, depth and distance, low visibility may require an accessory like the **LYYN visibility enhancement system**, **sonar** and/or a **position tracking system**.

Piloting in Current

Working in current presents challenges that you may not be able to overcome if the current is too strong, but there are several strategies that you can apply depending upon the situation. Current can be consistent throughout depth, or there may be wind driven current on the surface, and tidal or other currents below. This will of course complicate the situation, but there are techniques to try before giving up.

- Use the minimum amount of tether possible and use performance or negative tether to minimize the effects of drag.
- If you are working deep or along the bottom, add a weight to the tether several meters behind the ROV. Make sure to distribute the stress of the weight connection along a section of tether rather than tying the weight to one point.
- To turn around while facing downstream, you must get the tension off of the tether. If you do not, then attempts to turn around to go upstream will probably result in overturning and facing back downstream again. To turn around, first apply reverse thrust to relieve the tension, and then turn.
- If you can position yourself upstream, you can try to weather vane the ROV and let it float downstream while you move side to side if necessary. By moving your tether deployment location, you may be able to cover the areas needed.

Piloting in Deep Water

Working in deep water presents its own set of challenges.

- For long tether runs, use negative tether because it can transmit more power and has minimal drag. A short section of performance or neutral tether should still be used at the ROV unless the tether can always be held above the ROV.
- Add a weight to the tether several meters behind the ROV. Make sure to distribute the stress of the weight connection along a section of tether rather than tying the weight to one point. Remember, you will need to retrieve the weight, and this can be difficult if the tether is long.
- To speed descent, grasp a weight in the manipulator. When you reach your operating depth release the weight in order to be able to pilot the ROV better.
- Use the vertical thruster to pitch the nose downward, and then use the horizontal thrusters to add more power to your dive or surfacing.

Image and Video Editing and Production

You can record snapshots and video. The count of snapshots and videos is displayed in the video window's title bar at the top. These numbers are for the current session and reset each time you start VideoRay Cockpit.

You can edit and produce video files or DVDs. The following sections provide more information on each of these steps.

The best quality output requires good input. Adjust the lights and focus to give the best starting image quality. More light does not always provide a better picture - back scatter from particles can obscure your intended objective. Light position can also make a big difference. Auxiliary lighting from the side can produce an image that looks like it was taken in air.

The camera supports several special lighting modes like Wide Dynamic Range, Back Light Compensation and Digital Slow Shutter. See the **Camera Menu** in the **VideoRay Cockpit Guide** for more information.

Video Snapshots

Video snapshots can be captured using the snapshot button on the hand controller. Snapshots will include any text overlay that is active at the time the snapshot is recorded. The video window title bar will also display the number of snapshots captured during the current session. Snapshots can be captured while video recording is active. Video snapshots are stored in .JPG format in "My Documents\VideoRay\Imagery\".

Video Recording

Video recordings can be captured using the record button on the hand controller. Pressing the button starts the recording. Pressing the button a second time stops the recording. When recording is active, the video window title bar will display the word "Active" and a red circle will flash in the upper left hand corner of the video. The red circle will not be recorded. The video window title bar will also display the number of recordings captured during the current session. Video recordings will include any text overlay that is active at while the video is being recorded. The camera menu will also be recorded if it is active while the video is being recorded. Snapshots can be captured while video recording is active. Video recordings are saved as Windows .WMV (Windows Media Video) formatted files in "My Documents\VideoRay\Imagery\". Audio can also be recorded from the PC microphone while the video recording is active.

Video Editing

The Pro 4 includes a limited edition version of CyberLink's Power Director. This program provides a full suite of video production tools including capture, edit, produce and create deliverables (CDs or DVDs). Some of the advanced features are disabled, because it is a limited edition, but the software can be upgraded online to enable all of its features in including picture-in-picture and other advanced capabilities.

Power Director's editing tools allow you to clip sections of video, add titles, transitions and other effects, and add background music and audio tracks. See the Power Director help file for information on how to use Power Director.

Video Production

The Pro 4 includes a limited edition version of CyberLink's Power Director. This program provides a full suite of video production tools including capture, edit, produce and create deliverables (CDs or DVDs). Some of the advanced features are disabled, because it is a limited edition, but the software can be upgraded online to enable all of its features in including picture-in-picture and other advanced capabilities.

A limited edition version of Power Producer is also included. This software is used to create deliverables and provides similar features to Power Director, but in a streamlined product designed to be easier to use if you just want to create deliverables (CDs or DVDs).

Deliverables can be created as DVDs that play in a conventional DVD player.

See the Power Director and Power Producer help files for more information on how to use these products.

Accessory Overview

The Pro 4 architecture supports several methods for mounting and using accessories, and the accessories can be divided into categories based on whether they are used on the topside or the ROV and their requirements for power and/or communications.

VideoRay tether includes an APIC (Auxiliary Pair of Independent Conductors) that can be used to communicate with accessories. The Pro 4 ROV has a 9 pin accessory port that includes access to the APIC as well as to power, and the ROV communications and video buses. The Control panel likewise has an AUX port for topside access to the APIC.

 See the **ROV**, **Tether** and **Control Panel** sections of the **Equipment Guide** for more information about the APIC and connections.

Most accessories that require communications with the topside, rely on the APIC. The signal travels from the accessory, through the ROV's accessory port to the tether and then to the AUX port on the control panel. There is usually a topside interface that connects to the AUX port and converts the raw signal from the APIC (typically RS-485 or Ethernet over twisted pair using DSL modems) to RS-232 or USB so that it can be interfaced to the topside computer for processing. In the Pro 4, several popular accessories can have their interface built into the control panel. These include BlueView and Tritech as well as any device that uses RS-485. In these cases, there is an additional switch on the control panel that can direct the APIC directly to the AUX port (for raw output), or through the built-in interface. The built-in interface is connected to the computer through either an Ethernet or USB connection (depending upon the type of interface). If the device uses USB, the standard USB connection between the control panel and the computer can be used so another USB connection or cable is not required. Even with systems that contain built-in interfaces, the AUX port allows any device to be connected, including Pro 3 versions of accessories. This maintains forward compatibility of existing accessories and backwards compatibility of the Pro 4.

