Seaeye

Seaeye House, Lower Quay Road, Fareham, Hampshire, PO16 0RQ England

Falcon DR

Technical Manual

SYSTEM 1290

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WARNING

System Compatibility Issues

SEAEYE Systems utilise major assemblies that may appear, on casual external examination, to be generic items common to all systems in the modern SEAEYE fleet.

However, the use of increasingly complex technology and the frequent implementation of customer-requested system-specific modifications above baseline specifications may result in a Health and Safety Risk to personnel and damage to equipment and material should such modified equipment be substituted between systems.

CONSEQUENTLY, SEAEYE TECHNICAL DIRECTORATE ADVISE THAT SERIAL NUMBERED MAJOR ASSEMBLIES SUPPLIED WITH A VEHICLE SYSTEM SHOULD AT ALL TIMES REMAIN WITH THAT SYSTEM.

SEAEYE ARE UNABLE TO ACCEPT RESPONSIBILITY OR LIABILITY FOR EQUIPMENT IF THIS IS NOT OBSERVED.

Should major assemblies (e.g. SI-SCU, SI-PSUs, Junction Boxes, Umbilicals, Software etc) from one system be utilised (as spares provisions or as repair-by-replacement items in the field) on another system, Health and Safety risks to personnel and risks of damage to equipment and material exist.

Operators possessing SEAEYE ROV Systems who wish to interchange major assemblies between one system and another do so at their own risk. Where any doubt exists as to the compatibility of major assemblies between one system build and another, SEAEYE may be contacted for advice prior to attempting such operational interchange.

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In respect of the Electromagnetic Compatibility Directive 89/336/EEC, attention is drawn to the following:

- The SEAEYE FALCON DR system 'as delivered' complies with the essential protection requirements of the EMC Directive 89/336/EEC.
- In order to ensure that the SEAEYE FALCON DR system complies with the Directive when installed for operational use, the installation instructions contained within this Technical Manual must be adhered to and the surface equipment installed within the screened enclosures with which they were supplied.
- The end user of (or authority responsible for) the installation of the SEAEYE FALCON DR system becomes responsible for the complete installation's compliance with the Directive, particularly under the following circumstances:
  - additional equipments are used in conjunction with the system (unless they are supplied by SEAEYE MARINE LTD), or
  - modifications are made to the system (or part thereof), or
  - surface equipment is removed from its 'as-built' enclosures for subsequent installation in third-party racks or consoles.
- During Maintenance Procedures, when the system is operated outside its normal operating environment and/or screened enclosures are opened for access, the equipment may emit, or be susceptible to, electromagnetic interference (EMI). The equipment should be sited away from safety critical, essential communication, or navigation systems during such activities. It is advisable to site the surface equipment away from critical electronic systems at all times.
- It is recommended that electrical power for the SEAEYE FALCON DR system is provided using a dedicated supply which is not also used to power safety critical, essential communication, or navigation equipment.
- Any questions in respect of the Compliance of any SEAEYE MARINE LTD equipment with the EMC Directive, or any field reports of EMC related faults, should be addressed to the Technical Director at SEAEYE MARINE LTD.

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PREFACE

The purpose of this Technical Manual is to provide the Remotely Operated Vehicle (ROV) maintainer/operator with concise information and instructions on the operating, technical and maintenance aspects of the ROV system. The book is written for a maintainer/operator with a reasonable understanding of electrical and mechanical principles and a sound understanding of safe working practices. It is recommended that on receipt of the ROV system that the handbooks are read in their entirety prior to assembly, installation and first operational use. If a specialist understanding of the technical and maintenance aspects of the system is required a training course can be provided by Seaeye Marine Ltd.

The Technical Manual consists of the following:

Chapter 1 – System Overview

- Provides a general description of the main units as an introduction to the system, the ROV system technical specification and any related information.

Chapter 2 – Controls and Operation

- Provides a description of unit controls and indicators for easy reference.

Chapter 3 – Assembly and Installation

- Instructions on how to assemble, install, configure and operate the system.

Chapter 4 – Operational Use

- Provides basic information on the operation of the Seaeye Falcon Deep Rated (DR).

Chapter 5 – Function Description

- Provides functional descriptions of data, video and power systems of the Seaeye Falcon DR with the aid of system block diagrams.

Chapter 6 – Maintenance Information

- Provides example pre-and post-dive checklists, schematic drawings, mechanical drawings and additional information not covered elsewhere in the manual.

Chapter 7 – Diagnostic Maintenance

- Provides diagnostic information and trouble shooting flow charts to aid fault finding of the Seaeye Falcon DR.

Chapter 8 – Parts

- Provides a list of Falcon DR System 1290 parts and consumables.

Appendix – Data Sheets

- Provides data sheet information on the additional units fitted to the Falcon DR System 1290.

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CONTENTS

CHAPTERS

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WARRANTY STATEMENT

Products sold by SEAEYE MARINE LIMITED (hereafter referred to as SEAEYE) are guaranteed to the **original** purchaser as follows:

Subject to the exceptions and upon the conditions stated hereafter, SEAEYE agrees to correct, either by way of repair, or at SEAEYE's sole discretion, by way of replacement, any defect of material or workmanship which develops as follows:

- SEAEYE Remotely Operated Vehicle (ROV) Systems : 12 months,
- SEAEYE MCT Thruster Motors : 12 months,
- SEAEYE parts returned on completion of Repair : 3 months,

from dispatch of the product to the **original** purchaser by SEAEYE or it's authorised representative, provided that the investigation and factory inspection by SEAEYE disclose that such defect developed under normal and proper use and not due to fair wear and tear or misuse by the user for its intended purpose. Repair or replacement are the exclusive remedies under this guarantee, and further provided that the guarantee granted hereby shall not include parts, materials, or spare parts that SEAEYE considers as expendables under normal operating conditions.

The exceptions and conditions mentioned above are as follows:

a) SEAEYE make no guarantee concerning components or accessories that are not of it's own manufacture. All goods sold and manufactured by other manufacturers are sold subject to the manufacturer's guarantee, which shall be assigned to the purchaser or authorised representative. SEAEYE in so far as it is appointed by the agents of a manufacturer to carry out repair work under such guarantees will, where it considers it appropriate, carry out the necessary repair work on terms agreed by SEAEYE and purchaser or authorized representative having regard to the liability of the manufacturer under it's guarantee. Notwithstanding anything in this paragraph, any goods sold but not manufactured by SEAEYE are not supplied with any warranty whether express or implied and warranty imposed by common law or statute including the warranty of merchantable quality and the implied warranty of fitness for a particular purpose contained in the UK Sales of Goods Act 1979 Section 14 is expressly excluded although SEAEYE undertakes to take reasonable care in supplying suitable goods and giving particulars of performance.

b) SEAEYE shall be released from all obligations under its guarantee in the events that repairs or modifications are made by persons other than its own authorised service personnel or trained and authorized representative, unless such repairs or modifications by others are made with prior written consent by a Director of SEAEYE. In the event of a failure, and the purchaser or agent authorized by the purchaser or the operator fails to take prompt and reasonable action to prevent further damage, SEAEYE will not accept any responsibility for consequent damage. "Normal and Proper use" of a product includes without limitation performing routine preventative maintenance in accordance with the appropriate instructions within the appropriate service and/or maintenance manual.

c) SEAEYE products, systems and parts are Ex-works at the company's UK site. SEAEYE is not responsible for carriage/shipment/duty/taxes/insurance or any other costs for any product, system or part either dispatched to or from the company's UK site.

d) There are no guarantees which extend beyond those expressly provided for herein and the aforesaid guarantee and SEAEYE's obligations and liabilities there under are in lieu of, and the customer waives, all other guarantees, express or implied, and all other liabilities therefore arising by law or otherwise, including without limitation any implied guarantee of merchantability or fitness for a particular purpose, and all obligations and liabilities with respect to loss of use, revenue or profit, or indirect, consequential or incidental damages of any kind and from manufacture, sale, handling, shipment, repair, maintenance or replacement of said products.

e) Representations and warranties made by any person, including dealers and representatives of SEAEYE that are inconsistent or in conflict with the terms of this guarantee (including but not limited to the limitations of the liability of SEAEYE as set forth previously), shall not be binding upon SEAEYE unless reduced to writing and approved by an officer of SEAEYE.

f) SEAEYE's liability arising from the sale or use of a product sold by SEAEYE shall be limited to SEAEYE's cost of correcting defects, as provided herein, or the total cost of such product as shown on the purchase order pursuant to which it was purchased, whichever is less. All such liabilities will terminate upon expiration of the guarantee period.

g) This guarantee shall be provided for and governed by the prevailing laws of England.

GENERAL INFORMATION

Specifications: SEAEYE reserves the right to change specifications at any time without due notice and without incurring any obligation to incorporate any new features in any of it's previous products, whether or not they have been sold.

Damage in Shipment: Each new product is carefully examined and checked prior to dispatch from SEAEYE's premises. It should be carefully examined and operationally tested on receipt by the receiving party. If the product is damaged in any way, then a claim should be lodged with the carrier. New or repaired product that has been damaged in transit should not be returned to SEAEYE without first obtaining specific shipping instructions from SEAEYE.

Repairs: If any fault develops, the following steps should be taken:

- Notify SEAEYE and give full details of the difficulty. Include in this notification the model type and its serial number. On receipt of this information SEAEYE may elect to either issue service instructions or provide full shipping data for the return of the equipment.
- After shipping instructions are supplied, forward the product(s) prepaid and repairs will be estimated and the client informed prior to any repairs to the fault(s) being carried out.
- The client may then issue SEAEYE an approved purchase order to cover the costs of the repair, if the fault has been caused by misuse or is not under guarantee.

NOTES TO READERS

Warnings, Cautions and Notes

Throughout this Publication warnings and notes are used to direct the readers attention to specific information.

A **WARNING** is used to alert the reader to operational or maintenance activities that may, under certain circumstances, represent a threat to safety and health. A warning precedes the paragraph or procedure which gives rise to such a threat.

A **Caution** is used to alert the reader to operational or maintenance activities which, may under certain circumstances, cause damage to equipment and/or material. A caution precedes the paragraph or procedure to which it refers.

A **Note** contains information of a specific or general nature and is printed immediately after the paragraph to which it refers.

