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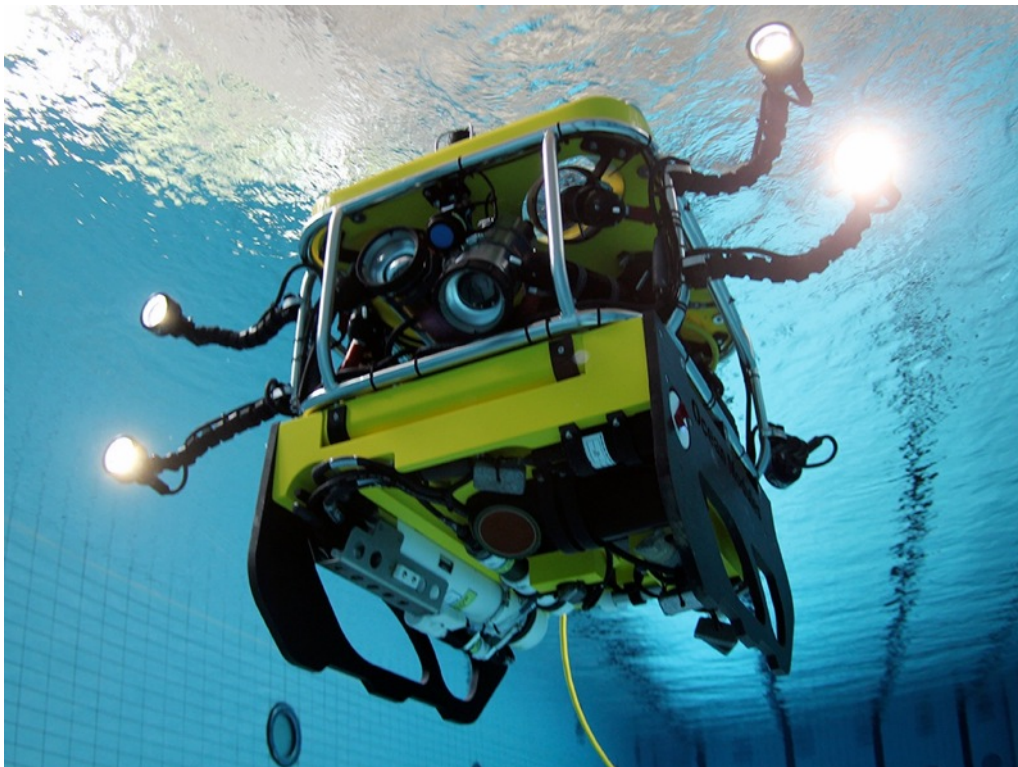
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Ocean Modules V4 / V8 Sii ROV Manual



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Preface

Scope

This manual covers the technical description and operating instructions of the Ocean Modules V4 and V8 Sii remotely-operated underwater vehicle system, providing the basic knowledge required for proper, safe and economical use.

Please observe that certain information encompasses all V4 and V8 Sii systems while some information is version-specific. Where the information is version-specific it will be noted.

In some cases the V4 or V8 Sii may be delivered with customer-specific interfaces, sensors, tools, equipment or functionality. In these cases this manual may require complementary technical data and operating instructions.

Utilizing the content of the technical documentation will help to avoid hazards and to reduce repair and downtime costs, as well as to increase the reliability and lifetime of the system.

Ocean Modules Sweden AB reserves the right to change, modify or update designs and specifications as part of ongoing product development.

Supplementary Instructions

This manual describes the standard Ocean Modules V4 and V8 Sii remotely-operated underwater vehicle systems only. A system delivery may include optional equipment such as generators, launch and recovery systems or tether management systems, and sensors such as cameras, sonars, altimeters or positioning systems. Please read the corresponding manuals supplied by each equipment manufacturer.

This manual does not cover national regulations on work safety, health protection and environmental protection. Neither does it cover topics such as work organization, work instructions, instructions on supervising or reporting obligations.

Target Group

This manual is intended for all operations and maintenance personnel on site. Personnel authorized to work with the system shall have read and understood this manual.

Storage of Manual

This manual should be stored in the vicinity of the work area, available to operators and supervisors at all times.

Reading Instructions

Please read the entire manual before attempting to set up or operate an Ocean Modules ROV system.

It is important to comply with all safety regulations in this manual and any additional operating instructions and safety regulations relevant to the work environment and the specific equipment in use.

This manual contains warnings relating to the risk of accidents that may or will result in personal injury or severe material damage. This information has been categorised, depending on the probability of accident or the gravity of the possible consequences, as either a note, caution or warning as follows:

NOTE

Indicates important information, and may indicate a risk of breakdown or malfunction of material, if not followed.

CAUTION

Indicates that an accident might occur if the regulations are not followed. The accident might result in personal injury or material damage.

WARNING

Indicates that an accident might or will occur if the regulations are not followed. The accident might result in serious material damage, personal injury or death.

Definitions and Abbreviations

The following terminology will be used throughout this manual:

ROV	Remotely-Operated Underwater Vehicle
VCT	Vehicle Control Tube
FVCT	Fiber-optic Vehicle Control Tube
PT1	Power Tube 1
PT2	Power Tube 2 (on some systems identical to PT1)
MCT	Motor Control Tube
FT	Fiber Tube
IMU	Inertial Measurement Unit
JB	Junction Box (Subsea)
SJB	Surface Junction Box
SU	Surface Unit
PU	Power Supply Unit
SEU	Surface Expansion Unit
SIU	Surface Interface Unit
PCU	Pilot Control Unit

Umbilical	Umbilical tether cable
Fiber	Fiber-optic communication link
Copper	Copper wire communication consisting of multiple twisted pairs
AC	Alternating current
DC	Direct current
Aft	Rear of a marine vehicle (pointing backward)
Fore	Front of a marine vehicle (pointing forward)

Warranty

The product warranty applies to new ROV systems delivered by Ocean Modules to the original customer. Any repair or modification to the design not authorized by Ocean Modules in writing, including, but not limited to, replacement of cables or optional equipment, will render the warranty void.

The warranty does not cover any defects that have been caused by failure to follow the instructions in this manual.

Exceptions or additions to the warranty may be included in the sales contract for each individual system delivered, please refer to the delivery documentation for details.

Copyright

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System Overview

Both the Ocean Modules V4 ROV and the Ocean Modules V8 Sii ROV are classified as ROV Class II – observation vehicles with payload option, in accordance with the NORSOK standard U-102 (see www.standard.no for details) which are equipped with lights, video cameras, and a navigational sonar as standard.

Class II vehicles are capable of operating without loss of original function while carrying at least two additional sensors. The V8 Sii ROV has the capability to carry equipment and sensors such as manipulators, multi-beam sonars, high-definition video cameras, transponders, cathodic protection measurement systems, etc.

The Difference between a V4 ROV and a V8 Sii ROV

The V4 and V8 Sii ROV systems share all basic components, from surface units and cables to thrusters and electronics tubes.

The main difference is that the V8 Sii has eight thrusters and onboard power conversion from 600V DC whereas the V4 only has four thrusters, does not have the 360° pitch and roll capabilities of the V8 Sii and is fed 160V DC directly from umbilical making it smaller and lighter.

Both the V4 and the V8 Sii are available with fiber-optic or copper-based umbilical tether cables. Where there are differences they will be noted in the manual.

The V4 or V8 Sii ROV System

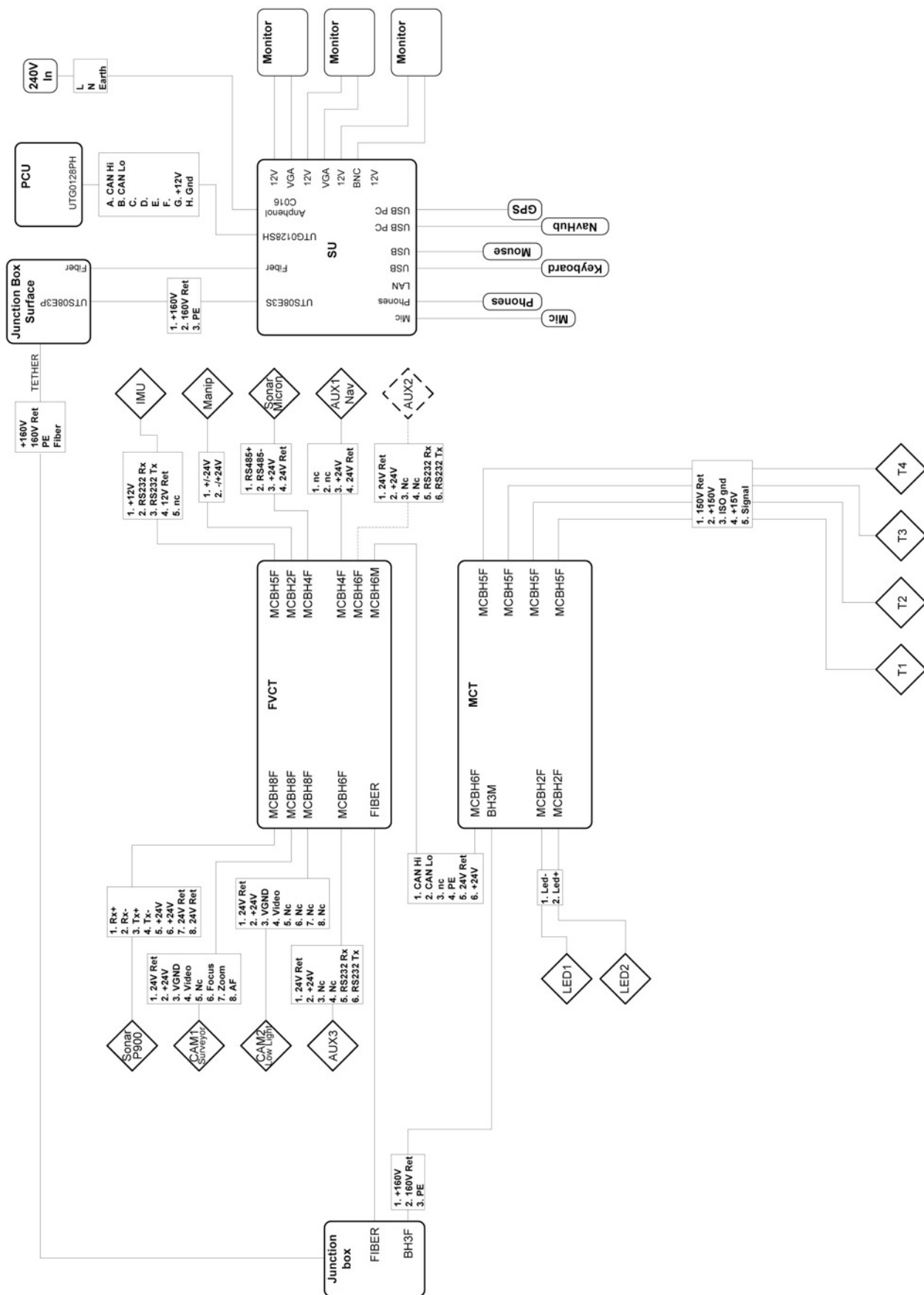
An observation class ROV system from Ocean Modules consists of four major sub-systems. Interconnecting cables link the various subsystems to each other:

1. SU (with or without SEU and/or computer)
2. PCU
3. Umbilical (with or without a winch)
4. ROV

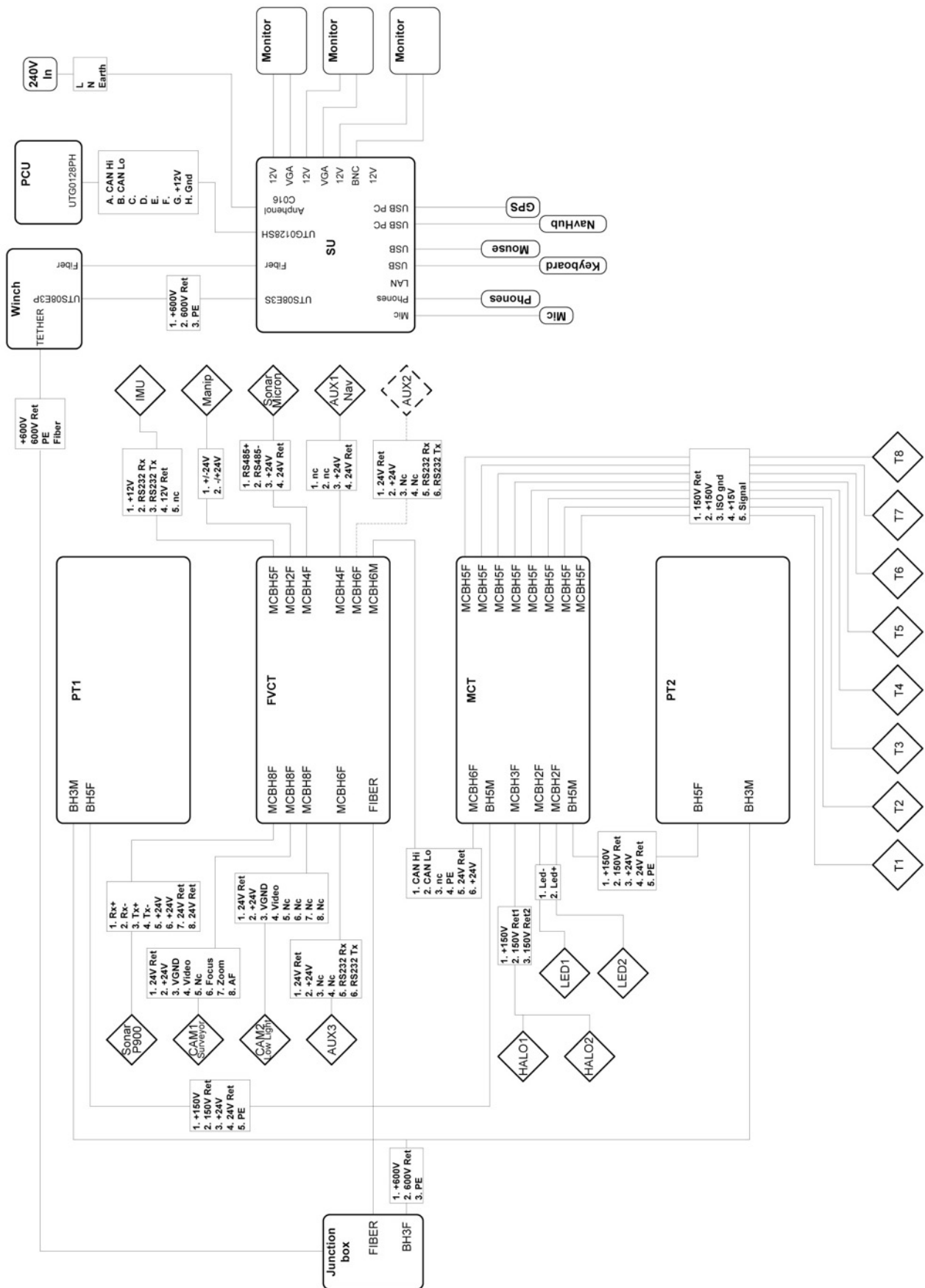
The V4 or V8 Sii ROV System Drawing

The exact contents of the SU, port configuration, connector specifications, cable type, equipment mounted at time of delivery and so on will be documented in the System Drawing delivered with each system. Examples of three different typical System Drawing documents are included on the next three pages, but are provided as examples only.

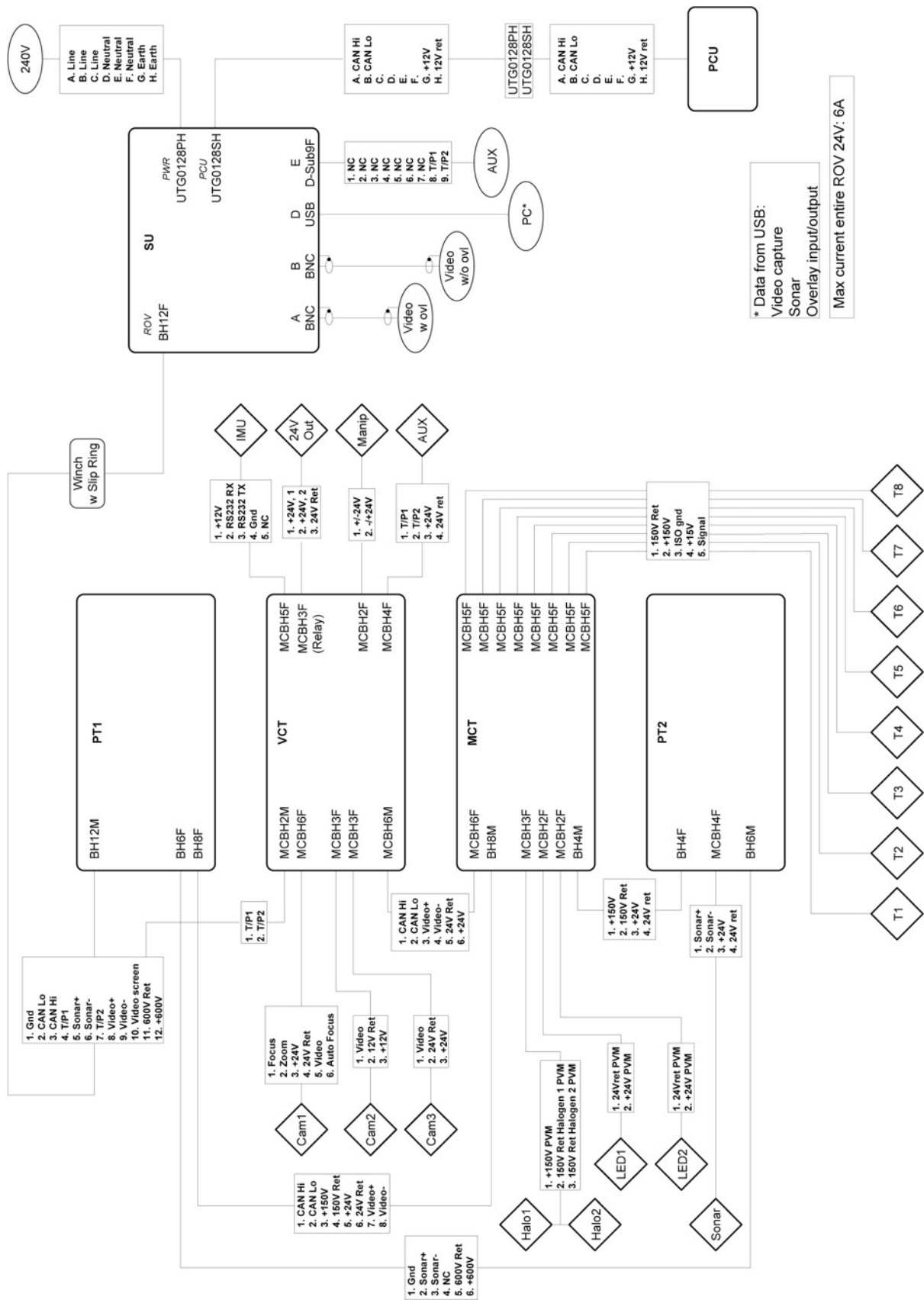
Please refer to the System Drawing delivered with each specific ROV system for details on that particular system.



A typical V4 ROV System Drawing



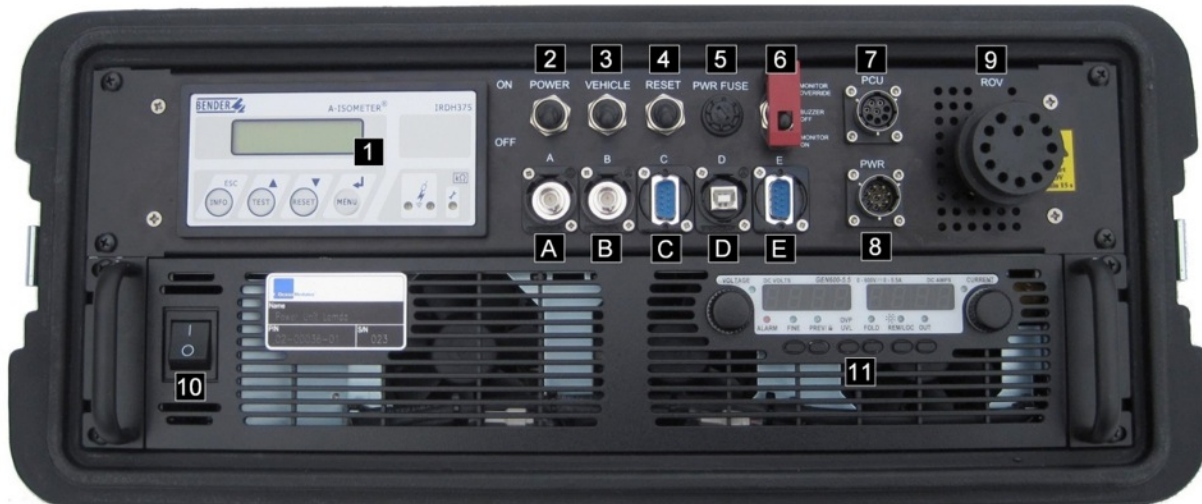
A typical V8 Sii fiber-optic umbilical ROV System Drawing



A typical V8 Sii copper-based umbilical ROV System Drawing

SU (Surface Unit)

The SU is a collective designation for several units which may or may not be housed together in one container. Every V4 or V8 Sii ROV system contains at least a PU and a SIU, but may also contain a SEU, computer and additional peripheral equipment such as video recording units, video switches, UPS equipment or broadcasting hardware.