In addition to using the APIC for accessories, the Pro 4 can communicate with low bandwidth devices over the ROV's RS-485 communications bus. This allows multiple accessories that require communications with the topside to be used simultaneously, and tighter integration of the software. For example, the Videoray radiation sensor used to require the APCI and a separate software program. With the Pro 4, the radiation sensor can use the ROV's communications bus and a VideoRay Cockpit instrument to display the data. This means that the Pro 4 can carry the radiation sensor and another accessory, such as sonar, simultaneously, and the radiation sensors data can be overlaid on the video or trigger events, such as alarms, in VideoRay Cockpit.

Topside Accessories

Topside accessories include those that support operations and logistics and those that integrate with the control panel

- Topside Logistics
    - Awning, tables, chairs, etc. - for operator comfort
    - Gloves - for handling the tether
- Topside Integration
    - Generator - to provide power to work in remote locations
    - Extra display monitor - to provide live video for observers
    - LYYN visibility enhancement system - to improve video quality

ROV Mounted Accessories

ROV mounted accessories include intervention tools like the manipulator and cutter and additional sensors like sonar and water quality sensors. Examples of the types of integration and a few sample devices are listed below:

- Power Only
    - Transponders for Desert Star Pilot and Seafloor and Tritech Micron Nav
- Power and ROV Communications Bus
    - Auxiliary Lights, Manipulator and Cutter
- Power and the APIC
    - Sonar

The Smart Tether is a unique example of integration. It is currently the only device that uses power from the Tether. It also uses the ROV communications bus for transmitting data.

Using Accessories

For specific instructions on mounting and operating accessories, see the user manual that came with the accessory.

Maintenance Guide

Users are encouraged to become familiar with the basic routine maintenance procedures and this documentation will provide the necessary information. For advanced diagnostics and repairs, VideoRay recommends users contact a VideoRay Factory Authorized Service Center for assistance or training.

VideoRay offers the VideoRay Advantage! Comprehensive Maintenance and Support Program. This optional program includes free checkups, repairs for operational losses, upgrades and other advantages. For more information about VideoRay Advantage! contact **VideoRay**.

Topics in this Section

Best Practices

The best maintenance programs begin before trouble occurs, and preventative maintenance should be your first step on the road to reliable system performance.

Inspections

Be observant for signs of loose parts, wear or impending failure - catch small problems before they become big problems. Always conduct the pre-dive and post-dive inspections.

CAUTION Failure to inspect and replace thruster cartridge seals as necessary is the most common reason for systems to be returned to VideoRay for repair. Water ingress through the thruster cartridge seals typically leads to major internal component damage, which is expensive to repair. See additional **warnings** and view example **cartridge seals**.

Care and Handling

Do not abuse the VideoRay and be careful not to damage the system's components through normal use. For example, avoid letting the tether connectors come in contact with the ground where dirt damage the contacts.

Cleaning

VideoRay systems should always be cleaned after use. When used in salt water or contaminated environments, make sure to thoroughly rinse and then soak all wet components. It is especially important that you rinse the pressure sensor and allow it to drain. You must remove the float block to do this.

CAUTION Use care when cleaning the pressure sensor to avoid damaging the sensor. Do not insert anything into the pressure sensor cavity, and do not apply high pressure spray to the sensor.

Storage and Transport

Always pack the system securely to make sure it is not damaged in transport.

Service

Follow procedures and use the proper tools. Work in a clean environment.

Trained Operators

Do not subject equipment to accidental or inadvertent abuse by someone who is not trained in its proper use.

Trained Technicians

Maintenance should be completed by trained technicians, and using factory authorized parts. VideoRay recommends that you create and maintain a system logbook. The logbook entries can include details of missions (date, location, conditions, dive time, etc.) and maintenance performed (date, procedure, parts replaced, etc.). The logbook may help identify possible causes of problems and systemic issues that should be reported to VideoRay for further investigation.

Routine Maintenance

DANGER CAUTION To avoid injury or damage to the videoray, disconnect the system power and tether before commencing any maintenance and/or repairs.

VideoRay's sealed components are designed to be tight fitting. Forcing a component open or closed may damage it permanently. If components do not come apart with bare hands or "soft" tools, check to ensure that all fasteners have been removed. Many VideoRay components are anodized aluminum and will be damaged by contact with steel.

Cartridge Seals

View example **cartridge seals**.

CAUTION **Cartridge seals must be checked before every dive and must be replaced with new ones before the air bubble reaches 1/2 of the volume of the seal. Cartridge seals must also be replaced with new ones if they contain contamination or look milky instead of clear. On long duration dives, the cartridge seals should be checked at hourly intervals during the dive unless this is impossible (for example, continuous extended video is required). Any cartridge seal that shows a high rate of air bubble growth or increasing contamination should be replaced (if unable to be replaced on-site, it must be checked more frequently until it is replaced). When replacing seals that are worn, the shaft must be checked for scoring or other signs of wear that could lead to premature seal failure. The shaft must also be checked for wobble (bent), which could also lead to premature seal failure. Thrusters should not be run for more than a minute in air, which could also result in premature seal failure. Cartridge seals must be replaced in a clean environment to ensure a good water tight fit of the O-ring and seals.**

If these recommendations are followed, the ROV should NEVER experience a flood through the cartridge seal unless the seal itself suffers a catastrophic failure. VideoRay's warranty does not cover damage due to flooding of the ROV through a cartridge seal unless the customer can demonstrate that they have followed the above recommendations and there is reasonable evidence that the seal failed catastrophically due to a manufacturing defect.

Cartridge Seal Storage Recommendations:

- Cartridge seals should be stored in a sealed plastic bag so they do not attract dirt.
- Recommended storage temperature is between 2 to 15 degrees C (35 to 60 degrees F) to keep the storage gel from softening and allowing the oil to drain.
- Storage or transport at low air pressure (checked baggage in an unpressurized cabin) is not recommended.

O-Ring Care and Handling

O-Ring Rule of Thumb - If in doubt, throw it out! Generally, when compared to the equipment they are protecting, O-rings are very inexpensive. Should an incorrectly sized or damaged O-ring be installed, the result can be catastrophic. If there is any doubt as to the suitability or condition of an O-ring it should be replaced. O-rings and other components with sealing surfaces should never be handled with dirty or gritty hands. A small amount of dirt trapped next to an O-ring will cause leakage, which could result in serious damage to the ROV's internal components. The most common situation is a single strand of hair or lint, so care should be taken to ensure a clean work area. Should an O-ring or sealing surface become dirty, wash it with mild soap and water, and then rinse it with clean water. Avoid scratching the surfaces of the O-ring grooves and landings. Do not use sharp objects such as a knife or screwdriver to pry apart sealed assemblies or remove O-rings. Serious damage to the O-ring or the seat may result.