The following symbols are used through this document:

WARNING – Risk of Personal Injury

WARNING – Take precautions against Static Electricity

WARNING – Risk of Electric Shock

WARNING – Heavy Object

WARNING – Moving Parts

WARNING – Chemical Hazard

CAUTION – Wear Protective Equipment

LIST OF ABBREVIATIONS

A	Ampere
AC	Alternating Current
ADC	Analogue to Digital Converter
CCD	Charge-coupled Device
CP	Cathode Potential
CPU	Central Processing Unit
DAC	Digital to Analogue Converter
DC	Direct Current
Deg.	Degree(s)
EPOD	Electronics Pod
FET	Field Effect Transistor
Fig.	Figure
GRP	Glass-reinforced Plastic
SI-HCU	Hand Control Unit
Hz	Hertz
IGFET	Insulated Gate Field Effect Transistor
I/O	Input/Output
SI-JB	Junction Box
Kbd	Kilo baud
LIM	Line Insulation Monitor
SI-MCT	Thrusters
MCB	Mains Circuit Breaker
MFIO	Multi-function Input/Output
SI-NAV	Navigation Unit
PCB	Printed Circuit Board
PDU	Power Distribution Unit
SI-PSU	Power Supply Unit
PWM	Pulse Width Modulated
ROV	Remotely Operated Vehicle
SCR	Silicon-Controlled Rectifier
SIT	Silicon-Intensifier Target
SSRS	Solid-state Rate Sensor
STU	Surface Transformer Unit
SI-SCU	Surface Unit
Toggle	Change to one of two states. H/W or S/W
VAC	Volts AC
VDC	Volts DC
W	Watts

WARNINGS

1. **DANGER OF FATAL ELECTRIC SHOCK. BEFORE REMOVING OR OBTAINING INTERNAL ACCESS TO THE EQUIPMENT, ISOLATE ALL THE UNITS POWER SUPPLIES.**

2. **DANGER OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL. WHEN THE SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ROV SYSTEM IS TO BE UNDERTAKEN ONLY BY PERSONS FULLY AWARE OF THE DANGERS INVOLVED AND HAVE TAKEN ADEQUATE PRECAUTIONS.**

3. **POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE ROV SYSTEM, ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENANCE ACTIVITY IS IN OPERATION.**

4. **POSSIBILITY OF TOXIC HAZARDS. DURING MAINTENANCE OR REPAIR IT IS POSSIBLE TO COME INTO CONTACT WITH SUBSTANCES HARMFUL TO HEALTH. PRIOR TO ALL MAINTENANCE OR REPAIR TASKS ENSURE THAT THE RELEVANT DATA HAZARD SHEETS AND LOCAL COSHH PROCEDURES HAVE BEEN READ AND UNDERSTOOD.**

5. **POSSIBILITY OF DAMAGE TO EQUIPMENT. ENSURE THAT ALL INTERCONNECTING EQUIPMENT IS CONNECTED TO A COMMON EARTH.**

6. **POSSIBLE DANGER TO PERSONNEL AND DAMAGE TO EQUIPMENT. SOME EQUIPMENT MAY BE HEAVY, AND CARE SHOULD THEREFORE BE TAKEN WHEN LIFTING.**

7. **DANGER TO PERSONNEL AND EQUIPMENT. THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE VEHICLE IS CLEAR OF ANY OBSTRUCTION AND PERSONNEL PRIOR TO ENERGISING THE DC SUPPLY.**

CAUTIONS

1. **Danger of damage to PCBs. Do not remove or replace PCBs unless the supply is switched off. PCBs must be handled in accordance with electrostatic discharge handling procedures. Damage to PCBs could affect the safe operation of the equipment.**

2. **Danger of damage to equipment. When checking connections, care is to be taken not to slacken them, otherwise their watertight integrity may be breached.**

3. **Danger of damage to equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.**

4. **Danger of damage to Thruster Motor. Do not operate the Thruster Motor in air for longer than one minute.**

5. **Danger of damage to lights. Do not operate the vehicle lights for longer than ten seconds in air.**

6. **Possibility of damage to equipment. Ensure all vent plugs are securely fitted and shut prior to immersing the vehicle.**

7. **Possibility of damage to equipment. Ensure that the Surface Power Supply Unit (SI-PSU) transformer tappings correspond to the external input power supply.**

8. **Possibility of poor vehicle handling. Addition of equipment or poor vehicle ballast or trim will affect vehicle performance. Ensure the vehicle trim and ballast is correct after adding or removing equipment.**

ENGINEERING ADVICE NOTES (EANS)

The purpose of an engineering advice note is to bring to the operator/maintainer's attention any safety, maintenance or operational related information that may present a threat to health or cause damage to equipment and are to be used in conjunction with the manual.

Any relevant EANs raised after the publication of this handbook will be issued by letter and are to be inserted into this manual.

IMPORTANT ADVICE NOTICE AR1

ADDITIONAL RECOMMENDATIONS

The following recommendations and instructions have resulted from observations and reports experienced by operators in the field:

- Do not subject the ROV or associated equipment to shock or impact; do not drop, or allow objects to impact the equipment.
- To prevent damage to or unnecessary stress on chassis components, always use the lifting point(s) factory fitted to ROV vehicles and TMS launch-systems.
- Operating an ROV in close proximity to pile drivers will subject the vehicle to high levels of shock and pressure. This may well result in destruction of lamp unit filaments due to severe vibration. Over-pressure created by underwater equipment such as pile drivers or explosive processes may exceed the ROV's proof-pressure test certificate, resulting in damage to seals and enclosures and subsequent flooding.
- Do not remove electrical components, equipment or PCB's while the system is electrically live.
- Permitting thrusters or ROV lamps to operate in air for periods in excess of that described in the Technical Manual may cause irreparable damage. Observe the cautions obtained in the relevant sections of the Technical Manual.
- Equipment should not be left exposed to direct sunlight as extreme temperatures can damage the electronic components.
- Equipment should not be left exposed to freezing conditions. Provide suitable covers or stow in a protected area.
- Do not disassemble equipment, particularly thrusters beyond the level described in the maintenance section.
- Do not attempt to increase the performance of the thrusters by subjecting them to voltages in excess of specified levels. Ensure that the SPSU is set up and compensated correctly for the umbilical being used.
- System modifications carried out by customers or operators will not appear in either the Technical Manual or associated Wiring Diagrams Manual or in amendments issued by Seaeye.
- Adding or removing equipment from an ROV alters the vehicles payload and ballast, and therefore changes ROV performance. Always re-ballast and trim the ROV prior to operations when such payloads changes have been made.
- Ensure that all surface and subsea connectors are securely mated. Subsea neoprene connectors must be totally dry, clean and their end faces lightly coated with silicone grease before mating.
- It is usually necessary to carry out a complete Configuration procedure if PCB's and items of control equipment have been removed or replaced in the system.
- Conducting pre and post-operational checks reduces operational downtime.
- Check for the security of fasteners, fixtures and fittings prior to and on completion of operational use.

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CHAPTER 1

SYSTEM OVERVIEW

Contents

Figures

Tables

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1. SYSTEM OVERVIEW

This chapter provides a general description of the main units as an introduction to the Falcon Deep Rated (DR) system serial number 1290, the ROV system technical specification and any related information. The Falcon DR 1290 operational setup is shown in Figures 2 and 3 with its specialist equipment configurations. The surface equipment setup is shown in Figures 4 and 5.

1.1 The Remotely Operated Vehicle System

The Seaeye Falcon is a highly versatile Remotely Operated Vehicle (ROV) and can be employed to carry out a variety of survey, search, inspection and maintenance tasks. The operator or pilot uses a hand controller to 'fly' the vehicle remotely by sending commands via an electrical umbilical. The vehicle can be moved in any direction and by using its autopilot functions, can remain accurately on course and depth to provide a stable platform. The pilot can control the vehicle's video system, lighting and all other equipment fitted.

The Falcon DR 1290 system can be configured for two operational setups. The first option is configured for 'swallow' operations using the 'Twisted Pair Video' option as shown in Figure 2. The second option is configured for 'deep' operations using the 'Fibre Optic' option shown in Figure 3. When changing from the Twisted Pair configuration to Fibre Optic configuration, or vise-versa, a number of Printed Circuit Board changes and system configurations need to be carried out. These are detailed in Chapters 3 and 6 of this manual.

The system software can be configured to suit individual pilot requirements. The ROV 1290 system consists of the following major units:

- Seaeye Surface Power Supply Unit.
- Seaeye Surface Control Unit.
- Seaeye Falcon Cabin Junction Box (used with the Fibre Optic configuration).
- Seaeye Hand Control Unit.
- Seaeye System Monitor and Keyboard.
- Seaeye Falcon DR Vehicle serial number 1290.
- Seaeye Tooling Skid Unit with 5-Function Manipulator System.
- Seaeye Manipulator Hand Control Unit.
- Type 5823 Umbilical for Fibre Optic operations.
- Type 5769 Umbilical for Twisted Pair operations.
- Seaeye Hand Operated Winch (used with the Twisted Pair configuration).
- Seaeye Deployment and Transit Cases.

An overview of the Falcon 1290 System connection can be found in Chapter 6, together with detailed circuit diagrams of all major components.

1.2 Surface Control Equipment

An overview of the Falcon DR 1290 Surface Control Equipment is shown in Figures 4 and 5.

1.2.1 Surface Power Supply Unit

The Surface Power Supply Unit (PSU) Type SI-PSU04 requires a customer selected power input of either 110 VAC or 240 VAC and provides all power for the ROV system. It provides a 500 Volts DC transmission voltage and contains a series of protection devices for safe operation.

The 500 Volt transmission voltage allows reduced electrical current, reduced conductor sizes and therefore smaller umbilical cross section and less cumbersome umbilical handling. When switched on, the internal supplies of the vehicle are initialised, making the ROV ready for operation.

The PSU incorporates a Line Insulation Monitor (LIM). This is a circuit breaker that monitors isolation from earth in the high voltage areas of the system. In the event of a fault in the tether or the Vehicle Power Supply, the LIM will trip and the Output LIM Fail indicator will illuminate. Output power to the umbilical/vehicle will be shutdown and rendered safe.

The PSU has an Output Adjust Potentiometer located on the front control panel that enables the operator to adjust the vehicle supply voltage, to compensate for voltage drop in different types and lengths of umbilical connection. A main feature of the PSU is that the internal electronics automatically allow for transient variations in the supply voltage, thus providing a stable platform for the complete system.

Detailed information on switch operation and unit indications can be found in Chapter 2. Circuit diagrams can be found in Chapter 6.