A typical SU for a copper-based umbilical V8 Sii system in a plastic mobile case containing only a PU and a SIU

All SU units are 19" rack-mountable and can be delivered in a variety of different housings depending on customer requirements, from rack cabinets for permanent ship installation to rugged and waterproof mobile cases.



A typical SU for a fiber-optic umbilical V4 system in an aluminium mobile case containing a PU, SIU and computer

PU (Power Unit)

Electrical resistance of long copper cables in the umbilical cause loss of voltage. To avoid increasing the diameter of the copper leads, which would increase the weight and thus also the diameter of the tether, the current is transferred as high-voltage DC.

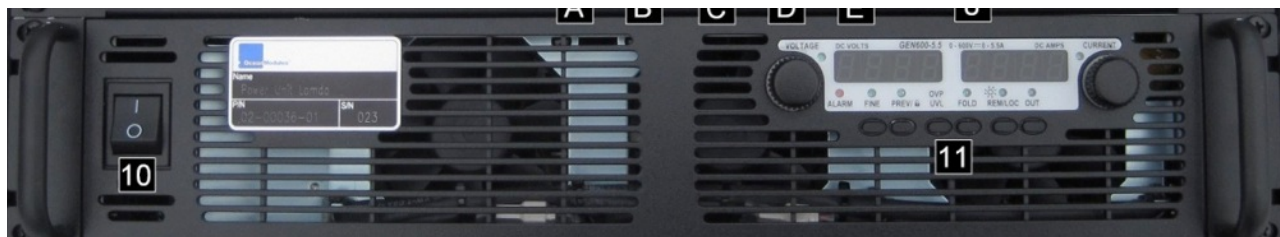
Doubling the voltage reduces the current required to deliver the same amount of power by half, which also reduces the loss by half, thus increasing the efficiency.

For the V4, the PU converts 170–265 VAC mains supply to 160 VDC, which is led through the umbilical to the ROV, where it is converted used directly for thrusters, but converted to 24 VDC for peripheral equipment.

For the V8 Sii, the PU converts 170–265 VAC mains supply to 630 VDC, which is led through the umbilical to the ROV, where it is converted again to voltages used by the ROV thrusters and sensors.

The PU provides a consistent voltage with a maximum current of 5.5 A, allowing the ROV to utilize more than 3 kW of power if required. For more information on the PU please refer to the TDK Lambda Power Supply Manual.

The V4 and V8 Sii can be run off the same PU, however it **MUST** be set to 600V for V8 Sii use and to 160V for V4 use. The PU will be locked to the voltage required by the system it was delivered with. For use with multiple systems, please see separate documentation provided by Ocean Modules with such deliveries.



The PU

The PU contains a power switch and a control interface.

- 10. Lambda power switch (always set to the "ON" position)
- 11. Lambda control interface

NOTE

There should never be any reason to change or monitor the PU configuration, it has been set correctly and tested before delivery. The power switch can be left in the "ON" position as the power to the PU is automatically cut when the system power switch on the SIU is switched off.

WARNING

Never use a PU delivered with a V4 with a V8 Sii ROV system or vice versa, unless first reprogramming the PU for the proper voltage.

V4 systems intended to run with short cables in high-power mode are delivered with a PU capable of putting out a maximum of 300 VDC. Such a PU cannot be used with a V8 Sii system.

See the chapter on system operation for monitoring and diagnostic tasks that can be performed using the control interface.

SIU (Surface Interface Unit)

The SUI is primarily a collector and distributor of all the data and video signals that are sent to and from the ROV via the umbilical. The SUI houses the fiber-optic converters and data processors necessary to amplify, convert or relay data to the PCU and peripheral user interfaces such as computers and monitors.

The SIU front panel holds the connectors for the system power supply, the PCU, the umbilical and peripheral systems.



A typical copper SIU configuration



A typical fiber-optic SIU configuration

The connectors and indicators situated on the front panel of the SIU are:

1. Ground fault monitor status display (see chapter on system operation for details)
2. Main system power switch
3. Vehicle (ROV) sub-system power switch
4. Video overlay reset switch
5. Power fuse 15AT, 6.3x32 mm ceramic (not required for newer systems)
6. Ground fault monitor alarm override switch
7. PCU connector
8. Mains power connector
9. ROV umbilical connector

Fiber-optic systems will have two connectors in place of the 12-pin wetmateable ROV umbilical connector, one fiber-optic ST connector and one power connector, both of which need are connected to the fiber-optic umbilical surface junction box or winch junction box, of the system includes a winch. Please refer to system-specific configuration documentation for details.

Interface connectors A-E will vary depending on ROV system configuration. Examples of possible interfaces include:

- A. BNC, analog video output including video overlay
- B. BNC, analog video output without video overlay
- C. D-Sub, IMU data output
- D. USB, digital video and sonar interface
- E. Auxiliary throughput, typically used for serial devices or Ethernet

NOTE

Please note that the interface connectors are system-specific, check the system configuration diagram for connector type and available internal interfaces. Please also note that some SEU and computer connections may be routed through connectors in the back panel.

SEU (Surface Expansion Unit)

The SEU holds additional hardware interface components required by special sensors or tools, such as sonar network extension interface cards, junction circuit boards for underwater positioning systems and specialized recorders or interpreters.

The SEU has been designed specifically with the Tritech MicronNav USBL positioning system and the Ocean Modules SPOT.ON survey management software in mind.



A typical SEU with MicronNav Hub installed

Computer

A computer is not required to operate the V8 Sii ROV system, but a computer is required to run sonar software, positioning software, digital video recording applications and the Ocean Modules SPOT.ON survey software.

Any type of computer may be used, but a standard Ocean Modules computer mounted in the SU has many advantages. The number of cables required is drastically reduced which increases mobility and safety while reducing setup time.

It is also a standardized component that has been tested with the complete V8 Sii ROV system.

On some fiber-optic systems the computer will also contain virtual ports, allowing access to sensors and other peripherals on the ROV with a serial RS232/RS485 or Ethernet interface. Please refer to system specific configuration documentation for details.

PCU (Pilot Control Unit)

The PCU is the main user interface for controlling the ROV. Maneuvering is primarily managed through two three-function joysticks and a pitch wheel.

Different controls may be engaged simultaneously, so that the vehicle may be maneuvered freely in six degrees of freedom. When a joystick is released to the center position, the ROV will immediately stop and maintain the given attitude and depth.

The switched labeled TRIM allows the operator activate a function similar to a car's "cruise control", keeping the ROV moving at a constant speed in any direction and at any angle even though no controls are active, until switched off.

The video overlay will display a flashing "TRIM" text when the function is active.

Four continuous dimmers are used to individually control the intensity of up to four lights.

The VEHICLE MODE is used to select one of several different operating modes. The various modes offer the operator different controls and automatic functions, which may be chosen to suit operator preference and the job at hand. Please refer to the chapter on system operation for more information.



A typical PCU

1. X (Configuration-dependent, normally manipulator open/close)
2. Y (Configuration-dependant)
3. Thrust (On / Off)
4. Power Indicator
5. Link Indicator
6. CameraSelect(1/2/3)
7. Camera Focus
8. Camera Zoom

9. PCU Display
10. Left Joystick (Depth and Roll)
11. Right Joystick (Forward / Reverse and Heading)
12. Pitch
13. Aux 1 (Configuration-dependant)
14. Aux 2 (Configuration-dependant)
15. Aux 3 (Vehicle Status Check)
16. Trim
17. Roll (On / Off)
18. PCU (On / Off)
19. Light Dimmer Controls
20. Vehicle Mode
21. Menu
22. Attitude Reset (push button on left joystick)

A number of switches and buttons provide, thruster on/off, manipulator control, camera selection, camera focus, camera zoom, camera auto-focus, roll deactivation lock and PCU reset.

The standard video overlay, which can be switched on or off, displays the vehicle's pitch, roll, depth, heading, date, time, a software-set text string and a compass rose. Additional data can be selected, such as a turn counter or system diagnostics. The overlay color can be set to light, dark, light with dark background or dark with light background to suit different conditions.

For detailed operating instructions of the menu system and the operating modes please see the chapter on system operation.

The Remotely Operated Vehicle

The Ocean Modules V4/V8 Sii ROV is primarily a platform designed to carry and position whatever sensors and tools required to perform a particular underwater task.

The ROV has been constructed around a watertight open stainless steel frame, whose main purpose is to provide a protective cage for the payload, and a steady mount for sensors and tools.

Two floatation blocks provide the buoyancy required to compensate for the weight of the payload. The V8 Sii ROV's maneuverability, with six degrees of freedom, is made possible by the the unique design, placing the two floatation blocks above and below the payload instead of at the top.

This configuration aims to place the center of buoyancy and the center of gravity in the middle of the vehicle. Keeping the vehicle neutrally buoyant and allowing it to rotate freely around its own center is important for the vehicle's performance, which is why the weight and balance of the ROV should be adjusted.

The ROV is kept stable, propelled, and maneuvered through direct and indirect control of eight powerful brushless thrusters.