O-ring Lubrication - VideoRay recommends the use of pure silicone spray or the O-ring lube kit that comes in teh standard tool kit. Other lubricants can lead to deterioration and failure of the O-rings and components. Do not use other lubricants! Other lubricants may cause deterioration or attract dirt and lead to leaks or premature failure.

O-ring Inspection - O-rings wear out over time. Inspect all O-rings whenever a sealed assembly is apart. "Healthy" O-rings are soft, flexible and have not been pinched or nicked. Should an O-ring appear brittle, or have apparent cracks, nicks, or evidence of being pinched or permanently compressed, it should be replaced. Sealing surfaces should also be inspected while an assembly is apart. The surfaces should be examined to determine that they are free of dirt, nicks, scratches, or damage, which may result in seal failure once reassembled.

O-ring Storage - O-rings should be stored in clean plastic bags to protect them from dust when not in use. Avoid prolonged storage in direct sunlight as this may result in deterioration of the O-ring material. Stored O-rings should be sorted with regard to type and size with that information noted on the storage bag. Use of an incorrect O-ring can result in an ineffective seal.

Main and Light Dome Care and Handling

The domes should be cleaned with mild soap and water. They are acrylic and small scratches can be buffed out.

CAUTION Do not use cleaners that contain alchohol or other solvents. Solvents can make the dome brittle.

Maintenance Tools Required

VideoRay is designed with ease of maintenance in mind, and only a few tools are required to service the system. In fact, many maintenance procedures, such as changing light modules can be done without tools. VideoRay also includes a small tool and spares kit with each system delivered that contains most of the required tools. The following list of tools is recommended:

Tool	Typical Use
O-ring lubricator	Lubricating O-rings and O-ring grooves and landings.
Multi-tip screwdriver with 1/4" and 5/16" nut drivers	Miscellaneous screws and main hull rods
5/16" Open end wrench	Main hull rods
7/16" Open end wrench	Propeller locking nuts
Rubber tipped pipe pliers*	Thruster cones
11/16" Open end wrench*	Termination block (tether connection)
13/16" Open end wrench*	Termination block (tether connection)
3/4" Open end wrench*	Pressure sensor
7/8" Open end wrench*	Pressure sensor
1-1/4" Open end wrench*	Vertical thruster
Multi-meter*	Electrical circuit testing
Soldering iron*	Electrical circuit repair
Flashlight*	Internal inspections

* - These items are not included in the standard tool kit that comes with the Pro 4.

Changing a Propeller and Horizontal Thruster Nozzle

The Pro 4 propellers are held on smooth shafts using a collet similar to the ones used to hold drill bits. Also note that the Pro 4 uses counter rotating propellers and a smaller diameter propeller for the vertical thruster. VideoRay recommends that you only remove one propeller at a time to avoid using the wrong propeller for that location.

If the propellers do get mixed up, the following will help determine the correct locations.

- The vertical propeller is smaller - 60 mm (2.4 inches) versus 100 mm (4 inches) for the horizontal propellers.
- When viewing the horizontal propellers from the rear, with one blade pointing up, the blade pointing up should curve toward the center. The two blades pointing up should form the shape of an "O."

  To remove a propeller, loosen the nut a few turns (do not remove it), and pull the propeller from the shaft.

  CAUTION When pulling on the propeller, pull close to the hub. Do not pull on the blades. Doing so can break a blade.

   If the propeller does not come off easily, tap the dome of the nut a few times while pulling on the propeller. This should loosen the collet and allow the propeller to be removed easily.

  To install a propeller, slide it over the shaft until it stops. The propellers are designed to fit just right. If the propeller is tight against the cartridge seal, or there is a significant gap, make sure the cartridge seal is seated or that the propeller does not have something in it.

  Once the propeller is installed all the way onto the shaft, tighten the nut. It should be tight enough so that while holding the propeller, the edge of the blades will start to hurt a little while turning the nut.

Horizontal Thruster Nozzle

To remove a horizontal thruster guard, first remove the propeller. Grasp the thruster nozzle and rotate it counter clockwise (when viewed from the rear). This should loosen the thruser cone nut. Unscrew the thruster cone nut and slide the thruster nozzle off the thruster tube.

To install a horizontal thruster, slide it over the thruster tube. Install the thruser cone nut and screw it on until it is snug. Grasp the thruster nozzle and turn it clockwise while turning the thruster cone nut until the assembly is tight.

Changing a Thruster Cartridge Seal

View example **cartridge seals**.

Cartidge seals are universal and fit on any shaft.

Replacing a cartidge seal requires removing the propeller.

To remove a cartridge seal, first remove the propeller following the **instructions**.

Next, grasp the cartridge seal and slide it off of the shaft. You may need to twist it a little to remove it.

To install a cartridge seal, make sure the O-ring and thruster tube are clean. Slide the cartridge seal over the shaft and make sure it seats. You will note a small amount of grease will be pushed out of the cartridge seal by the shaft. This is normal and the grease can be wiped away with a paper towel or rag.

Each cartridge seal has an index line that is aligned with a small hole that allows the oil to reach the shaft and lubricate the seals on each end of the cartridge. For maximum life, horizontal cartridge seals should be aligned so that the index line is pointing downward. The alignment of the vertical cartridge seal does not matter.

Note that the cartridge seals have a small white washer inside the end closest to the propeller. New cartridge seals include the washer, but you should check to make sure it is there when installing a new cartridge seal.

Cartridge Seals

Example Cartridge Seals

New cartridge seal.

Cartridge seal with an acceptable bubble - this seal is okay to use.

CAUTION Nearly empty cartridge seal - this seal should have been replaced when the oil level reached 1/2 of the original volume.

Cartridge seals like this should not be used.

CAUTION Cartridge seal with contamination - this seal should be replaced.

Cartridge seals like this should not be used.

Changing a Light Dome or Light Module

To remove a light dome, unscrew the light dome from the thruster.