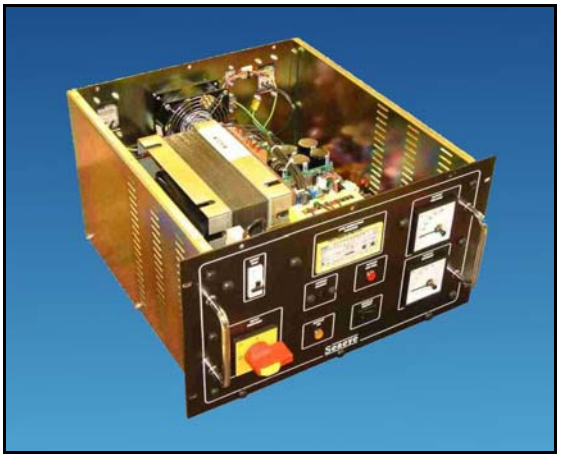


Fig. 1. Surface Power Supply Unit

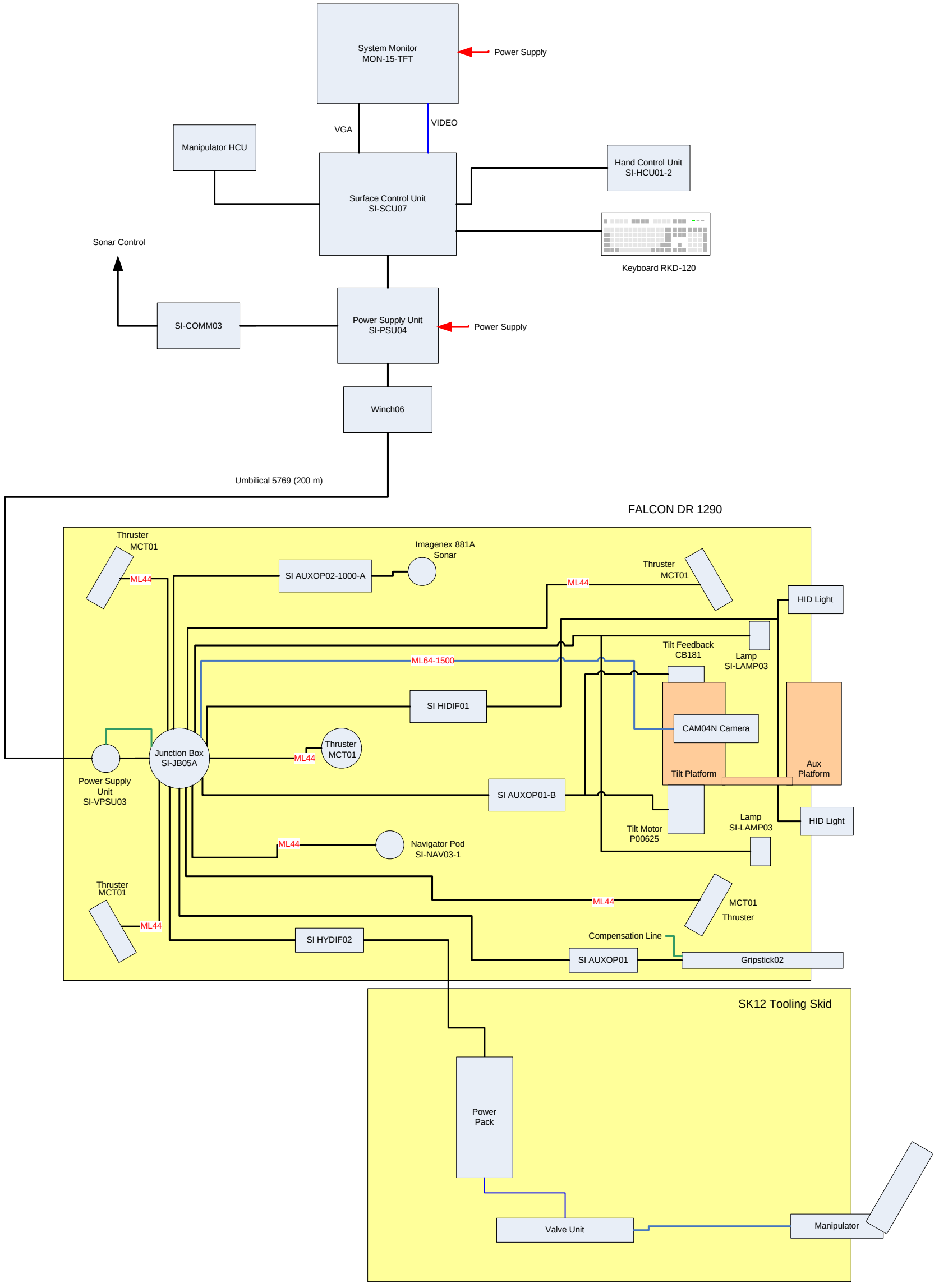


Fig. 2. Falcon System Twisted Pair Operational Setup

Falcon DR System 1290

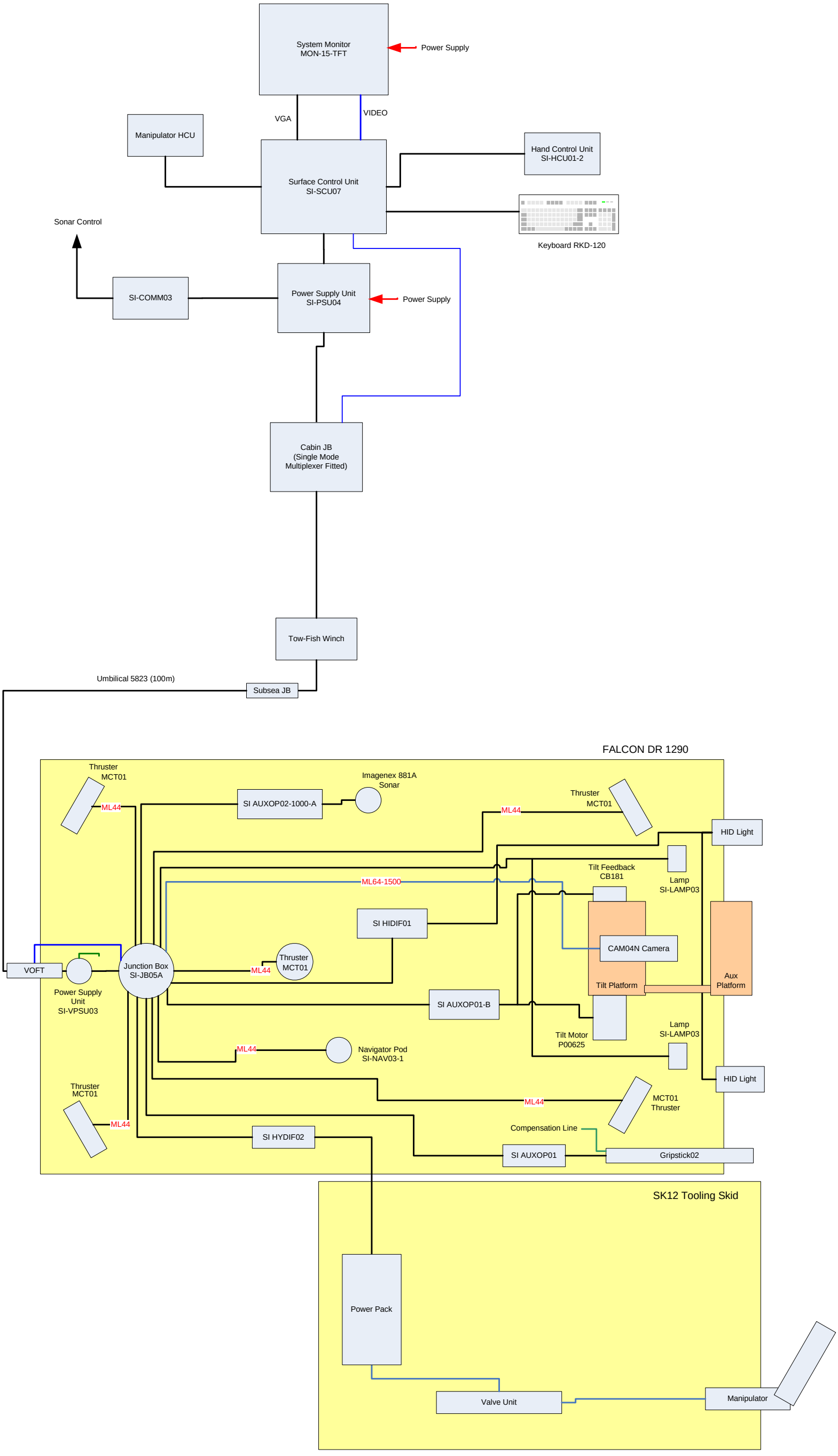


Fig. 3. Falcon System Fibre Optic Operational Setup

Falcon DR System 1290

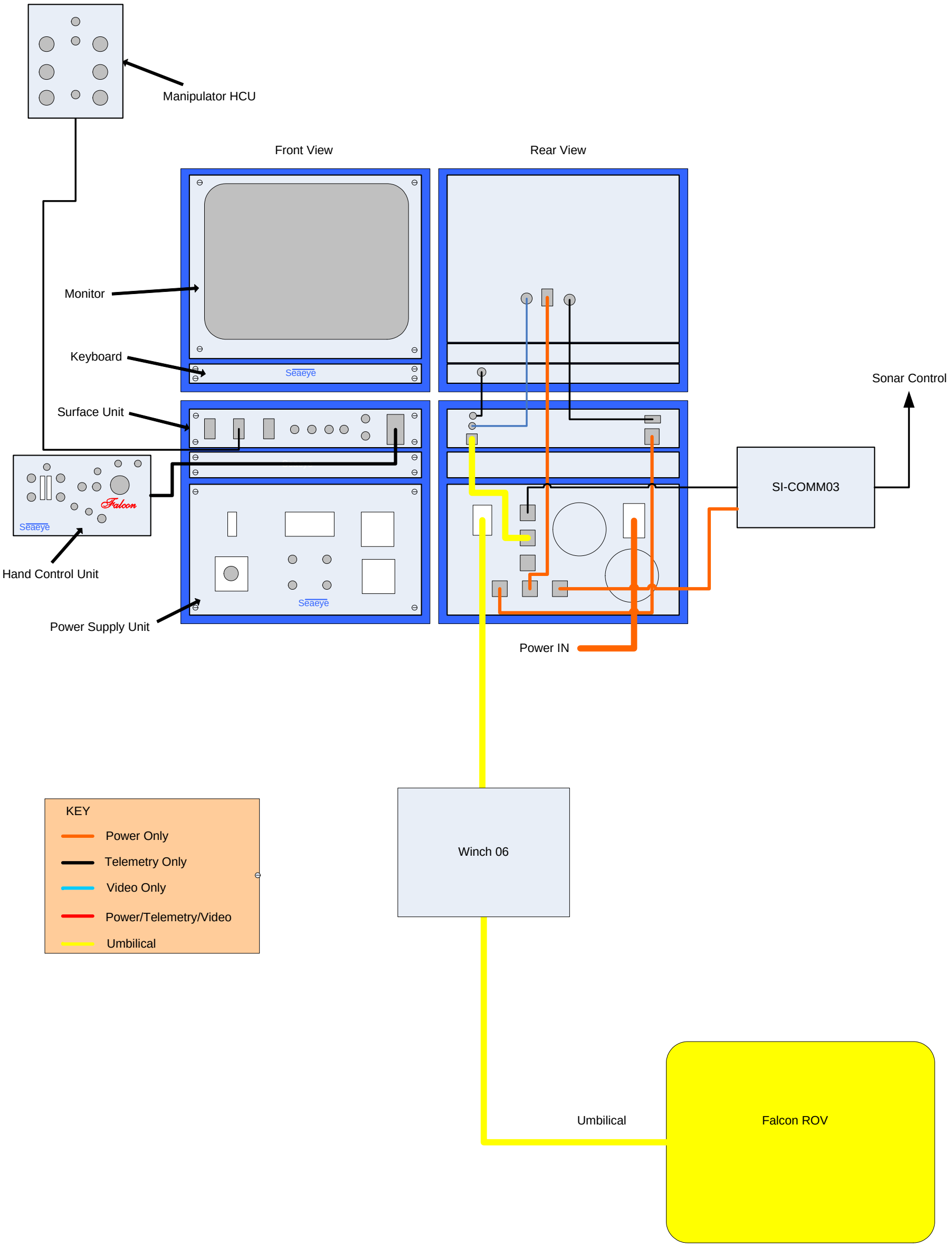


Fig. 4. Falcon System Twisted Pair Surface Equipment Setup

Falcon DR System 1290

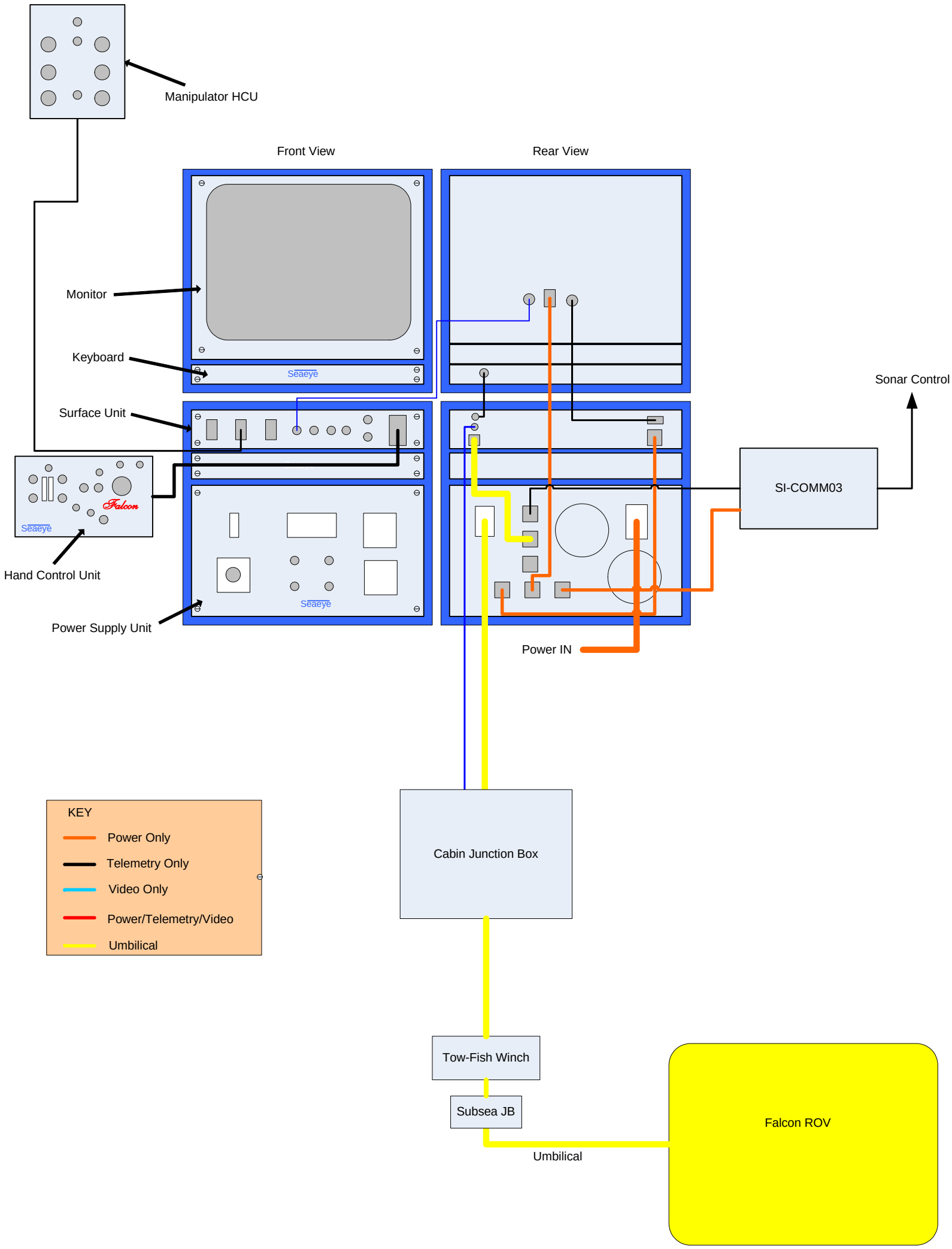


Fig. 5. Falcon System Fibre Optic Surface Equipment Setup

1.2.2 Surface Unit

The Surface Control Unit (SCU) Type SI-SCU07 is the control interface to the ROV, interpreting the commands given by the pilot from the Hand Control Unit (SI-HCU) and transmitting them down the umbilical to the ROV via a serial link.

In addition, it receives video and telemetry information from the ROV. The telemetry information such as heading and depth is overlaid onto the camera picture and displayed on the monitor.

The SI-SCU07 contains a computer processor that communicates to all the ROVs assemblies or units such as Thrusters, Tilt Motor, Lamp, Video switching unit or any additional assembly. Each assembly has an on-board processor with a unique identity or address that responds only to specific commands applicable to that assembly or unit. These individual processors are called nodes and the system known as 'Distributed Intelligence System'. The Video Switching unit is therefore, instructed by the Video Switching node processor. When an additional unit is fitted to the Falcon System, it, too, contains a node that is set up so that the SI-SCU07 can communicate with it alone.

Circuit diagrams can be found in Chapter 6.

Fig. 6. Surface Control Unit

1.2.3 Cabin Junction Box

The Cabin Junction Box (FALCON-CJB) is a self-contained metal unit that provides termination of the umbilical from the ROV to the Surface Unit. The CJB provides umbilical termination for the ROV power supplies, video connection and data control connection. Located in the CJB are:

- PCB for video, power and telemetry configuration.
- Fibre Optic Module for the Falcon Fibre Optic video.
- Fibre Optic Power Supply Unit for powering the Fibre Optic Module.
- Termination of all through power and telemetry connections.
- RS232 Connections (Sonar uses RS232 connection).

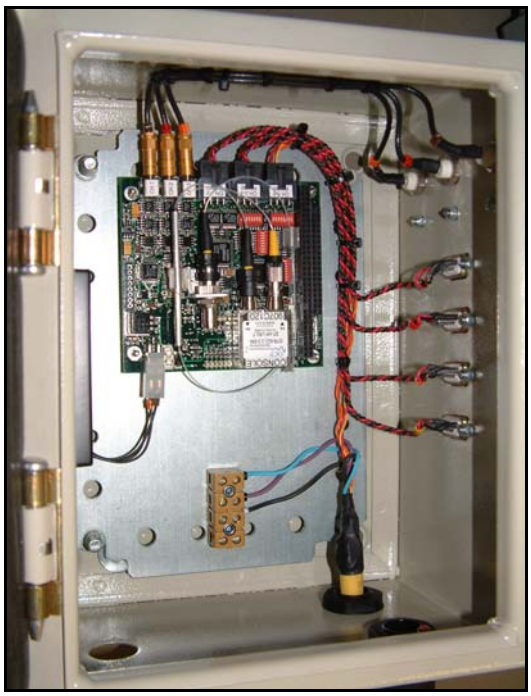


Fig. 7. Cabin Junction Box

1.2.4 Hand Control Unit

The Hand Control Unit (HCU) Type SI-HCU01-2 provides the interface between the operator and ROV by a series of switches and variable controls. It is connected to the front panel of the SI-SCU07 using a Harting connector. The SI-HCU controls the following:

- ROV movement and speed.
- Camera tilt.
- Lighting.
- Thruster enable.
- Video camera select.
- Auto depth and heading.
- Single Function Manipulator control.

Detailed information can be found in Chapter 2. The circuit diagram can be found in Chapter 6.

Fig. 8. Hand Control Unit

1.2.5 System Monitor and Keyboard