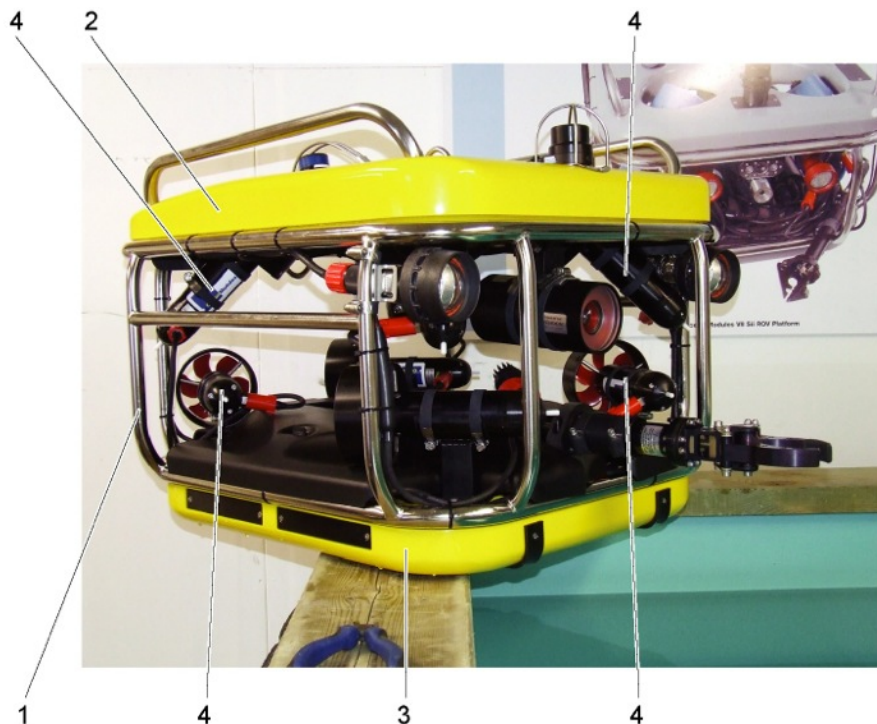
Four of the thrusters are situated in the upper floatation block mounted vertically and outward from the center, to provide thrust for movement vertically, horizontally, pitch and roll.

Four additional thrusters are mounted in the lower floatation block, horizontally and tangentially to the center, to provide horizontal and rotational movement. The thrusters are primarily controlled by a feedback control system. The control system continuously monitors the attitude of the ROV in the water, and uses that information to turn each individual thruster so that the ROV either maintains its position or is moved according to the operator's commands.

The vehicle's power conversion, control system and data interfaces are contained in five sturdy anodized aluminum tubes. Each tube contains electronic circuit boards, processors and software for such functions as DC/DC voltage conversion, amplification, data communication, command and control and data conversion.

The electronic tubes are connected through wetmateable connectors and cables, as are all sensors and tools requiring power or a data link.

Electrical power to the ROV and a communications link for command and control is provided to the ROV from the SU through the Umbilical. The vehicle's range of operation is therefore limited to the length of the tether. However, the length of the tether may in some cases exceed the vehicles maximum dive depth, which in turn is limited by the floatation blocks or equipment mounted on the vehicle.



V8 Sii ROV

1. ROV stainless frame
2. Upper buoyancy block
3. Lower buoyancy block

4. Thrusters

V8 Sii ROV Sub-systems

The standard V8 Sii ROV consists of either four or five electronics tubes, depending on if the umbilical is fiber or copper, an IMU pod, eight thrusters and interconnecting cables.

1. PT1
2. PT2
3. VCT
4. MCT
5. IMU
6. FT (only on fiber systems)

FT (Fiber Tube)

The FT is the fiber-optic interface for all communication, data and video signals sent between the ROV and the SU. Some V8 Sii systems do not have an umbilical terminated by a JB, in these cases the FT will be permanently terminated to the umbilical.



Interface connectors on permanently terminated FT

Depending on the customer-specific configuration the FT will house modems, Ethernet converters, serial digital interfaces, HD video converters and so on.

All connectors mounted on the FT are electrical, except the fiber-optic interface to the JB, on systems which do not have the FT permanently terminated to the umbilical.

PT1 and PT2 (Power Tubes)

The two Power Tubes (PT1 and PT2) share the task of transforming 600V DC, provided from the surface, to 150V DC and 24V DC for use by the various ROV sub-systems.

The content of the two Power Tubes, consisting mainly of switch mode power converters, are identical. However, the connector layout varies depending on the ROV configuration.

On some systems PT1 and PT2 are identical, with a 3-pin male connector for the 600V DC input and a 5-pin female connector for the 150V and 24V output.

On other systems PT1 and PT2 are equipped with 3 connectors where PT1 is easily identified by the main 12-pin female connector.

For more detail on the connectors and their function please refer to the pin configuration section, and the customer-specific configuration documentation delivered with the ROV system.

VCT (Vehicle Control Tube)

The VCT contains the electronics boards, processors and software that make up the control system for the V8 Sii ROV.

The control system reads heading and attitude data from the IMU, depth information from the depth sensor, located at the back end of the VCT, and receives the operator commands from the PCU.

This data is then used in a continuous loop of measuring, receiving pilot commands, calculating and controlling in order to determine which thrusters to turn, and the power necessary, to either keep the ROV stationary or to maneuver it in accordance with the operator's commands.

The VCT may also contain interface connectors for auxiliary equipment, such as cameras, lights, altimeters, positioning systems and manipulators. Please refer to the customer-specific ROV configuration documentation to determine which interfaces are available.

MCT (Motor Control Tube)

The MCT contains the circuitry which converts the digital control signal output from the VCT to electrical control signals (0-5V) that determine the revolutions per minute of each propeller.

The MCT also contains DC/DC converters which provide 15V DC, required by the controller cards located in the thrusters as well as light controllers used by dimmable halogen or LED lights.

The thrusters require 150V which is relayed from PT1 and PT2 to the thrusters through the motor connection cards housed in the MCT. The two cards hold one fast-blow ceramic fuse for each thruster. In most cases where a thruster has failed due to propeller blockage the fuse will have blown before the thruster has sustained any damage.

Thruster Model 110

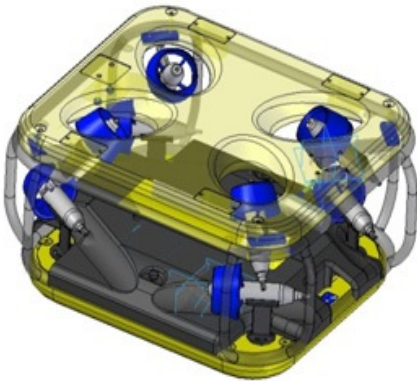
The V8 Sii ROV is equipped with eight brushless thrusters, each delivering approximately 12,5 kg of thrust. The thrusters all rotate in the same direction, the propellers are identical, all thrusters are completely interchangeable.

The thrusters are filled with a non-toxic medicinal white oil for lubrication and to prevent water penetration, and are kept pressurized by a pre-tensioned spring and a piston. A white pin at the back end of the thruster functions as a gauge for the oil level. When only a few millimeters of the pin remain visible, it is recommended that the oil be re-filled. The oil will seep out very slowly under normal circumstances, but may leak due to high

temperatures, low pressure during air transport or damaged o-rings. It is advisable that a leaking thruster be serviced.

After each use the thrusters propellers should be visually inspected to ensure that they are no obstructions such as seaweed or fishing line. If obstructive material has been wrapped around the propeller axel, the propeller can be removed with a hex key and the material removed.

Other than rinsing with fresh water after use, inspection for damage or obstructions and monitoring of the oil level the thrusters require no specific day to day maintenance.



V8 Sii ROV thruster placement

Thrusters must be connected to the correct corresponding connectors on the rear lid of the MCT. Failure to do so will result in erratic ROV behavior. The connectors are numbered, and need to be connected according to the following configuration, looking at the ROV from behind and in the forward direction:

1. Top right forward thruster
2. Top right rear thruster
3. Top left rear thruster
4. Top left forward thruster
5. Bottom right forward thruster
6. Bottom right rear thruster
7. Bottom left rear thruster
8. Bottom left forward thruster

NOTE

The vector angle of the thrusters must not be changed without also updating the control software. Contact Ocean Modules for details.

Older V8 Sii ROV systems were delivered with thrusters supplied by a different manufacturer. These thrusters can be identified by the blue cowling. For systems with these thrusters, please refer to the specific manual supplied with the system. If no such manual is available, contact Ocean Modules.

IMU (Inertial Measurement Unit)

The IMU is a small can containing accelerometers, gyros and magnetometers which measure movement, attitude and heading. The data from the IMU is crucial input to the control system, which requires continuous feedback to be able to stabilize and maneuver the ROV.

Data from the IMU, such as heading, pitch, roll and depth, may also be displayed on camera video image overlay, depending on ROV configuration. It may also be available as RS-232 output from the SU, through a D-Sub or USB connector, depending on ROV configuration, allowing the data to be used in other systems.

The IMU is located on bottom side of the upper buoyancy block, close to the back end of the ROV. It is important the IMU is mounted so that the heading measured by the compass is in line with the heading of the ROV. For this purpose there is an engraving on the IMU that is to be aligned with the forward direction of the ROV.

NOTE

The sensors in the IMU are sensitive to magnetism, it is important to not mount magnetic materials on the ROV. If the ROV is used in a magnetic environment, such as the steel hull of a ship, the IMU may be disturbed, which may cause the ROV lose automatic heading functionality, resulting in erratic behavior.

Cables

The V8 Sii ROV sub-systems, including the MCT, the VCT, PT1, PT2, the thrusters and all mounted sensors and tools are electrically connected using wetmateable connectors and cables.

These connectors and cables are made from neoprene rubber and are designed to be water-resistant to full ocean depths. Since the connectors are made of rubber and require a tight fit to prevent leakage, it is important that they be kept clean and lubricated.

Furthermore, the connectors must be disconnected and connected with a firm grip around the connector (not the cable) and without bending and twisting. The lifetime of cables and connectors can be lengthened by proper care and avoidance of prolonged exposure to heat and sunshine.

Most cables used in the V8 Sii ROV are provided by Subconn®, however some tools and sensors are delivered with connectors from other manufacturers. These connectors may or may not be wetmateable, and may come with their own care instructions. Please refer to the sensor manufacturer's documentation for details.

Standard Equipment

All sensors delivered with the V8 Sii ROV system are optional, and Ocean Modules provides a wide range of sensors to choose from, but there are a number of pieces of equipment which are so standardized that they are normally always purchased with the ROV. These include at least one video camera, two lights, a scanning sonar for navigation and obstacle avoidance and a one-function grabbing manipulator arm.

In addition, the V8 Sii ROV can also be equipped with additional lights, additional cameras with capabilities such as low-light, high-definition, wide-angle or still footage, imaging

sonars, altimeters, cathodic protection probes, multifunction manipulators and transponders, just to name a few.

Some equipment can be mounted and interfaced directly on a standard vehicle, other equipment may require special electrical or mechanical interfaces, or additional buoyancy to increase the vehicles maximum payload capability. If additional interfaces are required, please contact Ocean Modules for more information.

Cameras

The ROV will require a forward looking camera for navigation and inspection, however, a backward looking is recommended for situations such as reversing the ROV out of tight spaces and tether management.