To install a light dome, make sure the O-ring is clean and not damaged. Lubricate the O-ring. The thread pitch is small compared to the diameter of the light dome and it is easy to cross thread the light dome. Carefully align light dome and threads and screw the light dome onto the thruster.

To remove a light module, remove the light dome according to the procedures above, and then lift out the light module. Separate the wire connector by pressing on the release clip.

To install a light module, connect the wire connector making sure to align the release clips and when connected, the clips are secure. Align the notch at the rear of the light module with the screw that holds the thruster tube to the main hull and insert the light module into the thruster tube. Install the light dome according to the procedures above.

Light domes and light modules are interchangeable from port to starboard.

Changing a Main Dome

The main domes are interchangeble from front to rear.

When working on the main domes, the ROV skid needs to be removed. It also helps to remove the float block and horizontal thruster nozzles.

To remove a main dome, first float block and horizontal thruster nozzles. Next, remove the ROV skid by removing the four screws at the bottom of the main dome retaining ring at the front (2 screws) and the back (2 screws).

Next, remove the acorn nuts from the rear of the main hull rods, and then remove the locking nuts from the rear of the main hull rods. At this point, the dome retaining rods can be removed.

Remove the dome by pulling on the tabs.

To install a main dome, make sure O-ring is clean and lubricated. Align the tabs so that they will not interfere with the main hull rods, and press the dome over the hull ring until it seats.

Install the main dome retaining ring with the tab aligned downward. Place the ROV on a flat surface and make sure both retaining rings are even and the ROV is setting level.

Install the main hull rods and secure them with the locking nuts.

CAUTION Do not over tighten the main hull rods. Doing so will bend the main dome retaining rings. The locking nuts should be tightened so there is just enough room to install the acorn nuts.

Screw on the acorn nuts.

Replace the skid, nozzles and float block.

Diagnostics and Repair

Are you having a bad day with your Pro 4? You've come to the right place.

Solving problems requires either a methodical diagnostics approach, or lots of luck. If you don't like to gamble, the following may help you overcome challenges that inevitably present themselves from time to time.

Before providing the specific details of diagnosing and repairing the Pro 4, some basic troubleshooting guidelines are in order. Following these practices should make your efforts much more efficient and successful.

- Suspect and check the obvious first - It's easy to get distracted and overlook something obvious.
- Recheck the obvious - Have someone verify your work. If you're helping someone, verify what you've been told. Sometime just talking through the details can help you relized you missed a step or fact.
- Understand correct operation and expected results - How should it work and what should happen? Does it?
- Learn and recognize symptoms - What are the results telling you? What are the most likely suspects and what can be ruled out?
- Isolate, Divide and Conquer - Classify the problem to sub-systems, remove what you can and substitute known working parts if possible. Or, try suspect parts with a known working system.
- One step at a time - Be logical and make each test provide results you can use to narrow down the problem.

The pro 4 is a collection of relatively simple components, but when something goes wrong, it's easy to get overwhelmed. The following steps should be your first response to a general system malfunction, especially if the power and communications warning indicators in the ROV Health instrument are lit.

1. Power down the system, check the connections and restart using the recommended procedures.
2. USB problems can be the root of several basic system malfunctions. Disconnect the USB cable from the back of the computer, wait a few seconds and then reconnect it. Sometimes the USB contoller can be locked up. Try connecting the USB cable to a different port on the computer or rebooting the computer.

If the problem is more isolated to a specific function, or these steps fail to resolve a general problem, it's time for a closer look at the symptoms and subsystems.

Diagnostics and Repair - Power

When the ROV powers up, you will hear a series of tones, the lights will flash, and you should be able to see some internal LEDs light up. If none of these occur a power problem is possible. Power problems can occur on the AC side or DC side. If some, but not all of the start-up indicators work, a power problem is less likely, and a communications or other ROV internal problem is possible.

AC Power Problems

If the control panel will not turn on, the first place to check is the power cord and power source. Press the GFCI test button. The GFIC will not trip without power being applied to it. If the system does not trip, either there is no power (more likely) or the GFCI has malfunctioned (less likely). If you confirm there is power and the power cord is plugged in, but the GFCI will not trip, a faulty GFCI is possible.

If the system passes the GFCI test, then the 2 IEC outlets on the rear of the panel should have power when the GFCI is turned on - the computer should show it is operating on AC power and not its battery. If the GFCI is on, and there is no power at the IEC outlets, a faulty GFCI switch or wire fault in the panel is possible.

AC Power Problems

When you turn on the power switch, you should hear the fans turn on, and the green power LED should light. You should also be able to measure 75 Volts DC in the tether connector between pins 3 and 5. If any of these do not work, it could be a faulty power switch, power supply failure or wiring problem (loose or disconnected connector).

If you measure 75 Volts DC in the tether connector, but the ROV still does not have power, it could be a fault in the tether or ROV. Connect the ROV directly to the panel without the tether. If the ROV works, it could be a problem in the tether or its connectors. If the ROV does not work, it could be a problem in its tether connector, or it could be a board failure in the ROV.

Diagnostics and Repair - Communications

Communications problems can result in loss of control of the ROV. Communications in the Pro 4 occurs at several levels.

The computer has to communicate with the control panel via the USB cable. First verify that the cable is connected. The computer must also recognize the control panel devices, specifically the RS-485 interface. The RS-485 device will only be recognized while the control panel is turned on. To check the status of the communications with the RS-485 device, the control panel must be turned on. The RS-485 interface can be confirmed by checking the Ports in Device Manager. To access device manager, open the Windows Control Panel, and in the Classic View, click on System. Next, click on the Hardware tab, and then the Device Manager button. Click on the plus sign (+) next to Ports and confirm that the SeaLevel RS-485 port is listed as one of the ports. If the RS-485 device is not listed, unplug the USB cable, wait a few seconds and plug it back in. If the RS-485 device is still not listed, power down the control panel and reboot the computer. If the RS-485 device is not listed after a shut down, restart and reboot, a problem with the USB cable, RS-485 device, or internal USB hub or controller is possible.

The control panel must communicate with the ROV through the tether. Communications occur via pins 7 and 8. verify the continuity of the tether to ensure all conductors are intact. The tether conductors are straight through - pin 1 to pin 1, pin 2 to pin 2, etc. You can also connect the ROV directly to the control panel without the tether to either rule out or confirm whether the tether is the problem.