The Falcon System incorporates a monitor Type MON-17-TFT that displays the video information from the camera and system information as overlaid or superimposed data. The keyboard is a Type RKD-120 rack mounted keyboard and connects to the SI-SCU.

Fig. 9. Monitor and Keyboard

1.2.6 Sonar

The Falcon 1290 System is delivered with the Imagenex Sonar Type 881A. This is a multi-frequency sonar that can generate highly detailed full-scale images. Using the surface Laptop Computer and respective software, the 881A is a programmable multi-frequency digital imaging sonar that the user can operate using default frequency settings (310 kHz, 675 kHz or 1 MHz) or customize the configurations from 280 kHz to 1.1 MHz in 5 kHz steps for their own situation.

It uses a Window™ Operating System 95, 98, Me, NT, 2000 or XP. Modes include Sector, Polar and Side Scan, with ranges from 1m to 200m.

Full details of the Imagenex 881A Sonar are provided in the handbooks supplied with the unit.

Fig. 10. Sonar Control

1.2.7 Sonar RS232/RS485 Converter

The RS232/485 Converter Type SI-COMM03 provides data conversion between the Surface SI-PSU and Sonar Surface Computer. Detailed information can be obtained from Seaeye Marine Ltd.

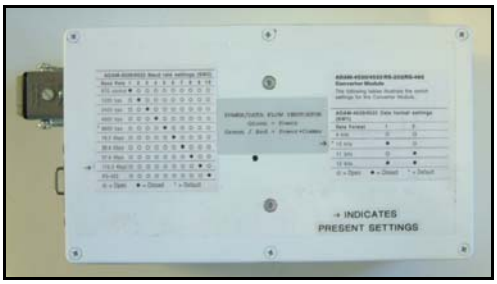


Fig. 11. RS232/RS485 Converter

1.3 Umbilical

The Falcon 1290 System is delivered with a 200m umbilical cable, Type 5769 for the Twisted Pair System configuration. The multi cored electrical umbilical cable is used for carrying Power, Telemetry Control and Video signals from the Surface Power Supply (PSU) to the vehicle. Telemetry control and video signals are routed through the PSU to the Surface Unit.

The fitted umbilical is used for the following:

- DC power distribution.
- Subsea AC power distribution.
- Video signals.
- Vehicle telemetry.
- Sonar data.
- Aux.
- Earths.

The umbilical 5769 is composed of the following:

- 0.22 mm² pair, EPC insulation, Al/My screen with 0.35 mm² drain, Mylar.
- 0.96 mm² conductors, EPC insulation.
- 0.14 mm², EPC insulation.
- 0.22 mm² quad, EPC insulation, 0.14 mm² drain, Al/My screen, Mylar.
- Core filled with hydrophilic gel and wrapped with Mylar.
- Thermoplastic Elastomer Inner Jacket, nominal 1mm wall thickness.
- Embedded Vectran torque-balanced braided strength member.
- Orange lightweight proprietary outer jacket, printed with Seaeye Marine Ltd nominal 3.8 mm wall thickness.

The Falcon System uses the Type 5823 umbilical cable and deck cable for carrying Power, Telemetry Control and Video signals from the Surface Power Supply (PSU) to the vehicle when in the Fibre Optic configuration. Telemetry control and video signals are routed through the PSU to the Surface Unit. It is fitted with a Vehicle Oil Filled Termination (VOFT) to allow separate interfacing of the fibre optic connection and power/telemetry connection to the vehicle.

The fitted umbilical is used for the following:

- DC power distribution.
- Subsea AC power distribution.
- Video signals.
- Vehicle telemetry.
- Sonar data.
- Aux.
- Earths.