If required it is possible to interface a third camera on the V8 Sii, depending on the customer-specific configuration of the ROV system.

Video signals from multiple video cameras can be displayed either simultaneously or one at a time, chosen with a switch on the PCU, depending on system configuration.

In the standard configuration one camera interface is supported, which has controls for zoom, focus and auto focus available on the PCU. However, this requires that the selected camera has these capabilities and that they are supported by the camera interface.

Lights

The V8 Sii ROV can, in the standard configuration, be equipped with up to four dimmable LED lights. There is up to 2x250 W available to power the lights, however, used at maximum power they will reduce the power available for the thrusters. For this reason, the V8 Sii ROV is normally equipped with 2x100 W LED lights, which is sufficient for most purposes.

Sonar

The underwater environment tends to offer poor optical visibility, which often makes a mechanical scanning sonar a necessity. Ocean Modules recommends a Tritech Micron scanning sonar as a cost-efficient alternative for navigation and obstacle avoidance. The Tritech Micron provides a 360 degree image of the surrounding environment with a practical range up to 80 meters.

There are several types of sonars, some providing higher resolution, greater range, real-time images or good coverage. However, the laws of physics do not allow sonars to have all these properties at the same time. The operator must therefore select a sonar that best suits the task at hand. The V8 Sii ROV can be equipped with sonar systems such as, but not limited to, the Tritech SeaKing scanning sonar, the Kongsberg MS1000 scanning sonar, the Tritech Gemini multibeam imaging sonar or one of the BlueView multibeam imaging sonars.

Different sonars use different methods for data communication such as RS-232, RS-485 or Ethernet, but they are all digitally controlled through a computer and the sonar images displayed on the computer screen.

For more information regarding the sonars performance or how to operate them, please refer to the corresponding manufactures data sheet and manuals.

Umbilical (Umbilical Tether Cable)

The umbilical connects the vehicle to the surface, providing power supply, a communications link and a physical connection with which the vehicle can be retrieved.

The umbilical consists of copper power supply leads and multiple twisted-pair or fiber-optic cables in a filler of silicone, which in turn is surrounded by a light plastic to provide volume, and thus buoyancy.

A thin plastic foil, which is grounded by a drain wire, surrounds the core for the detection of ground faults on the 600 V copper leaders. A braid and a jacket of hard hard plastic provide physical protection and the main tensile strength of the umbilical.

It is important to treat the tether with care, avoiding cuts, kinks, impact or compression, which may damage lead wires or cause the jacket to leak. Therefore, avoid:

1. Pulling the tether over sharp stones, barnacles, etc
2. Exceeding the minimum bend radius, especially when the tether is under tension
3. Jamming it in doorways, rolling loads over it, dropping heavy equipment on it

During ROV operations always employ a tether manager, who shall:

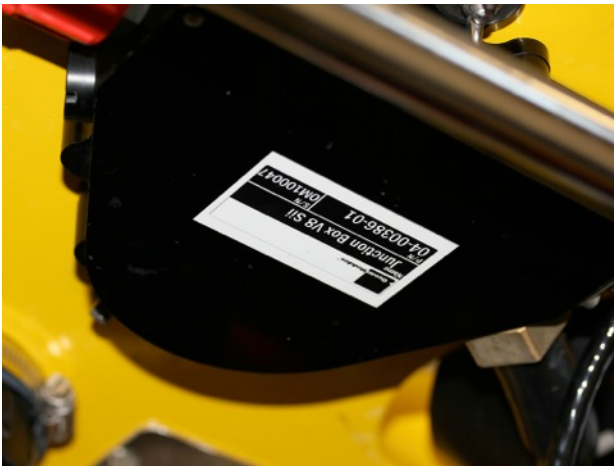
1. Give out tether and take home slack and properly coiling it
2. Keep the tether from drifting under the working platform, into propellers, etc
3. Keep the tether away from sharp edges, stones and barnacles
4. Keep the tether from knotting, tangling and snagging
5. Keep a lookout for boats, which could run the over tether
6. Keep track of the amount of tether in the water

The tether manager shall always be able to communicate with the ROV-pilot and, if working from a moving boat, with the skipper.

When not in use the tether should be stored coiled up in figure eights or in over and under loops (to avoid knotting and entanglement during deployment) away from direct sunlight and extreme temperatures.

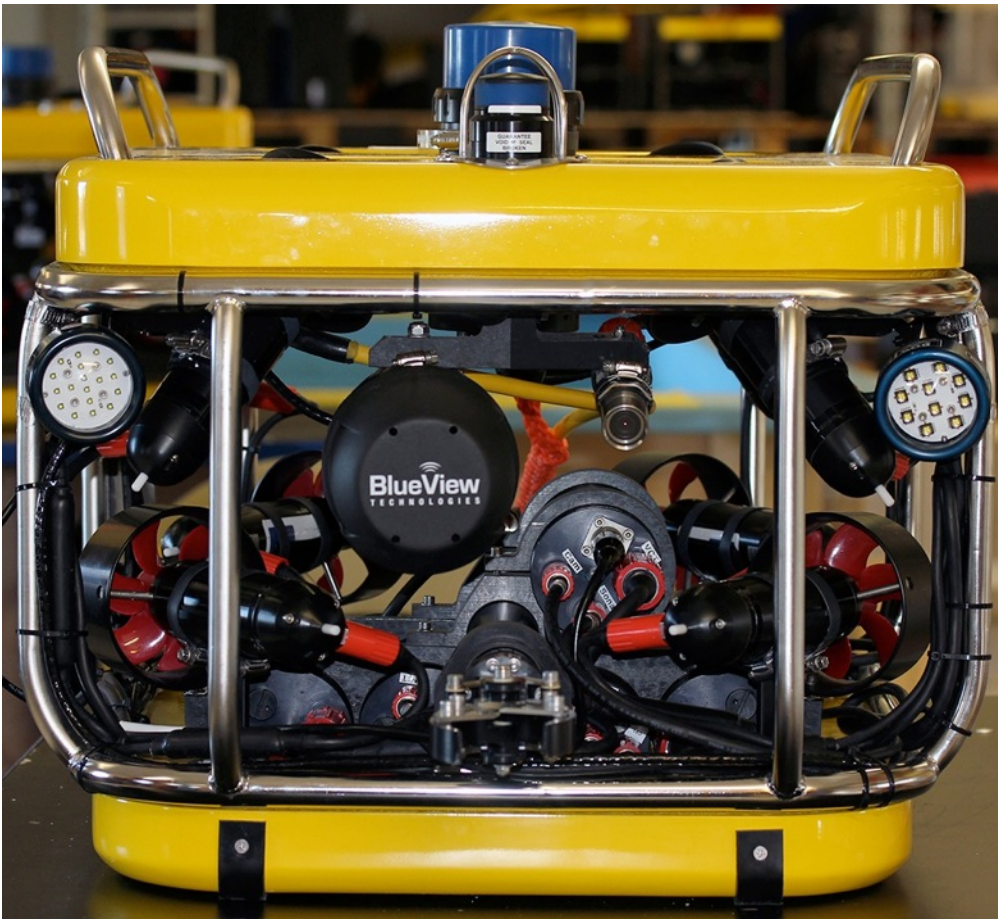
JB (Subsea Junction Box)

The JB is part of the umbilical for fiber-optic V8 Sii ROV systems. The SJ is permanently connected to the subsea end of the umbilical and splits it into fiber-optic and power interfaces, which are then connected to the FT and PT1/PT2 using subsea cables.



Mounted JB underneath top buoyancy block

Not all fiber-optic V8 Sii ROV systems have a JB, some have a FT which is terminated directly onto the the umbilical, in which case 600 VDC power supply is provided to PT1/ PT2 from the FT. Please refer to system specific configuration documentation for details.



V8 Sii ROV with FT and JB

SJB (Surface Junction Box)

The SJB is part of the umbilical for fiber-optic V8 Sii ROV systems. The SJB is permanently connected to the surface end of the umbilical and splits it into fiber-optic and power interfaces, which can then be connected to the separate connectors of the SIU using a fiber-optic deck cable with ST connectors and a deck power cable.

If a winch is used, the SJB is mounted over the axle bearing and slip ring, on the short end of the winch. If not, the SJB is simply a stand-alone unit connected to the end of the umbilical.



V4 ROV with FT and JB

Copper umbilicals connect directly into the SIU, or in the case of a winch, using a deck cable that is in fact identical to a short umbilical.

Umbilical Winch and Slip-ring

The use of a hand wound or electrical winch may facilitates tether deployment and transportation, especially when the umbilical length exceeds 200 m.

To enable the electrical and/or fiber-optic signals to pass from the static cable to the rotating tether on the winch drum, the winch is normally equipped with a slip-ring. The slip-ring is mounted in the center of the winch drum, connected directly to the center of the SJB on fiber-optic systems.

Ocean Modules delivers a number of different models of winch to suit a variety of customer requirements such as tether length, working environment, tether management and price. For information regarding a system-specific winch, please refer to the corresponding user manual.

System Setup

Do not attempt to power on the ROV system before reading the entire manual.

SYSTEM LIMITATIONS

The ROV system shall only be used in environments for which it has been specified, fresh or salt water only. Examples of environments for which the ROV

system has not been specified include, but are not limited to, water contaminated with fuel or oil, strong electro-magnetic fields or corrosive gas.

The ROV is not designed for high impact collisions and vibrations. This is of particular importance to observe when launching, recovering or transporting the ROV system. Surface units are not protected from ingress, keep them sheltered from swell, spray and harsh weather.

CAUTION

Always ensure that all power switches are set to the "OFF" position before any cables are connected! Failure to do so may might damage equipment and can cause present a serious personal injury safety threat. Before connecting any cables, check that all power switches including light dimmers on the PCU and SU are in the "OFF" position.

Always ensure that the power supply is properly grounded, and observe all warnings displayed on the system's information screens.

Never disconnect cables without first disconnecting mains power and allowing time for component discharge.

The ROV system contains high voltage components. Never open SU subsystem cases or electronics tubes without first consulting Ocean Modules and receiving written authorization to do so.

In case of component failure, power may be present in the system for several minutes after system shutdown.

Connector and Cable Handling

Mistreated cables and connectors can lead to ground fault warnings and other problems. To avoid these issues follow these best practice handling instructions for the connectors.

All connectors must be carefully cleaned and properly lubricated. The manufacturer of the connectors does not recommend any type of lubricant other than Molykote 44 Medium. Other types of lubricant may provide too much or too little friction, crystallize under pressure or even conduct electric current.