Diagnostics and Repair - Control

Control problems can occur due to a communications problem, a hand controller problem, a problem with an ROV subsystem, poorly adjusted buoyancy, or a physical problem like a stuck tether or fouled propeller.

VideoRay Cockpit instruments can confirm that a hand controller input is being received. If the instrument does not indicate a controller input, such as the camera indicator does not move when you press the camera tilt button, then check to make sure the hand controller is plugged in. You can also check whether the hand controller is recognized by Windows. You can check if the hand controller is recognized by Windows using the Game Controller application in the Windows Control Panel.

If the hand controller is working, but you cannot pilot the ROV, check for a loose or fouled propeller. If the propellers are clear, the problem could be a thruster motor or motor controller. If the problem is vertical control, then you might need to adjust the ballast.

If the ROV can be piloted, but another subsystem, like camera tilt, is not functioning, verify the hand controller function as listed above, and then suspect the subsystem.

 See the **Control Sensitivity** and **Systems Tuning** section of the **VideoRay Cockpit Guide** for more information about adjusting the responsiveness and power settings of the thrusters.

Diagnostics and Repair - Video

Video problems are widely variable. It could be a faulty cable, signal problem, video noise, improper camera setting for the conditions, or even lighting.

If there is no video signal, first verify that rest of the system is functional. If the rest of the system is functional, verify that the video circuit in the control panel is recognized by the computer. The video circuit can be verified by checking the Sound, video and game controllers section in Device Manager. To access device manager, open the Windows Control Panel, and in the Classic View, click on System. Next, click on the Hardware tab, and then the Device Manager button. Click on the plus sign (+) next to Sound, video and game controllers and confirm that the DVD Maker 2 device is listed. If the DVD Maker 2 device is not listed, unplug the USB cable, wait a few seconds and plug it back in. If the DVD Maker 2 is still not listed, power down the control panel and reboot the computer. If the DVD Maker 2 is not listed after a shut down, restart and reboot, a problem with the USB cable, DVD Maker 2 device, or internal USB hub or controller is possible.

If video noise seems to be a problem, it could be local interference, a mismatched ground, or a poor connection somewhere in the system. If you are operating off a local power source such as a generator, make sure the ground is the same as the water in which the ROV is being used. Also, check that each connection in the tether is clean and well seated.

If you do not have video on the second monitor, make sure the monitor is powered on, the cable connected and computer configured to display on two screens.

If the video image is poor, check the camera focus and the camera settings. You may also need to adjust the lights.

Customization Guide

The Pro 4 has unprecedented customization capabilities based on using a conventional laptop computer as the core of the system's topside architecture. Many new features will be available through software updates. Future software versions are already on the drawing board to include user customizations to the interface and functionality. Examples include variations on the cockpit instruments and piloting modes that will automate piloting maneuvers like dive and surface modes that pitch the ROV to take advantage of the powerful horizontal thrusters for vertical movement.

Software Updates

Software updates can be reviewed and downloaded using the Downloads button at the top of every page. See the **Software Updates** section of the **VideoRay Cockpit Guide** for more information.

Topics in the Section

- **Hand Controller Button Assignments**
- **SDK (Software Developers Kit)**

Hand Controller Customization

Any Microsoft® Windows® compatible game controller can be used with the VideoRay Pro 4. The hand controller button assignments can be modified to accommodate different controllers and personal preferences.

VideoRay Cockpit currently supports two hand controllers, the VideoRay standard industrial hand controller, and the Logitech® Cordless RumblePad™ 2. VideoRay Cockpit will recognize either of these controllers and use the default button mapping.

The button assignment to function mapping is handled through XML configuration files. Currently there is no graphical interface to modify these files, but the near term software development plan does include adding this capability. If you want to change the button assignments, the XML configuration files need to be edited by hand. This is not something VideoRay encourages users to do until the graphical interface is complete, but if you have a need to modify the hand controller button mapping in the meantime, please contact VideoRay for assistance.

SDK (Software Developer's Kit)

The VideoRay SDK (Software Development Kit) allows for the modification and enhancement of the VideoRay Pro 4. The SDK is divided into two major categories: the Host SDK and the Embedded SDK.

The Host SDK, written in C# and consisting of several .DLL's allows for the creation of applications running on a host computer to control the ROV. The Host SDK also provides facilities for enhancing and extending VideoRay Cockpit, the standard control software, through the use of a plug-in architecture. The recommended development environment is Microsoft Visual Studio/C#, however the SDK can be used from any .NET language.

The Embedded SDK, written in GNU C, can be used to develop firmware to run on directly VideoRay hardware. Currently two hardware platforms are supported, the Pro 4 and the PAM (Protocol Adapter and Multiplexer) module.

All higher level protocols (communications, memory maps, bootloader, etc.) are fully and openly documented.

Auto-generated documentation is provided for both the Host SDK and the Embedded SDK.

Additional information about the SDK is available from VideoRay online at: **http://download.videoray.com/developer/**.

Upgrader's Guide to the Pro 4

The VideoRay Pro 4 is a comprehensive technological overhaul of the Pro 3 system. While the basic form factor and size of the ROV's hull have remain unchanged, practically all of the other components have been updated. These updates provide advanced features and capabilities over the Pro 3 and are described in more detail in the next sections of this guide.