Fig. 12. Falcon Umbilical Cable

The umbilical used with the Falcon is a Type 5823 is composed of the following:

- 1.64 mm² CuClad aluminium conductor, EPC insulation, 4 places.
- Nylon fibre optic loose tube: 2- 50/125um MMF, gel filled 1 place.
- 0.14 mm² conductor, EPC insulation, 2 places.
- Core filled polyethylene filler and wrapped with Mylar.
- Linear low density polyethylene inner jacket, yellow.
- Torque balanced Vectran braided strength member.
- Linear low density polyethylene outer jacket, nominal 2.2 mm wall thickness, yellow.

1.3.1 Oil Filled Termination

The Falcon umbilical Type 5823 is fitted with a Vehicle Oil Filled Termination (VOFT14-1) designed to reduce the down time in the event of cable damage. The VOFT is an oil filled termination assembly connecting cables by a terminal block housed in PVC sheathed body held in place by two jubilee clips. A positive pressure is maintained in the VOFT by a compensator unit to prevent the ingress of water and provides some protection if the VOFT or cables become damaged. The compensator has an oil fill indicator to give indication of the pressure within the VOFT. The tether end can be back potted with polyurethane to reduce the amount of oil travelling back along the cable. The power cable is connected to the VPSU and the fibre optic cable connected to the VJB.

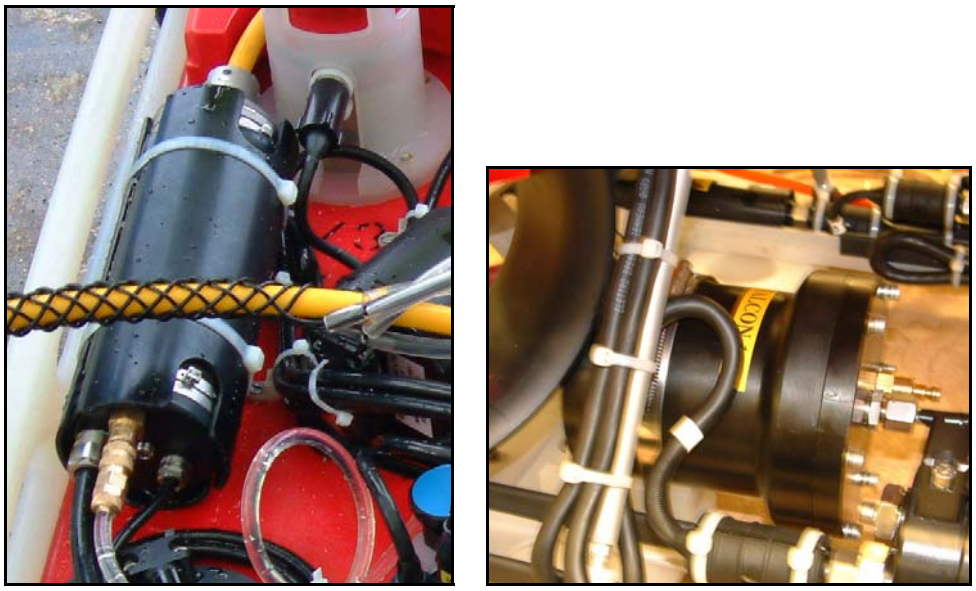


Fig. 13. Oil Filled Termination and Compensator

1.4 Manipulator Hand Control Unit

The Manipulator Hand Control Unit (HCU) Type SI-HYDSCU01 provides the interface between the operator and 5-Function Manipulator by a series of switches and variable controls. The SI-HYDSCU01 controls the following:

- Pump ON and OFF.
- Jaws – Rotation, opening and closing operation.
- Arm – Outward and aft directional movement.
- Slew – Rotation, outward and aft directional movement.

Fig. 14. Manipulator Hand Control Unit

1.5 Winch 06

This is constructed essentially of a Polypropylene body held with aluminium spacer bars, designed to manage the umbilical from the surface and fitted into a carry case.

Fig. 15. Winch 06

The winch is fitted into a carry case for easy transportation. The case is fitted with a carrying handle and wheels.

Fig. 16. Winch Carrying Case

The drum is constructed from High Density Polypropylene and is operated by the handle. The handle is fixed to the drum having a 1:1 ratio.

The umbilical is internally secured to the drum with a Kellams grip and cannot be undone.

The Winch incorporates a Slipring Type Focal 180 on the non-drive side, which terminates in the Fixed Junction Box.

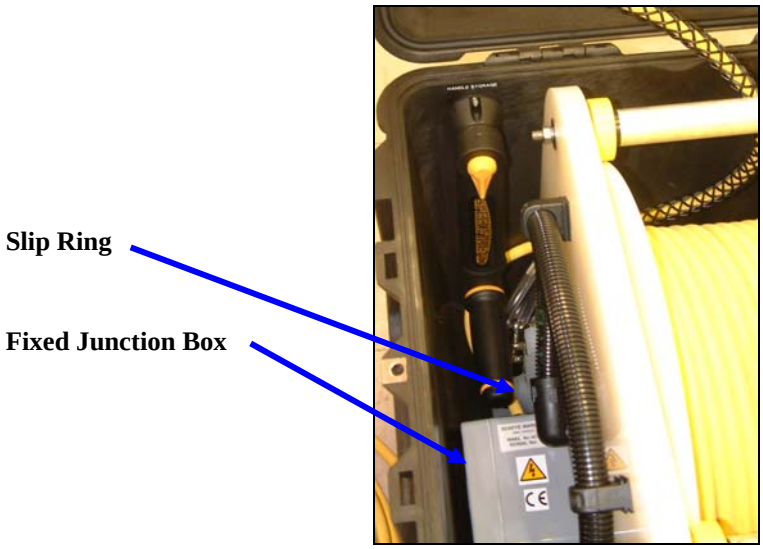


Fig. 17. Slip Ring and Fixed Junction Box

A Rotating Junction Box enables connection of the Umbilical to the Winch.

The drum locking socket, located on the framework, locks the rotating drum to the winch frame. This prevents the drum from rotating during travel and can act as a drum lock when the umbilical is deployed out. The socket is released by pulling and twisting to allow the operator to unlock the drum.

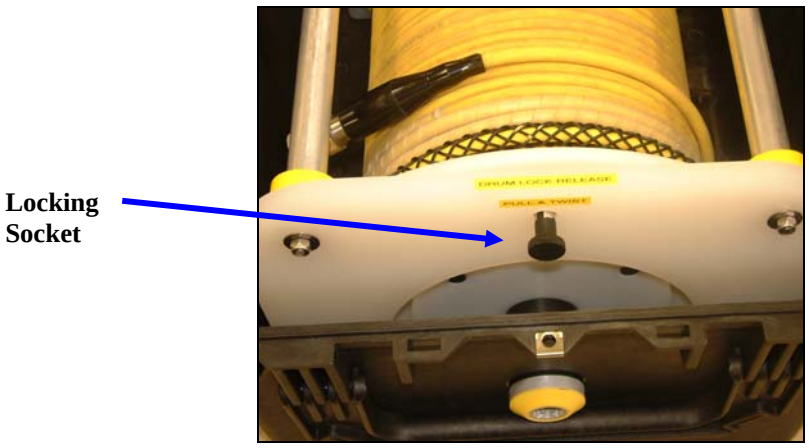


Fig. 18. Locking Socket

A Handle allows the operator to mechanically turn the drum. The handle stowage is located inside the carry case, and locates through the side of the case onto the drum.

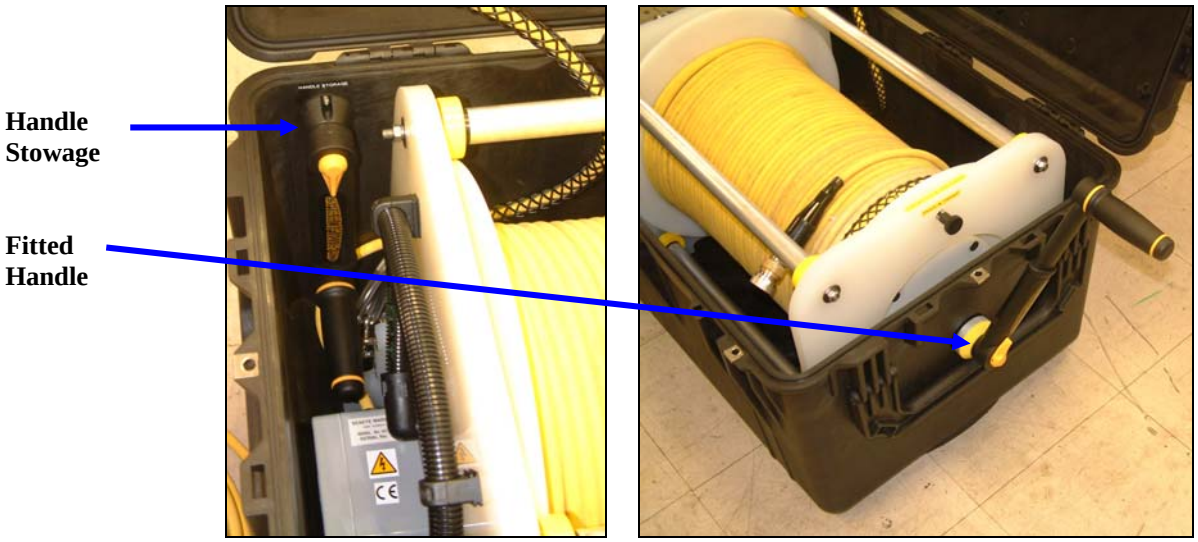


Fig. 19. Handle

1.6 Vehicle

The vehicle is constructed from rugged polypropylene and GRP Encapsulated syntactic buoyancy foam to provide neutral buoyancy containing the following equipment:

- Seaeye Vehicle Power Supply Unit.
- Seaeye Vehicle Junction Box.
- Five Seaeye Thrusters for Propulsion.
- Two Seaeye Light Units.
- Seaeye Camera Tilt Platform with Tilt Motor and Feedback Potentiometer, and mechanically linked to a Seaeye Auxiliary Tilt Platform.
- Two HID light units.
- Seaeye CAM04N Colour Camera.
- Single Function Manipulator.
- Auxiliary Power Supply Units.
- Seaeye Navigation Pod.
- Imagenex 881A-SYS-1000 Sonar Head.
- Trimming Weights to provide level flight characteristics.
- Seaeye Tooling Skid with 5-Function Manipulator system.