The following instructions must be observed to ensure correct operation:

1. Do not expose connectors and cables to long term heat or sunshine.
2. Connectors and cables are rated for a temperature range of -4°C to 60°C during use. Correct functionality cannot be guaranteed outside this range. If the V8 Sii has been stored or transported in temperatures outside this range, please allow cables and connectors to acclimatize before connecting or using.
3. Always ensure connectors are lubricated. A tube of Molykote 44 Medium has been included with the ROV service kit. Use Molykote 44 Medium very sparingly, apply just enough to coat the rim of the female connector allowing for easy insertion. Using too much may cause pressure in the connector pushing the male connector out. A video

demonstrating the correct amount to use is available here: <http://www.ocean-modules.com/cables/>

4. Never use any other type of lubricant. If other lubricants, such as silicone grease, have been used previously carefully clean the connectors before applying Molykote 44 Medium.
5. If required, connectors may be cleaned using warm soapy water and a cotton swab.
6. If a contact cleaner is required, isopropyl alcohol may be used on both contacts and rubber, but the connector must be properly washed with warm soapy water afterwards.
7. Any accumulation of sand, mud or other contaminants on the connectors, especially in the female contact, should be removed with fresh water. Failure to do so could result in the splaying of the female contact and damage to the o-ring seals.
8. If connectors appear very dry or brittle, soak in fresh water and lubricate before use.
9. Avoid sharp bends at cable entry. Ensure that there are no angular loads on bulkhead connectors. Check connections for any gaps caused by uneven pressure.
10. Do not disconnect connectors by pulling on the cable. Always pull the connector straight out, never at an angle.
11. Always check connector pins and sacrificial anodes for excessive corrosion.

If in doubt about any of these points, please contact Ocean Modules for advice.

Umbilical Tether Handling Instructions

The connector used to terminate the umbilical tether cable is particularly vulnerable where the flexible cable exits the rigid mold. In some cases, depending on usage, handling or environment, this point may be subjected to excessive stress.

Visually inspect the inline Subconn connector, especially taking notes of any wrinkles, cracks or “warts”. If in doubt, contact Ocean Modules.

Measure the resistance of each of the leads in the umbilical tether cable with a multimeter and take note of the values. This information will be very useful when diagnosing a cable that is suspected to be failing. Please note, due to varying thickness of the leads, not all will have the same resistance, this in itself is not indicative of a problem.

Umbilical Tether Transport Instructions

It is important that all cables, especially the tether and deck cable, are transported and mounted in such a way that sharp bends in the inline connectors can be avoided at all times.

The V8 Sii umbilical tether cable may be subjected to the same type of stress described above during transport, especially if it is wound on a drum.

A simple preventative measure is to make sure that the drum does not turn if it is mounted on a winch, and to place the connector mold inside a length of drainage pipe available at any plumbing shop.

Strap the pipe to the cable and secure the end of the tether to both sides of the winch and ensure that the drum is secured to the winch frame so that it cannot rotate during transport. This will guarantee that the inline connector cable cannot bend at a sharp angle.

Balancing the ROV

Correct balancing is essential for successful operation.

Balance the ROV to float just below surface, in a level position.

There are eight weight pockets, four in each of the buoyancy material blocks. These pockets are used to provide a basic configuration, in order to compensate for manipulators or other tools. Once a basic configuration has been established, the balance can be fine tuned by adding lead weights to the ROV frame with cable ties.



Lead weight pocket

If giving the vehicle ROV a light push, that should cause it to move shift in that direction. If it does not, most likely the vehicle ROV is bottom heavy.

Additional lead weights can be ordered from Ocean Modules.

Buoyancy will not be the same in fresh and salt water, so it will be necessary to rebalance the ROV when it is moved to a new environment.

Connecting the System

Always ensure that all power switches are set to the OFF position and that all mains power leads are disconnected before any cables are connected! Failure to do so can cause presents a serious personal injury safety threat.

To setup the ROV before launch, proceed as follows:

1. Position the SU in a protected environment. It is recommended to protect the SU from direct sunlight. Protect the SU fan inlets from exposure to water and debris.
2. Ensure that all switches on the SIU are in the OFF position.
3. Connect any required peripherals such as computers, monitors, GPS units or USBL systems to the SU.
4. Connect the main power supply cable to the power connector on the SU.
5. Connect the PCU cable to the PCU connector on the SU using the PCU-SU extension cable if required.
6. For fiber-optic ROV systems including a winch, connect the fiber-optic deck cable and power deck cable between the SIU and the SJB on the winch. If the system does not include a winch, connect the deck cables directly to SJB terminated directly to the surface end of the umbilical.

7. For copper ROV systems including a winch, connect the deck cable between the SIU and the winch slip-ring connector. For systems that do not include a winch, connect the umbilical directly to the SIU.
8. For fiber-optic systems including a JB permanently terminated to the umbilical, fasten the JB to the bottom of the top buoyancy block using the provided wingnuts. For fiber-optic systems with a the FT permanently terminated to the umbilical, slide the FT into the provided brackets and tighten the screws.
9. Connect the subsea end of the umbilical to the ROV. For copper systems, connect the 12-pin wetmateable connector directly to PT1. For fiber-optic systems including a JB permanently terminated to the umbilical, connect the provided subsea fiber-optic cable between the JB and FT, and the provided power cable between the JB and PT1/PT2. For fiber-optic systems with a the FT permanently terminated to the umbilical, connect all power and interface cables, see system-specific documentation for details.
10. Secure the strain relief to the aft eyelet. Failure to do so will place strain on the connectors, and possibly make it impossible to retrieve the ROV in case of failure.
11. Ensure that all the connectors are properly seated.
12. Connect the main power cable to a power source.

Startup Procedure

To start the ROV proceed as follows:

Always keep clear of the thrusters when the ROV is switched on or off. When the vehicle is started or stopped, the thrusters may rotate briefly at high speed. Ensure that all individuals persons in the immediate vicinity are aware that power is about to be supplied.

Always use Deck Mode when the vehicle ROV is out of water. Using any other mode will result in unpredictable spinning of the thrusters. Never run the thrusters at high speed out of water.

13. Ensure that the VEHICLE POWER switch on the SIU is in the OFF position.
14. Ensure the THRUSTER switch on the PCU is in the DOWN position.
15. Ensure the VEHICLE MODE dial on the PCU has been turned to the maximum counter-clockwise position, ensuring DECK MODE.
16. Toggle the MAIN POWER switch on the SIU to the ON position.
17. The ground fault monitor will perform a self-test. Proceed when the display shows that self-test has been completed successfully. Once a successful test has been performed the display will show the insulation value, which under normal circumstances will read >10 MΩ.
18. Ensure that the vehicle ROV, especially the propellers, are clear from of all fingers, tools and other obstructions, and that all personal individuals in the immediate vicinity are aware about that power is about to be supplied.
19. Toggle the VEHICLE POWER switch on the SIU to the ON position.
20. When power is applied to the ROV, a sound may be heard from the ROV, which is normal. Ensure that the PU does not indicate excessive current draw. Anything over 400 mA should be considered suspicious.

21. Ensure that the LINK INDICATOR and POWER INDICATOR on the PCU have turned green.

The system has now been powered on successfully.

CAUTION

The Power Tube start circuits are sensitive to quick restarts. If the power to the vehicle ROV is turned off, it is necessary to wait approximately 15 seconds before the power is turned on applied again. Failure to do so may result in system damage and need for repairs.

Dry Test Procedure

Carefully following the dry test procedure will minimize the risk of problems once the ROV has been launched.

CAUTION

Please note that the ROV is intended to be water-cooled. Therefore it is very important that dry testing is performed immediately prior to launch, and that the ROV is not left powered on out of water for an extended period of time. Monitor the temperature of the aft PT1/PT2 lids to determine if the system needs to be powered off or not. They should never become too hot to touch.

Always use Deck Mode when the ROV is out of water. Using any other mode will result in unpredictable spinning of the thrusters. Never run the thrusters at high speed out of water.

1. Perform a ROV system attitude measurement check one sensor at a time by tilting the ROV from side to side, fore to aft and rotating it left and right. The corresponding roll, pitch and heading values on the video overlay should change accordingly. The video overlay will not display any values until the vehicle ROV has shifted position, and the values have been updated.
2. Perform a ROV system depth check. The depth sensor at the center of the VCT rear lid, the video overlay depth display should give a brief indication when tapping it.
3. Ensure the VEHICLE MODE dial on the PCU is in DECK MODE. Switch THRUST to ON. Check thruster functionality by slowly giving forward, reverse up and down commands. All thrusters should have rotated in both directions.
4. Check the functionality of each light, sonar, camera, manipulator and other sensors as applicable. This doublechecks that all cables are properly connected. If a tool or sensor is not mounted, ensure that the corresponding connector is protected by a dummy plug.

Launching the ROV

The ROV should not be operated near divers, swimmers or sensitive marine life. Operation and maintenance of the ROV system shall at all times be supervised by personnel with proper training authorized by Ocean Modules.

To launch the ROV, proceed as follows:

1. Launch the ROV into the water.
2. Ensure that the ROV is correctly balanced.
3. If the ROV is not powered ON, follow the startup procedure.
4. Toggle THRUST to the ON position.
5. Choose a VEHICLE MODE other than DECK MODE using the dial on the PCU.
6. If possible in current environment, perform the dry test procedure again to ensure no errors have occurred during launch. In a hostile environment, dive immediately to a safe depth to avoid impact.

System Operation

Traditional ROV design places the buoyancy material at the top of the vehicle and ballast at the bottom, in order to create a stable platform. This is a standard solution which works well in many applications, but also limits ROV maneuverability and thus its capabilities in many operational scenarios.

The V8 Sii has been designed to be an extremely maneuverable vehicle with the capability to pitch and roll. The natural stability of the platform has been removed by placing the center of gravity and center of buoyancy in the middle of the V8 Sii ROV.

Stability is created artificially, using eight vectored thrusters, an advanced control system and feedback from precise sensors.

There is no natural up or down, which means that the ROV can be positioned at any attitude of pitch and roll. The ROV control system will maintain that set attitude (within certain limits) even though the ROV is affected by external forces.

The capability to rotate 360° in any dimension while maintaining platform stability allows an operator to conduct sonar and video inspections following the profile of sea floor, ship hull or subsea structure.

Unlike most ROV systems, the V8 Sii joystick commands are not sent directly to the thrusters, but are instead interpreted by the control system, providing power and control to the eight thrusters based on the directions the operator wishes to move in, while taking into account external forces such as tether drag and water flow.