Topics in this Section

- System Architecture
- Feature Updates
- Compatibility Issues

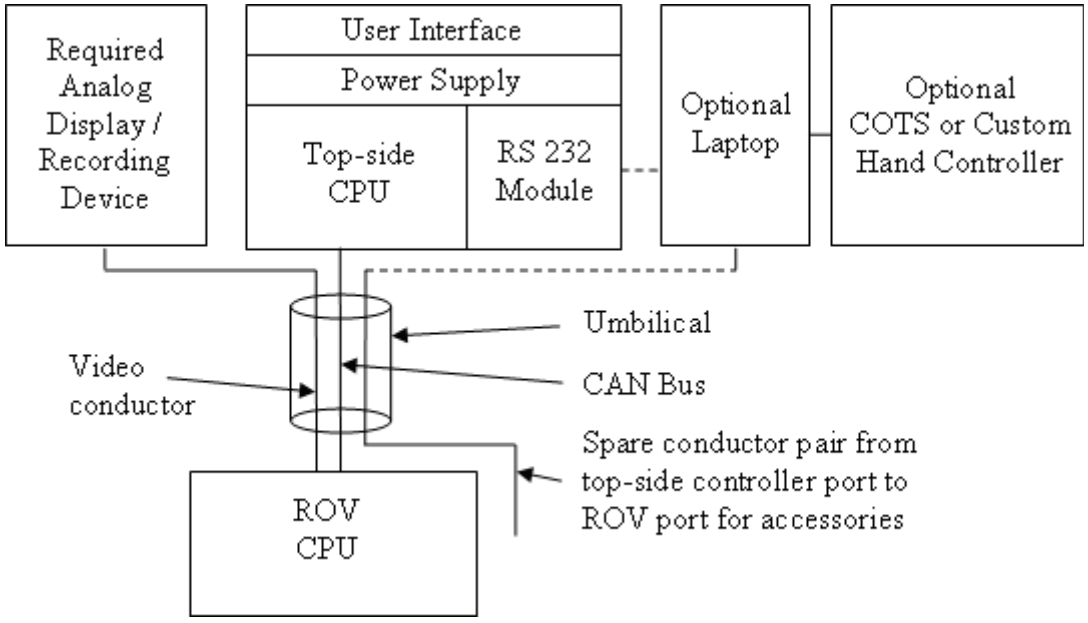
Pro 4 Architecture

The VideoRay Pro 4 represents a significant evolutionary, if not revolutionary, step in the development and capabilities of submersible Remotely Operated Vehicles (ROVs). Built upon a solid platform that was developed in the mid-1980s and which can now be found in service in more ROVs around the world more than any other system, the Pro 4 capitalizes on the features that have withstood the tests of time and adds the latest technological breakthroughs.

Pro 3 Background

The system architecture of the VideoRay Pro 3 consists of a proprietary controller (with hand controls, CPU board and power supply) on the top-side, the ROV (which also incorporates an onboard CPU) and an umbilical that connects the two. The CPUs are dated and the communications protocol between the topside and ROV relies upon CAN bus technology that became popular in the automotive industry in the early 1980s. While these systems continue to provide reliable operation, further extensibility and integration with new systems are limited.

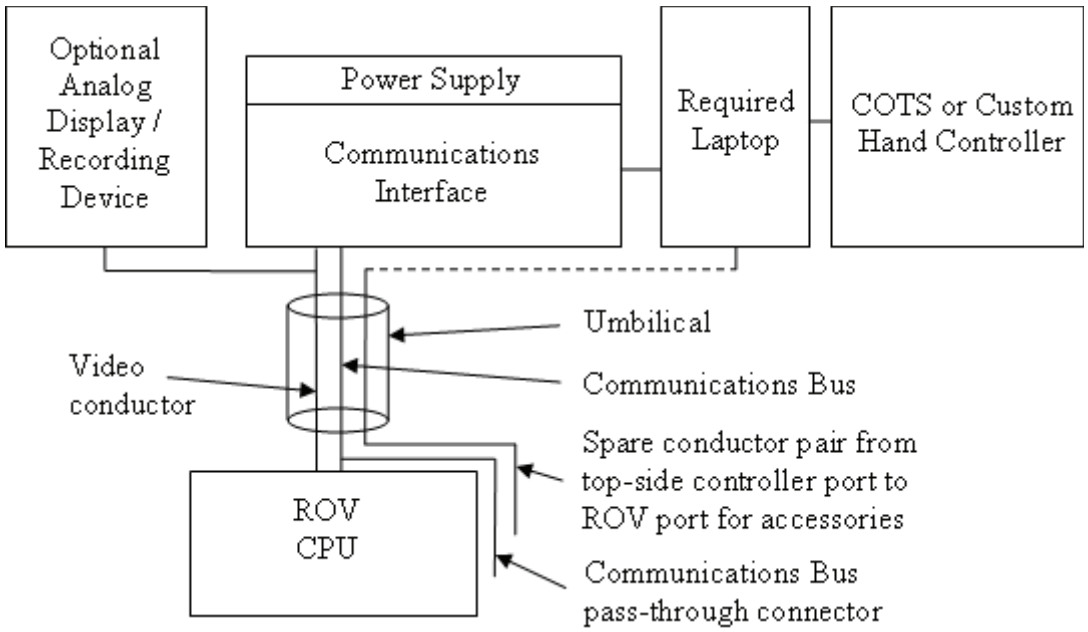
An RS-232 interface in the Pro 3's top-side CPU board allows an external computer to communicate control inputs, which in turn are relayed from the topside CPU to the ROV. This enables the ability to use COTS hand controllers, and add a few graphic features to the interface, but provides little more in terms of added features and functionality, and certainly doesn't exploit any of the true potential of today's modern CPU performance.



Pro 3 Functional Schematic

Pro 4 Control and Communications

In the Pro 4, this architecture has been overhauled and optimized. The new architecture is built around a new state-of-the-art high performance ROV CPU board and a more robust and extensible communications bus. The topside proprietary CPU board and dedicated user interface is eliminated, being replaced by a traditional high performance commercially available rugged computer and COTS or custom controllers.



Pro 4 Functional Schematic

This new arrangement affords direct communications from the topside computer to the ROV CPU. In practical terms, this means that the intensive processing requirements for sophisticated features like auto depth and dive control modes can be managed locally within the ROV instead of having to communicate with the topside. Additionally, by having the topside PC communicate directly with the ROV instead of just simulating operator inputs as it does in the Pro 3, the full power of today's most advanced dual and quad core processors can be exploited. High-level programming applications will augment or completely replace the current PC Pilot software and enable the creation of unprecedented control and integration opportunities. Examples include autonomous and semi-autonomous behaviors and integration with accessory devices. One specific example might be the use of a sonar application to take over piloting the ROV to guide it directly to the location of a target signature selected by the operator (or even selected automatically through image processing and recognition analysis). Without getting too far off track, other applications might include having the ROV automatically deploy packages or take samples when it crosses programmed depth thresholds, or follow search patterns automatically.

Within the Pro 3, both the topside and ROV CPUs rely on EEPROM chips to store their control software. There is no easy way to update these in the field. For the Pro 4, VideoRay will develop and deliver a Software Developers Kit (SDK). The SDK will include high-level routines that can be used as building blocks for rapid prototyping and development of new applications. The SDK will also include a module to upgrade the embedded code in the ROV. Users will be able to keep their Pro 4 up-to-date with the latest versions of control code and add new features as they become available. The VideoRay Pro 4 will not only be the best ROV platform today, but well into the future.