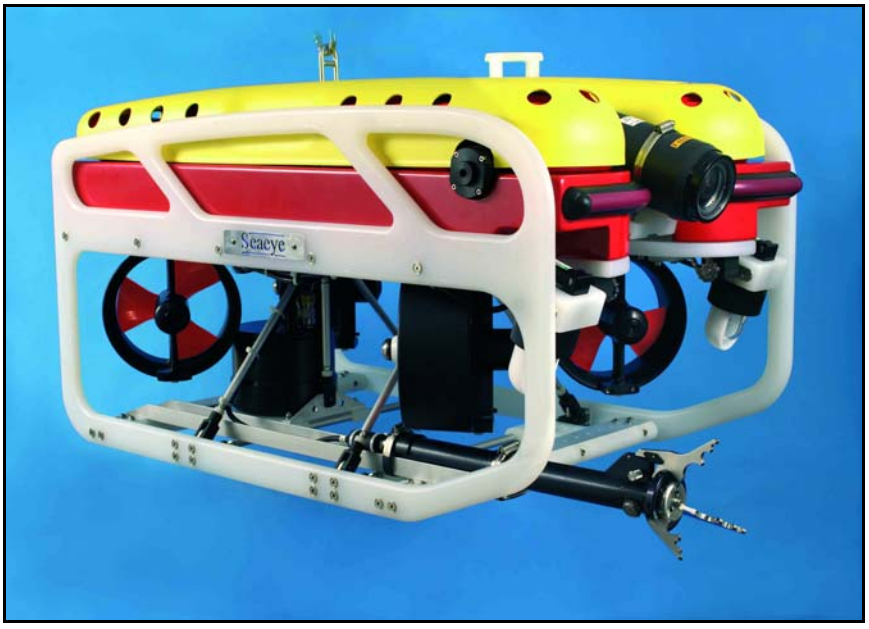


Fig. 20. Falcon DR Vehicle

Detailed circuits diagrams of the vehicle components are shown in Chapter 6.

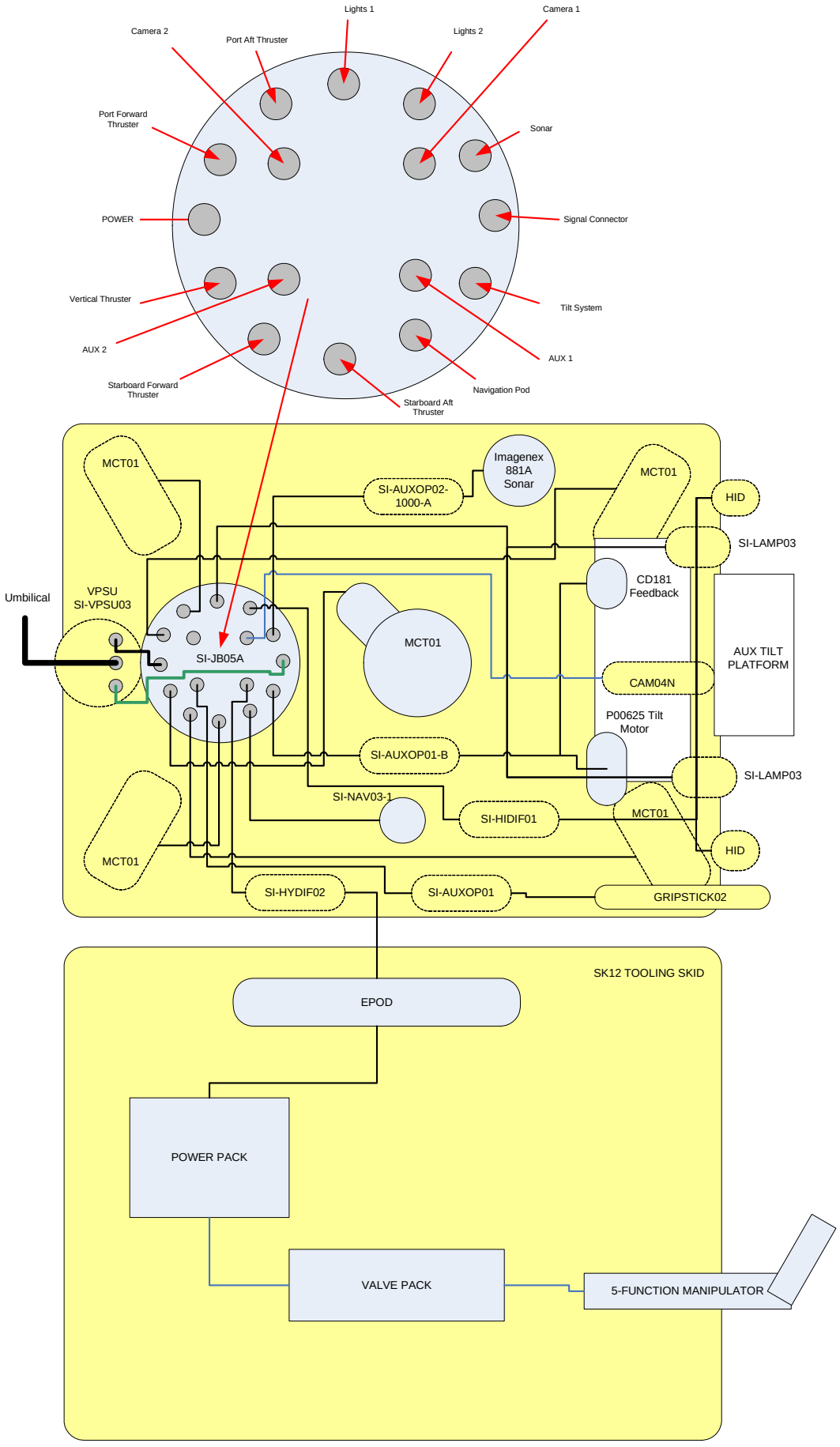


Fig. 21. Falcon Vehicle Components In Twisted Pair Configuration

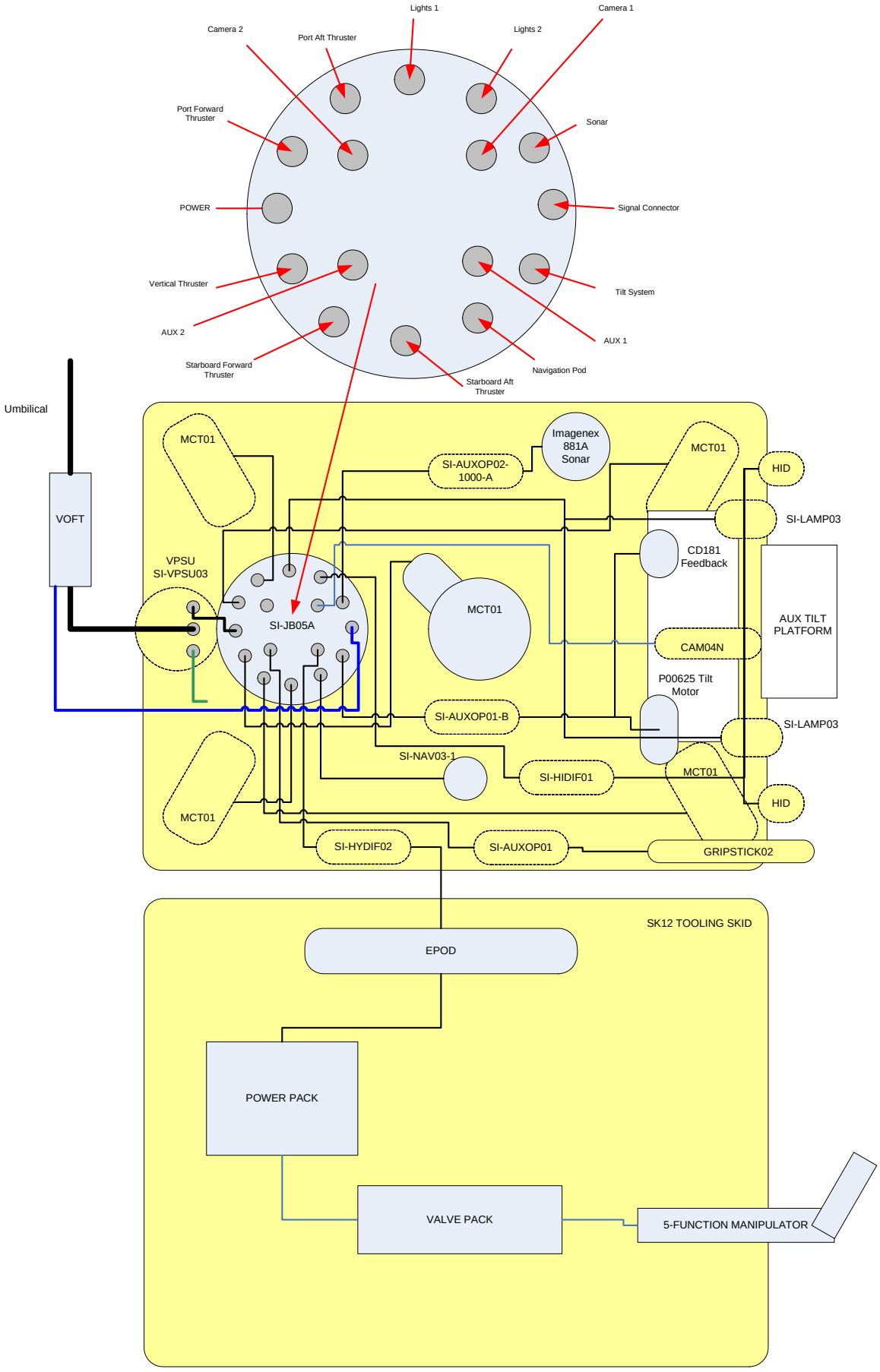


Fig. 22. Falcon Vehicle Components In Fibre Optic Configuration

1.6.1 Vehicle Power Supply Unit

The Vehicle Power Supply Unit (VPSU) Type SI-VPSU03 transfers 500 Volt DC from the Surface PSU to the 48 Volt DC supply required by the ROV system and nodes. A short cable connects 48 Volts DC to the Vehicle Junction Box, (JB).

When in the Twisted Pair configuration, the control and video signals are routed from the umbilical, through the VPSU and into the Vehicle JB via a separate 'Signals' cable. When in the Fibre Optic configuration, the control and video signals are routed from the VOFT directly to the Vehicle Junction Box. The controls cable on the PSU is terminated and stowed.

Fig. 23. Vehicle Power Supply Unit

1.6.2 Vehicle Junction Box

The Vehicle Junction Box (VJB) Type SI-JB05A distributes Telemetry control signals and Power to all vehicle assemblies, units or nodes. A Fuse board provides protection and a test facility for each node allows rapid fault diagnosis. The VJB also contains a separate camera control board.

When the system is setup for Twisted Pair operations, the VJB is fitted with a Type 6098P and Type 6102P Printed Circuit Boards (PCBs). When in the Fibre Optic configuration, the VJB is fitted with a Type 6098P and Type 6132P PCBs.

Details of these configurations and how to change the PCBs are found in Chapter 6 of this manual.

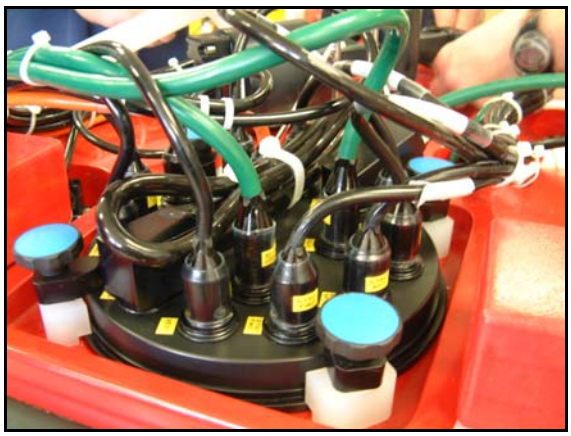


Fig. 24. Junction Box

1.6.3 Thrusters

Each Thruster Type SI-MCT01 provides 13 kg (at 240 W Power) of propulsive thrust.