The ROV can be operated at any angle, and in any direction, allowing it to operate in tricky spaces (360° around any axis), in a manner much more natural to the operator. Since sonar, cameras, lights and mounted tools, such as a manipulators or samplers, are always aligned, there is no need for separate pan and tilt controls, this reduce reducing the cognitive stress on the operator, and thereby the risk of losing sight of the object being tracked.

NOTE

"Vehicle Mode" can only be changed when power to the ROV vehicle is ON and the PCU has established connection with the control processor in the ROV vehicle, at all other times turning the MODE knob will have no effect on the system.

Operating Modes

A standard V8 Sii ROV system has five operating modes, which have different abilities depending on the specific model. The operating mode is chosen using the VEHICLE MODE dial on the PCU.

Deck Mode

DECK MODE is always the default mode when the ROV is powered on. No control system is active and all commands from the PCU are directly proportionate to thruster control. This mode is used when the vehicle ROV is out of the water or in constrained spaces, such as a TMS.

DECK MODE can also be useful if the operator finds it necessary to manually control the vehicle ROV in a situation where the IMU sensor has failed, if the ROV is stuck or if its buoyancy has changed and the automatic control modes struggle with the new operating conditions.

Horizon Normal

In HORIZON MODE all controls are relative to a horizontal plane, i.e. the water surface. In this mode the UP command will move the ROV straight up towards the surface even if the ROV has been pitched or rolled any number of degrees.

Body Normal

In BODY NORMAL all controls are relative to the body of the ROV. This means that if the ROV has been pitched or rolled and the UP command is issued, the vehicle will move in the direction that the top is facing.

If, for example, the vehicle ROV has been rolled 180 degrees, so that the top is facing straight down, the UP command will move the ROV downwards.

Horizon Vertical Gyro

HORIZON VG mode is the same as HORIZON NORMAL, except the auto heading feature is disabled. This mode is useful when working close to magnetic objects or in a situation where the compass has failed.

The drawback of the two VG operating modes is that the heading information drifts and becomes unreliable with time.

Body Vertical Gyro

BODY VG is the same as BODY NORMAL, except the auto heading feature is disabled. This mode is useful when working close to magnetic objects or in a situation where the compass has failed.

Reverse Mode

REVERSE MODE is the same as HORIZON NORMAL, but with the forward/reverse, left/right and lateral left/right commands swapped, so that, from the control system's perspective, the ROV has had its fore and aft reversed.

This mode is useful when the ROV has cameras or other sensors at both ends which are used for different tasks, or when attempting to reverse out of a tricky situation, for example when the umbilical has become entangled.

Using the PCU Menu and Display

The PCU menu joystick allows the operator to set a number of options. Pushing the joystick straight down enters the settings menu. Maneuvering the joystick to the left or right cycles through the various available options. For each option, up and down movement of the joystick selects the next available setting, and pushing the joystick straight down again saves the chosen setting.

Depth Settings

This option provides a means to recalibrate the depth sensor. The available settings are:

1. Zero Depth
2. Reset Depth

It is possible to set the zero depth at any depth. All readings will then be relative to the new zero level. Resetting the depth will restore the depth calibration to factory defaults.

Reset Turns

This option resets the recorded number of times the vehicle has spun a full 360° around its Z axis. This number may be useful for determining umbilical twist.

Turns

This option enables or disables the display of the number of turns. The available settings are:

1. Show Turns
2. Hide Turns

Overlay

This option turns the video overlay data on or off. The available settings are:

1. Overlay On
2. Overlay Off

Time & Date

This option enables or disables the display of the date and clock on the video overlay. The available settings are:

1. Time & Date On
2. Time & Date Off

System Stat

This option enables or disables the display of the system status on the video overlay. Enabling it displays the data sent to the control system from the PCU. This information may be valuable when attempting to fault search a V8 Sii that is not functioning correctly. The available options are:

1. System Stat On

2. System Stat Off

Heading

This option sets the display mode of the heading on the video overlay. The available settings are:

1. Heading Simple
2. Heading Compass

Set Clock

The year, month, day, hour, minute and second will be highlighted, one at a time, allowing the user to set the time used by the overlay.

Overlay Color

The overlay display color can be adjusted to suit different situations. For operation close to the surface in sunlight, a dark color may provide the best readability compared to operation at depth where a light color may be a better choice.

For mixed conditions it may be necessary to use one of the two options with a solid contrasting background. The available options are:

1. Light
2. Dark
3. Light with Dark Background
4. Dark with Light Background

Thrust Gain

This option sets the maximum gain of the thrusters. Reducing thruster gain can be useful on situations where collisions need to be avoided and very precise movement is required. The available settings are:

5. 100%
6. 75%
7. 50%
8. 25%
9. Exponential

Vehicle Status Check

Activating the Vehicle Status Check (Aux 3 on the PCU) provides an overview of the current state of a number of the vehicle's vital functions. The status display has two rows, each containing eight indicators. Ideally, the display will read:

1 2 3 4 5 6 7 8

A 1 1 1 1 1 1 1 1

B 1 1 1 1 1 1 1 1

A1-A4 and B1-B3 are not connected and will always read "1". The rest of the indicators provide an overview of the current state of a number of the vital functions of the ROV, and will read 1 when no issues have been detected and 0 when a fault has occurred. The various positions are to be interpreted as follows:

Power issues:

A5: PT2, 150V

A6: PT1, 150V

A7: PT2, 24V

A8: PT1, 24V

Link issues:

B4: Lamp Control

B5: Motor Control

B6: ROV Control

B7: Video Interface

B8: Overlay

The Vehicle Status Check data can displayed on the video overlay as well, by activating the System Stats from the PCU Menu.

Overlay Text

Depending on configuration, the ROV system may be equipped with a feature to add text to the overlay, in order to allow the operator to record events of interest.

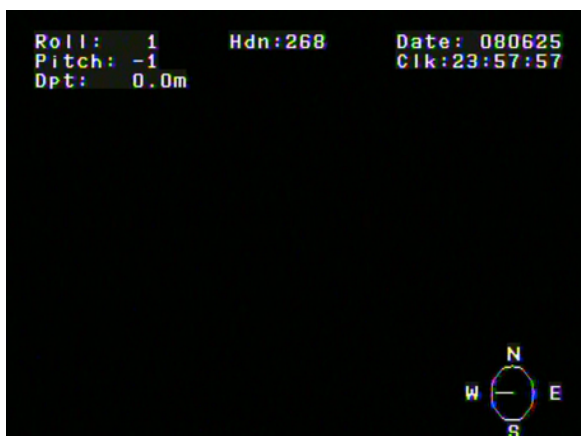
This feature is controlled using Microsoft Windows application Overlay Text provided by Ocean Modules, normally located on the desktop. Typing text in this application, sets the same text on the video overlay.

All normal standard characters and numbers are possible to use. To erase everything from the overlay, press the "Clear overlay" button, or use the ESC key.

Two lines of containing 25 characters each can be added to the video overlay screen. When the end of the first line has been reached the text continues on the second line.

Understanding the Overlay Data

The video overlay can be turned on or off using the PCU menu. It is also possible to have multiple video outputs on the SIU front panel, some with, and some without, video overlay.



Video overlay

Roll — Indicates the number of degrees the ROV has rolled, a positive number indicates a clockwise movement while observing the ROV from the rear. A negative number indicates a counter-clockwise movement.

Pitch — Indicates the number of degrees the ROV has pitched, a positive number indicates that the ROV has pitched upward and a negative that it has pitched downward.

Dpt — The current depth, relative the zero level set in the PCU.

Hdn — Indicates the heading, in degrees

Date — The date set on the PCU.

Clk — The time set on the PCU.

Compass Rose — A visual representation of the heading.

It is also possible to add additional information to the display by activating System Stat on the PCU. This is normally not used, but may prove useful for diagnostics and fault-searching.

ROV Recovery

CAUTION

Toggling Cycling the power to the ROV on and off too quickly, may might cause serious damage to the ROV system. Always wait at least 15 seconds before switching power back on again.

Always handle all parts of the equipment with care, and provide adequate cushioning for transport.

To recover the ROV after use, proceed as follows:

1. Complete any software recordings that have been started.
2. Maneuver the ROV to the retrieval apparatus and attach the hook if a LARS is to be used. If LARS is not used, position the ROV so that it can be retrieved by the umbilical without snagging or bending beyond its minimum bend radius.
3. Toggle the THRUSTER switch on the PCU to the OFF position as soon as possible to avoid debris getting entangled in the thrusters.
4. Toggle the VEHICLE switch on the SIU to the OFF position, to power off the ROV.

5. If the SU contains a computer, shut down Microsoft Windows.
6. Toggle the POWER switch on the SIU to the OFF position, to power off the entire ROV system.
7. Commence lifting and retrieve the ROV from the water.
8. Avoid bumping and scraping the ROV, taking special care to protect the camera lenses.
9. Disconnect all 240V power leads.
10. Rinse, or preferably submerge in fresh water, all parts of the ROV which have been exposed to salt water, biological material or any type of contaminant. Disconnected wetmateable connectors may be submerged as well, as long as all power has been disconnected. Fiber-optic connectors are not wetmateable.
11. Disconnect the umbilical from the ROV using the reverse procedure used to connect. Ensure fiber connectors have been dried with a clean cloth before disconnecting, and immediately cover it with a dust cap after disconnecting.
12. Remove each interconnecting surface cable, checking for wear and damage. Immediately cover fiber-optic connectors with clean dust caps.
13. Allow all components to dry before stowing all components in packing boxes.
14. Stow all components in their cases.
15. Take care that all loose components are properly cushioned by protective foam, so that shock, rubbing and vibration can be avoided during transport. Avoid excessive bending or twisting of the cables.

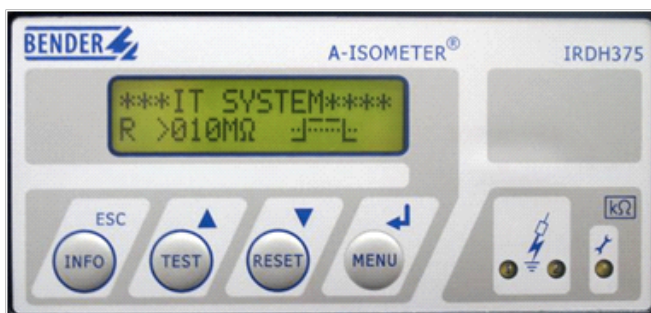
Monitoring and Diagnostics

There are a number of monitoring and diagnostics functions the operator needs to be aware of.