Pro 4 Communications and Accessory Support

In the Pro 3, a single accessory that requires a data path to the surface will monopolize the APIC (Auxiliary Pair of Independent Conductors) in the tether. This limits the number of devices that can be operated simultaneously and there is typically no coordination of the accessory data with the ROV operating parameters.

While the APIC remains available in the Pro 4, additional capabilities are created by using a more universal and robust RS-485 communications protocol. This RS-485 subsystem replaces the CAN bus used in the Pro 3. It is also made available externally on the ROV accessory port, which enables addressable networking of the ROV and accessory devices.

Comparison of VideoRay Pro 3 versus VideoRay Pro 4 Accessory Port Pin Function (Pro 3 / Deep Blue) Function (Pro 4) 1 Video - Video - 2 Video + Video + 3 48 VDC +, 30 Watts 24 VDC +, 30 Watts 4 Aux + Aux + 5 Ground Power Common (Ground) 6 Aux - Aux - 7 Manipulator 24 VDC - RS-485 Tx 8 Manipulator 24 VDC + RS-485 Rx 9 12 VDC +, 6 Watts 12 VDC +, 30 Watts 1. Changes are noted in bold. 2. The Pro 3 and Pro 4 manipulators are not interchangeable.

The external RS-485 connection makes possible unprecedented multiplexing and inter-communications of the ROV, accessories and/or sensor devices. Examples of the immediate possibilities include:

- Allowing accessories that require communications with the surface, which was typically supported on the APIC, to be operated using the ROV communications bus. This allows multiple accessories to be used concurrently.
- Allowing accessories to be addressed by a device ID. This will allow multi-axes manipulators or even multiple manipulators on one ROV to be supported.
- Allowing the VideoRay controller to operate accessory devices other than the manipulator, such as changing a sonar's range setting or inflating a lift bag.

Extended future possibilities include:

- Having the ROV be aware of an operator's change to the sonar's range setting during a ship hull inspection, and then having the ROV automatically adjusting its pitch angle and hull distance accordingly to deliver the optimal sonar image of the hull for that range.
- Reading previously placed RFID tags, retrieving information from a database related to each tag, recording new images and other data such as temperature or salinity and posting these to the database, all while the operator concentrates solely on piloting the ROV.

The first integrated accessory, available for immediate delivery with the Pro 4, is the KCF Technologies Smart Tether, which uses the same RS-485 communications bus. The ROV's Compass/NAV node (see below for more information) also serves as the ROV node for the Smart Tether further illustrating the tight integration made possible by adopting the RS-485 protocol.

Additional benefits of using the RS-485 protocol over the CAN bus are that the maximum tether length has been extended from about 360 meters (1,200 feet) to more than 600 meters (2,000 feet), and the ability to integrate new accessories is virtually limitless.

Pro 4 Modular Components

VideoRay ROV architecture is moving in the direction of increased reliance on software to support long term implementation of features, and hardware modularity to support the diverse nature of the capability requirements based on the variety of user applications. This plan begins with the Pro 4, and will continue through future evolutions.

Summary

The Pro 4 has taken the highly acclaimed and extremely reliable Pro 3 GTO to new levels of performance by overhauling and updating many of the key components while maintaining the basic structure and form factor of VideoRay ROVs. The new system architecture also allows a continuous stream of improvements from VideoRay and as new accessories and features are added and as the SDK is put to use by accessory vendors and research institutions.

Pro 4 Features and Capabilities Updates

The Pro 4 has been extensively updated to include many enhanced features and extended capabilities.

Pro 4 User Interface

The Pro 4 includes a custom hand controller that is built using the same industrial controls found in the Pro 3 controller. This controller is delivered with a default configuration, but can be customized to accommodate any user's preferences. Additionally, any COTS or custom controller that works with a PC can be used with the Pro 4, including wearable and immersive devices such as gloves and head mounted display/controllers.

Video can be displayed on two monitors, the built-in monitor and the PC display. Alternately, the video can be displayed on one screen while the other displays an accessory output such as a sonar or position tracking chart.

The Pro 4 video can be recorded digitally (on the included PC), or using standard analog devices (user supplied), or both. Digital recording of still images and/or video is built into the control panel and can be executed with the push of a button on the controller. Digital recording is in industry standard formats and ready for non-linear editing, on-line sharing, or DVD authoring.

The included PC can be configured to run accessory applications such as sonars, position tracking systems, VideoRay's radiation detector and other sensors.

Sensor feedback is provided onscreen and includes the camera tilt and focus positions, lights setting, and information from other onboard sensors, including temperature, humidity, power and communications status.

Pro 4 Power and Thruster Technology

The Pro 4 power supply has been upgraded from 48 Volts DC to 75 V DC, but still maintains the same low power consumption of the Pro 3 due to more efficient power circuitry. To support this increase safely, the Pro 4 incorporates a Line Insulation Monitor (LIM) protection circuit. Like a GFCI, the LIM detects minor changes that indicate a fault and safely powers down the system if a fault is detected. The voltage specifications at the accessory port have changed. The main bus is now 24 Volts DC, but it is isolated from the tether ROV power circuit and better regulated so that it is less susceptible to voltage variations under thruster load. The 12 Volt DC available on the accessory port is now capable of supporting loads up to 30 Watts instead of the 6 Watts available in the Pro 3. The VideoRay Pro 4's now includes custom designed and highly efficient brushless thrusters that deliver unparalleled performance and reliability. In order to provide the optimal blend of power and control, the VideoRay Pro 4's thrusters incorporate the following features:

- The horizontal thrusters, coupled with hydrodynamically optimized propellers and nozzles, produce the highest thrust-to-vehicle weight and thrust-to-drag ratios in the industry. This combination ensures users will have the power when they need it, along with the ability to pull long umbilicals and work in currents that divers wouldn't dare attempt.
- Direct drive horizontal thrusters improve efficiency and reliability over the Pro 3 GTO.
- The thruster placement and counter rotation provide a zero turning radius and extremely agile maneuverability as well as a stable platform for the camera and sensors.
- Vertical thrust now incorporates a 65 mm three bladed propeller, and ducted channels under the float block. The enhanced vertical thrust and pitch-controlled dive and surface modes expand on the raw power of the new thruster motor and propeller to deliver significantly higher performance than the Pro 3.
- Motor controllers are tuned for lightning-fast responsiveness. In conjunction with joystick sensitivity and independently adjustable gain these features ensure precision handling and the dexterity to

maneuver or maintain position as needed.