Magnetically Coupled Thruster Propellers render conventional shaft seals obsolete and greatly increase thruster durability with increased operational working life.

Each thruster is allocated an individual ‘node’ and each respective on-board processor controls drive circuitry for a brushless DC motor. Four thrusters control horizontal movement and one for vertical ascent and descent.

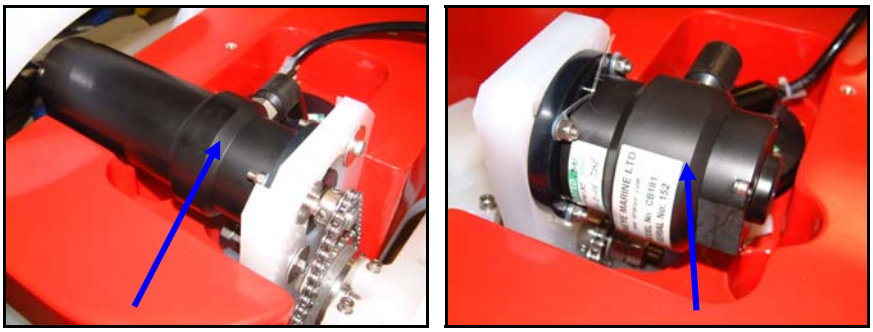
Fig. 25. Horizontal and Vertical Thrusters

Thruster Specification	
Nominal Voltage	48 VDC
Nominal Power	300 W
Forward Thrust @ 300W	13 kgf
Reverse Thrust @ 300W	12.8 kgf
Propeller Speed @ 300W	960 RPM
Propeller Diameter	180 mm
Weight in Air	4.3 kg (including propeller and nozzle)
Weight in Seawater	2.5 kg (including propeller and nozzle)
Depth Rating	1000 m
Control Signal	RS485
Connector	5-Way Connector

Table. 1. Thruster Specification

1.6.4 Tilt Motor and Feedback Unit

The Tilt unit comprises of a tilt motor, platform and feedback mechanism and is used to mount the cameras and lighting. The Tilt motor Type P00625 and feedback potentiometer Type CB181 are oil compensated and used to tilt the platform by means drive chains. Tilt positional information is displayed on the system monitor as overlay.



Tilt Motor **Feedback Unit**

Fig. 26. Tilt Motor and Feedback Assembly

Tilt Motor Specifications	
Power Requirement	24 VDC (± 10%) 3.6W
Length Overall (Max)	230 mm
Overall Diameter	80 mm (130 mm including connector)
Weight in Air	1.33 kg
Weight in Water	957 g
Depth Rating	Full Ocean Depth

Table. 2. Tilt Motor P00625 Specifications

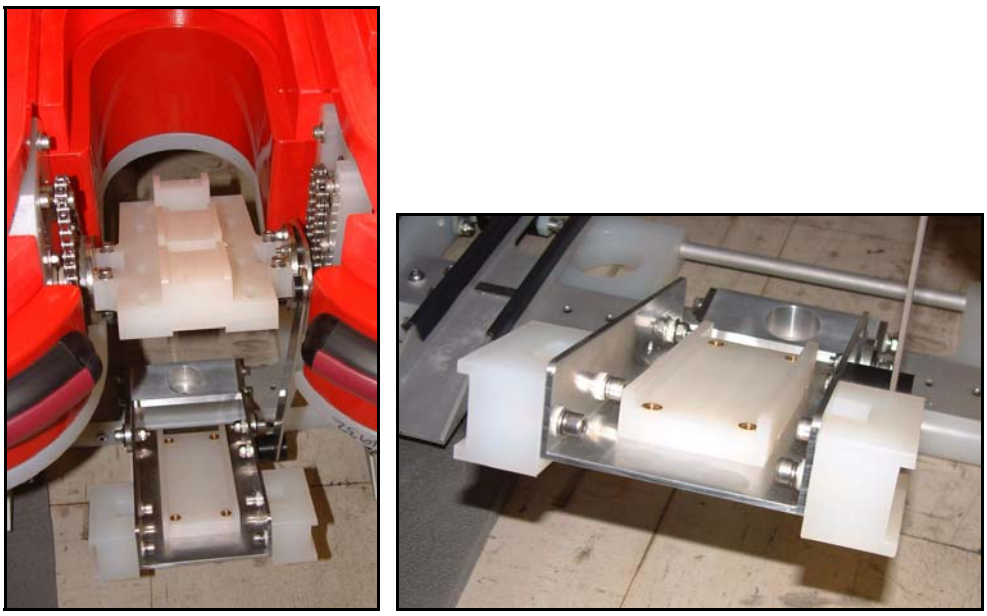


Fig. 27. Tilt Platforms

NOTE:

The Falcon 1290 is fitted with an auxiliary tilt platform which is mechanically linked to the main tile platform. The auxiliary tilt platform's range of movement is restricted to a maximum of 40 Deg up and 40 Deg down. This is factory set.

If the operator wishes to use the ROV without the auxiliary tilt (as per initial dispatch: twisted pair variant with single camera), it can be stowed as follows in order to achieve the full range of tilt for the single camera platform

1. **The 'coupling strap' can be disconnected at the main tilt motor and stowed in a safe position (cable tie or tighten down pivot bolt).**
2. **The auxiliary tilt platform can be immobilised by tightening down the two bolts on which it pivots.**

1.6.5 Navigation Pod

The Navigation Pod Type SI-NAV03-1 contains an electronic compass, a solid-state movement sensor or gyro and a depth transducer. Depth, Pitch & Roll and heading signals from these components are displayed on the monitor as well as being combined internally to provide the Falcon ROV with its Auto functions, which adjusts the thrusters to maintain depth and heading.

Fig. 28. Navigation Pod

Navigation Pod Specification	
Compass Accuracy	±1° (level)
Depth Sensor Accuracy	±0.5% Full Scale Deflection
Pitch & Roll Accuracy	±0.4° (@ 0° to 30°) ±1.0° (@ 30° to 60°)
Gyro Accuracy	0.1%
Weight	1.0 kg (in air); 430 g (in water)
Communication Protocol	RS485 ½ Duplex
Connector	5-Way Connector

Table. 3. Navigation Pod Specification

1.6.6 Lights

The Seaeye Falcon has two individual 75 W lamp assemblies Type SI-LAMP03 with smooth intensity control from fully OFF to fully ON. They are mounted on the tilt platform.

Fig. 29. Lamp Unit

Lamp Unit Specification	
Power:	75 W
Voltage:	48VDC
Operating Depth:	3000 m
Weight: In Air: In Seawater:	 0.82 kg 0.42 kg
Communication Protocol:	RS485 ½ Duplex
Connector:	5-Way Connector

Table. 4. Lamp Unit Specification

1.7 Seaeye CAM04N Colour Camera

The Falcon System is supplied with a Seaeye Camera CAM04N. This is a high resolution colour CCD camera which incorporates with auto-iris and fixed focus lens. The camera output has a resolution of 540 TVL with sensitivity of 0.35 lux. Video signals are sent via the Junction Box and displayed on the monitor. Selection is on the hand controller.

Fig. 30. CAM04N Camera

CAM04N Specification	
Pick-up element	½ ” Interline transfer C.C.D. Sensor
Scanning Frequency:	15.625 kHz by 50 Hz
Sync:	Internal
Video Output:	1V peak to peak, 75 ohm
Video S/N Ratio:	Better than 50 dB
Resolution:	540 Television Lines
Sensitivity:	0.35 Lux
Lens Mount:	“C” Mount
Power Requirement:	24 VDC (± 10%) 3.6 W
Lens Type:	½” Aspherical 3.8 mm lens, wide angle, fixed focus (Field of view: 91° in water)
Iris:	Automatic
Mount:	C/CS Mount
Length Overall (Max):	300 mm
Overall Diameter:	102 mm
Weight in Air:	2.75 kg
Weight in Seawater:	500 g
Depth Rating:	2000 metres

Table. 5. Colour Camera Specification

1.8 HID Lamp Unit

The Falcon is fitted with a HIDU03 lamp unit. The Seaeye HIDU03 comprises a high performance gas discharge lamp with associated electronic ballast and a wide input range AC or DC input power supply unit. The unit is fully sealed in a pressure rated marinised housing rated to 3,000m ocean depth. Connection is made via Seaeye’s proprietary metal shell connector and the light output is directed via a polypropylene reflector that adjusts at 90 degree intervals. Fine beam alignment is achieved via a slotted mounting bracket that can be adjusted in situ.

The discharge lamp itself is based on metal halide/noble gas arc lamp technology, and produces 75% of full output immediately on strike, rising to 100% after a 30 second warm up. The arc is almost invulnerable to shocks and impacts, an impact strong enough to displace the arc will cause the unit to instantly re-strike, so that even after a severe blow, light output will still be maintained.

Fig. 31. HIDU03 Lamp

HIDU03 Specifications	
Power	12 V Nickel Metal Hydride Rechargeable Batteries
Lamps	50 mm 18 Watts
Beam Spread	20 Deg. or 65 Deg.
Weight	2.4 kg (in air), 1.3 kg (in water)
Dimensions	69 mm (W) x 195 mm (L)

Table. 6. HIDU03 Specification

1.8.1 Imagenex Sonar Head

The Imagenex Sonar Type 881A is a multi-frequency sonar that can generate highly detailed full-scale images and is used with the surface Sonar Computer and respective software. Full details are provided in the handbook supplied with the unit.

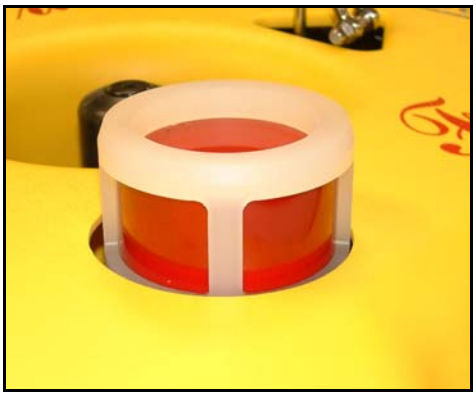


Fig. 32. Sonar Head

Sonar Head Specifications	
Frequency	310 kHz, 675 kHz, or 1 MHz (default settings)
Transducer	Imaging type, fluid compensated
Transducer Beam Width	310 kHz: 4° x 40° 675 kHz: 1.8° x 20° 1 MHz: 0.9° x 10°
Range Resolution	1 m – 4 m: 2 mm 5 m & up: 10 mm
Minimum Detectable Range	150 mm
Maximum Operating Depth	3000 m
Maximum Cable Length	1000 m on typical twisted shielded pair (RS-485)
Interface	RS-485 serial interface @ 115.2 kbps
Connector	Side mounted, four conductor, wet mateable (Impulse MCBH-4-MP-SS)
Power Supply	20 – 36 VDC at less than 5 Watts
Dimensions	79.4 mm diameter x 182 mm length
Weight in Air	3000 m unit: 2 kg
Weight in Water	3000 m unit: 1.1 kg

Table. 7. Sonar Head Specification

1.9 Single Function Manipulator

The Single Function Manipulator (Type GRIPSTICK02) allows the operator to remotely hold objects and manoeuvre them as required.