Ground Fault Monitoring

The integrity of the power supply from the SIU is constantly monitored by an insulation resistance monitor, the ground fault monitor.

Under normal circumstances the ground fault monitor will indicate $>10\text{ M}\Omega$.



Ground Fault Monitor status display

If the insulation resistance falls below $200\text{ k}\Omega$, a ground fault indicator and an audible alarm will inform the operator of the fault.

The alarm can be muted by setting the MONITOR switch on the PCU to the BUZZER OFF position.

The ROV will automatically shut down if the insulation resistance falls below 100 kΩ. If the ROV power has been shut down by the ground fault monitor, the power can be restored by setting the MONITOR switch to the MONITOR OVERRIDE position.

WARNING

Overriding the ground fault monitor function may might damage equipment and may present a serious personal injury safety threat. Only use these settings if absolutely necessary.

Power Output Monitoring

Before the ROV has been turned on the PU control interface will display a red blinking diode, labelled ALARM. This is normal, the alarm will stop when the ROV is powered on.



PU control interface

Please observe that most functions of the Lambda Interface are locked or disabled.

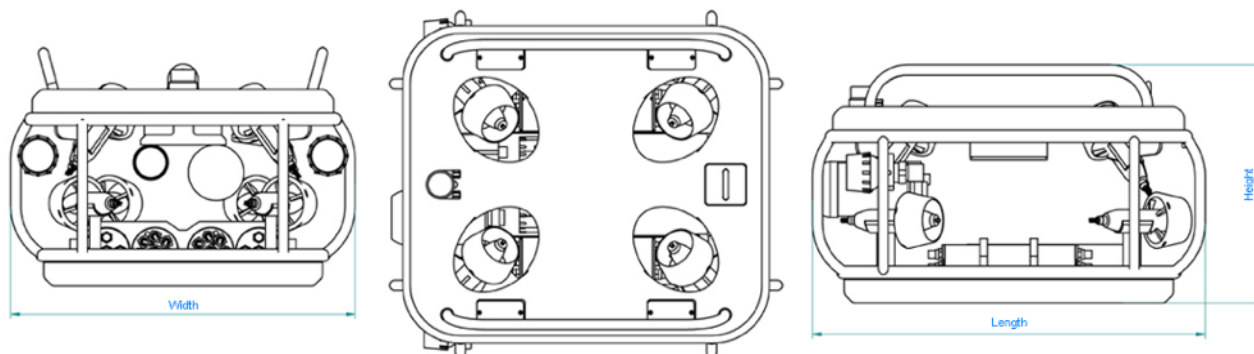
It is possible to check the power output settings before the ROV is powered up, by momentarily pushing the "PREV" button on the Lambda Interface. It will then display the set output voltage of 630 V and a maximum current draw of 5.5 A.

Once the ROV has been activated, with the "vehicle power switch" on the SIU, the Lambda Interface will display the output voltage, which should be approximately 630 V, and current draw that should be approximately 0.2 A when the ROV is idle.

Specifications

Specifications apply to standard systems. Specifications will change with customer-specific modifications.

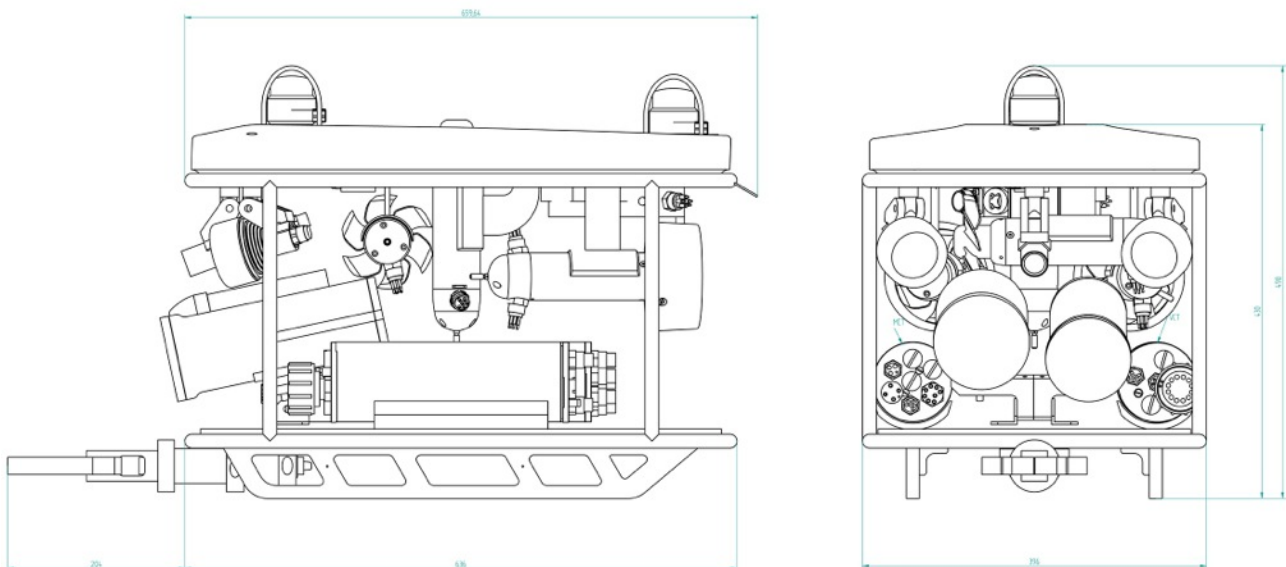
V8 Sii ROV System



Max copper umbilical length	500 m
Max fiber-optic umbilical length	800 m
Recommended system power	5 kW
Min storage temperature	-35°C
Max storage temperature	70°C
Min operating water temperature	-5°C
Max operating water temperature	40°C
Min operating surface temperature	0°C
Max operating surface temperature	40°C
Max depth	500 m
Length	750 mm
Width	650 mm
Height without rails or handles	480 mm
Payload in fresh water	10 kg
Weight in air	50 kg
Weight in fresh water	0 kg
Top speed forward	3 knots
Max vehicle power draw	3.6 kW
Balance rotation	Neutral
Number of thrusters	8
Thruster type	Ocean Modules T110
Control system	V8 360°
Analog video overlay	heading, pitch, roll, time, date, cable turns, compass rose
Overlay text input	2 rows, 20 characters each

Attitude functions	trim	Stability control, auto depth, auto heading,
Accelerometer range		±5g
Magnetometer range		±1.2 Gauss
Pitch/roll range		360°
Pitch/roll precision		±0.2°
Pitch/roll resolution		0.2°
Heading range		360°
Compass precision		±1°
Compass resolution		1°
Depth sensor resolution		0.1m
Depth sensor precision		1%FS (500m)
Number of expansion ports		5
24 V power output		200 W
Analog video		Max 3x
HD-SDI video		Max 1x
Simultaneous video channels		1x
Video functions		PCU zoom/focus
Video enhancement		LYYN option
24 V LED illumination		4x
Illumination functions		4x dimmable
Protective measures		Isolation monitor, emergency stop
Tool/survey skid option		V8 Sii Skid

V4 ROV System

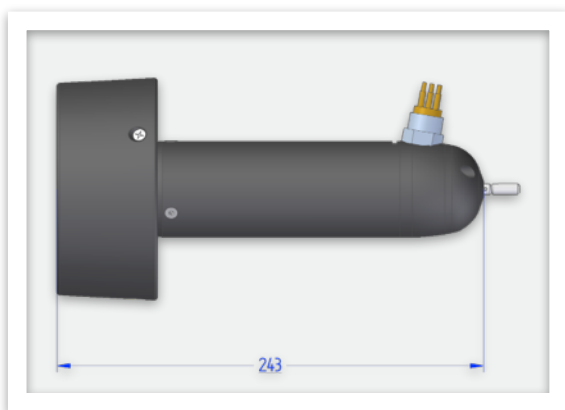


Max copper umbilical length	150 m
Max fiber-optic umbilical length	150 m
Recommended system power	5 kW
Min storage temperature	-35°C
Max storage temperature	70°C
Min operating water temperature	-5°C
Max operating water temperature	40°C
Min operating surface temperature	0°C
Max operating surface temperature	40°C
Max depth	300 m
Length	636 mm
Width	400 mm
Height without rails or handles	430 mm
Payload in fresh water	3 kg
Weight in air	25 kg
Weight in fresh water	0 kg
Top speed forward	3 knots
Max vehicle power draw	3.6 kW
Balance rotation	Neutral
Number of thrusters	4
Thruster type	Ocean Modules T110
Control system	V8 Stable
Analog video overlay	heading, pitch, roll, time, date, cable turns, compass rose
Overlay text input	2 rows, 20 characters each
Attitude functions	Stability control, auto depth
Accelerometer range	±5g
Magnetometer range	±1.2 Gauss
Pitch/roll range	360°
Pitch/roll precision	±0.2°
Pitch/roll resolution	0.2°
Heading range	360°
Compass precision	±1°
Compass resolution	1°
Depth sensor resolution	0.1m
Depth sensor precision	1%FS (500m)
Number of expansion ports	5
24 V power output	200 W
Analog video	Max 3x
HD-SDI video	Max 1x

Simultaneous video channels	1x
Video functions	PCU zoom/focus
Video enhancement	LYYN option
24 V LED illumination	4x
Illumination functions	4x dimmable
Protective measures	Isolation monitor, emergency stop
Tool/survey skid option	V8 Sii Skid

Thruster 110

Power input	150 VDC, 5.5 A
Isolated driver input	15 VDC, 100 mA
Speed command	+/- 5 V
Weight in air	1.5 kg
Weight in water	0.9 kg
Depth rating	500 m
Thrust	12.5 kg
Connector	Subconn MCBH6MSS
Oil	Shell Odina 917



Thruster 110

Umbilical

Tether diameter	12.5/14/18 mm, depending on type
Tether breaking strain	500 kg
Tether minimum bend radius	200 mm
Buoyancy	Close to neutral

SU

The SU specification will vary greatly depending on which units it contains and if it is housed in mobile or permanently mounted container. This specification applies to a mobile SU only containing a PU and a SIU.

Width	600 mm
Depth	600 mm
Height	250 mm
Weight	21 kg

PU

Power:	Single-phase AC, 170-265 V, 47-63Hz
Max. Draw:	3.3 kW
Output:	630 VDC (V8 Sii)
Output:	160 VDC (V4)

PCU

Width: 240 mm
Depth: 180 mm
Height: 130 mm (including joysticks)
Weight: 2 kg