Pro 4 Camera

The VideoRay Pro 4 is equipped with 2 high resolution color cameras.

The main camera is located in the forward pressure hull and the second camera can be positioned on top of or underneath the ROV. The forward camera tilts 180 degrees while the second camera tilts 180 degrees and pans 360 degrees providing full hemispherical coverage.

Both cameras are equipped with wide dynamic range and backlight compensation to deliver the highest quality images even in difficult lighting situations. The cameras are optimized for underwater use and offer ultra low-light sensitivity (0.0001 lux).

There are more than 20 user controllable settings that can be managed from the surface including automatic or manual switching between color and black and white modes, an automatic shutter and digital zoom capabilities.

Camera tilt and focus are now controlled using servo motors, which allow faster operation, precise positioning and feedback as to their current position. Position information for tilt and focus is displayed in the user interface.

Pro 4 Lights

The new highly efficient and high intensity LED lighting provides 3,600 lumens at a color temperature of 6500K. This intensity and color temperature provides significantly improved penetration at depth. The intensity can be boosted to 5,700 lumens and LEDs with different color temperatures will be available in the future.

The forward light reflectors have been engineered to distribute the light evenly throughout the camera tilt range, such that at 45 degrees vertically, the Pro 4 projects more light than other ROVs do straight ahead at the same distance.

Like the Pro 3, the lights are positioned outside the main hull to provide the greatest separation from the camera and to make servicing easier (although the service rating of the LED lights makes servicing virtually unnecessary). This separation is extremely important in minimizing backscatter due to suspended particles in the path from the lights to the camera target, and results in higher quality images.

The setting of the intensity of the lights is displayed in the user interface.

Pro 4 Compass and Navigation

The Pro 4's navigation system includes a 3 axis compass, accelerometer, and MEMS Rate GYRO. These devices are mounted on a single board and are the same as one of the nodes in the KCF Technologies Smart Tether.

You do not need to calibrate the compass.

The heading of the ROV is displayed in the compass and its attitude in the artificial horizon indicator.

Pro 4 Depth Gauge

The Pro 4's depth gauge is much more sensitive and has about 10 times the resolution of the Pro 3's depth gauge. You do not need to calibrate the depth gauge.

Auto-Pilot Modes

Auto heading is now included in addition to auto depth, and both features now support the traditional "set and forget" mode and a new "go to" mode.

Pro 4 Additional Sensors

Temperature and humidity sensors have been added to the internal components of the Pro 4 ROV.

Pro 4 Float Block

The Pro 4 float block has been redesigned to be more hydrodynamic, more durable and provide variable floatation to match the accessory payload.

Pro 4 Skid and Ballast System

The Pro 4 skid and ballast system have been redesigned to be stronger, more hydrodynamic and allow the ballast to be adjusted without requiring any tools. The system consists of a central accessory mounting adapter plate and two ballast weight pods. The weight pods are hinged and hold the ballast weights in slots that allow the pitch trim to be fine tuned.

Pro 4 Depth Rating

The Pro 4 depth rating has been increased to 305 meters (1000 feet) by using a stiffer hull, but the overall weight of the Pro 4 has been reduced when compared to the Pro 3 GTO.

Compatibility Issues between the Pro 3 and Pro 4

There are several compatibility issues between the Pro 4 and prior versions.

Control Panel

The control panel has been changed significantly from the Pro 3 to the Pro 4. The Pro 4 uses 74 Volts DC in the tether, while the Pro 3 uses 48 Volts DC.

CAUTION Do not attempt to plug a Pro 3 ROV into a Pro 4 control panel, or a Pro 4 ROV into a Pro 3 control panel. Doing so may cause damage to the components.

Accessory Port

The accessory port has been changed from the Pro 3 to the Pro 4. The table below lists the changes.

Pin	Function (Pro 3 / Deep Blue)	Function (Pro 4)
1	Video -	Video -
2	Video +	Video +
3	48 VDC + (30 Watts)	24 VDC + (30 Watts*)
4	Aux +	Aux +
5	Ground	Power Common (Ground)
6	Aux -	Aux -
7	Manipulator 24 VDC -	RS-485 -/A
8	Manipulator 24 VDC +	RS-485 +/B
9	12 VDC + (6 Watts)	12 VDC + (30 Watts*)

Lights

CAUTION The Pro 3 and Pro 4 lights are not interchangeable between these two systems even though the connectors are the same. Using a Pro 3 light bulb on a Pro 4 ROV, or a Pro 4 LED on a Pro 3 ROV may cause damage to the lights or the ROV.

Manipulator

CAUTION The Pro 3 and Pro 4 manipulators are not interchangeable between these two systems even though the connectors are the same. Using a Pro 3 manipulator on a Pro 4 ROV, or a Pro 4 manipulator on a Pro 3 ROV may cause damage to the manipulator or the ROV. You can tell the difference between Pro 3 and Pro 4 manipulators by the length of the main body. The Pro 3 body is about 75 mm (3 inches), while the Pro 4 body is about two times as long at 150 mm (6 inches). The Pro 3 manipulator uses pins 7 and 8 for + or - 24 Volts DC to drive the motor. The Pro 4 manipulator includes a processor board to allow multiple manipulators to be used on one ROV. On the Pro 4 manipulator, pins 7 and 8 are used for communications, pins 3 and 5 are used for power (24 Volts DC) and pin 12 is used to power the processor board (12 Volts DC, converted to 5 Volts DC on the board).

Calibration

The Pro 4's depth gauge and compass do not need to be calibrated.

Run Time

The run time of the Pro 3 is stored in the control panel. The run time of the Pro 4 is stored in the ROV. This provides a more accurate representation of the amount of hours of use of the ROV.

Tether

VideoRay tether can be used with any model. The maximum tether length of the Pro 4 has been increased from about 365 meters (1,200 feet) for the Pro 3 to about 600 meters (2,000 feet).