Fig. 33. Single Function Manipulator Arm

The manipulator is operated by the auxiliary output pod (SI-AUXOP01), which applies ±24V to the manipulator in order to open and close the jaw, in response to the manipulator control buttons on the HCU.

Single Function Manipulator Specification	
Depth Rating	1000 msw
Nominal Voltage	24VDC
Maximum Current	0.86A (Internally limited)
Maximum Grip Diameter	145mm
Grip at Jaw Tip	6 – 10 Kgf
Force at Cutter	30 Kgf
Weight in Air Weight in Sea Water:	1.54 kg with Cutter 1.45 kg without Cutter 0.82 kg with Cutter 0.76 kg without Cutter
Body Length:	520 mm (Allow additional 120 mm for connector)
Body Diameter:	41 mm
Connector:	2-Way - Power

Table. 8. Single Function Manipulator Specification

Pressing the HCU upper button marked “Open” will open the jaws of the manipulator. Releasing the button will maintain the current position of the jaws. Pressing the HCU lower button marked “Close” will close the jaws of the manipulator. Releasing the button will maintain the current position of the jaws.

The Manipulator length can be adjusted but it has to be done physically pre-dive. On the base of the chassis where the manipulator arm is fixed there are two jubilee clips, these are used to adjust the length.

1.10 5-Function Manipulator System

The 5-Function Manipulator System contains the following equipment:

- Auxiliary Power Supply Unit (SI-HYD01).
- Valve Pack (HLK-70150-M).
- Power Pack (HLK-91000/48).
- Manipulator Assembly (HLK-43000)
- Compensation Bladder.
- Bleed and Fill Valves.

The Manipulator Assembly is mounted on the Falcon Tooling Skid as show in Fig. 34.

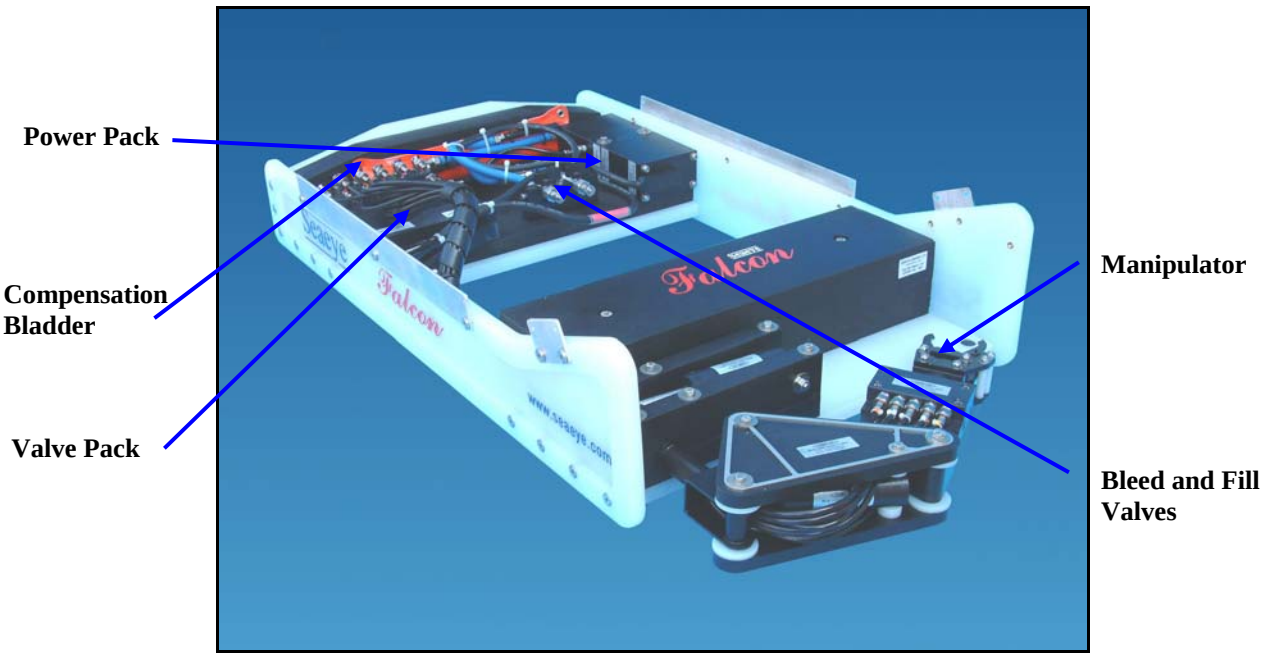


Fig. 34. 5-Function Manipulator Tooling Skid

1.10.1 Auxiliary Control and Power Supply Unit

The Vehicle Power Supply Unit (VPSU) converts 500 Volt DC from the Surface PSU to the 48 Volt DC supply required by the ROV system. The SI-HYD01 is connected to the vehicle junction box (VJB) and provides a 48VDC supply and control data for the manipulator equipment fitted to the vehicle skid unit. The manipulator is controlled through the main ROV system telemetry.

NOTE

Input supply must be fused with a F8A(T) fuse, located in the VJB (F12). (Refer to Chapter 3)

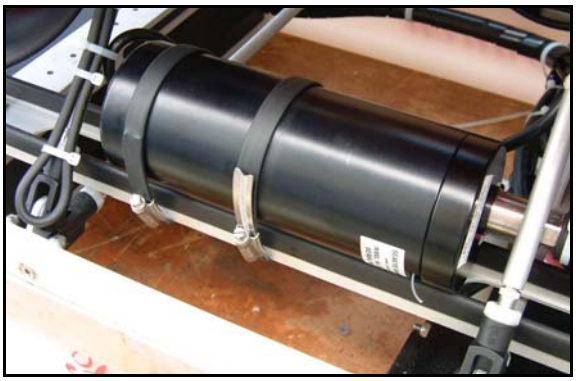


Fig. 35. SI-HYD01 Assembly

1.10.2 5-Way Valve Pack

The 5-Way Valve Pack (HLK-70150) is a compact, lightweight valve pack plastic unit. This can withstand up to 140 bar hydraulic pressures. The valve pack incorporates five standard bi-directional cartridge valves fitted with solenoid coils and is setup to operate at 80 bar for use with the Falcon System.

Fig. 36. Valve Pack

1.10.3 Power Pack

The Power Pack (HLK-91000) is a low profile, compact hydraulic unit, incorporating a pressure relief valve. It is driven by two 150 W DC motors coupled to a common drive shaft with a high-pressure shaft seal, to a gear pump. It is powered by a 48 VDC input from the SI-HYD01 unit. The power pack is setup to operate at 80 bar with the Falcon System, although it can withstand a maximum short term operating pressure of 210 bar.

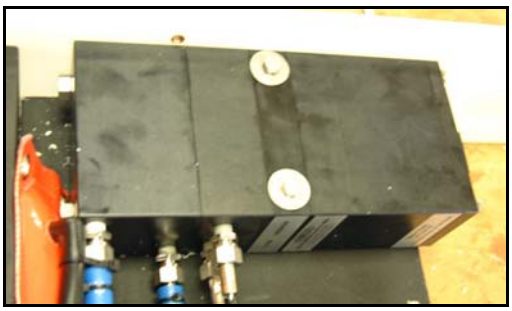


Fig. 37. Power Pack

1.10.4 5-Function Manipulator

The 5-Function Manipulator (HLK-43000) is unique in that it has no aluminium parts. The construction of plastic and stainless steel has kept the arm rugged and tough with the capability of lifting 10 kg at full reach, yet retaining a very light weight in water. The unique 5-function arrangement gives excellent dexterity for a small arm and enhances the operational capability of the Falcon Vehicle.

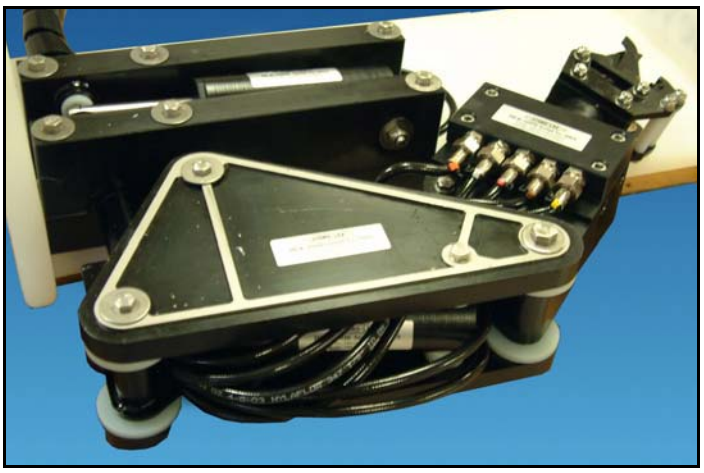


Fig. 38. Manipulator

Manipulator Hand Control Unit (SI-HYDSCU01)		
Dimensions	Length	223 mm
	Width	146 mm
	Height	55 mm
Manipulator (HLK-43000)		
Dimensions	Length of arm	553 mm
	Length of slew plate	210 mm
	Width	232 mm
	Height	97 mm
Capacities	Rotate	180°
	Torque at 80 bar	8 Nm
	Lift capacity at 80 bar	10 kg
Weight		5 kg (in air); 3 kg (in water)

Table. 9. 5-Function Manipulator System Specifications

Valve Pack (HLK-70150)		
Dimensions	Length	207 mm
	Width	200 mm
	Height	50 mm
Weight		4.8 kg (in air); 2.8 kg (in water)
Functions		5 x Bi-directional solenoid valves
Voltage		48 VDC
Electrical connector		16 pin Micro Series subconn male
Pressure Setup		Set to operate at 80 bar
Hydraulics		140 bar maximum working pressure
Porting		1/8” NPT
Power Pack (HLK-91000)		
Dimensions	Length	223 mm
	Width	110 mm
	Height	63 mm
Weight		4.0 kg (in air); 2.5 kg (in water)
Depth rating		1000 metres
Power		48 VDC, 300 W
Output		210 bar at 0.3 L/min
Pressure Setup		Set to operate at 80 bar
Hydraulics		210 bar maximum working pressure
Porting		1/8” NPT

Table. 10. 5-Function Manipulator System Specifications (continued)

Falcon Tooling Skid		
Dimensions	Length	1000 mm
	Width	600 mm
	Height	220 mm
Weight		35 kg

Table. 11. Falcon Tooling Skid Specifications

1.11 Auxiliary PSU Assemblies

The Falcon Auxiliary Power Supply Units (AUXPSU) provide a subsea interface for the additional equipment fitted to the vehicle. A regulated 24V 150W DC output is generated from the Vehicle 48V Power Supply Unit (VPSU) and is fully isolated and protected against damage from:

- Output short circuit.
- Input supply out of range plus input transients.
- Over temperature.
- Back EMF from inductive loads (contactors, solenoids).
- Regenerative loads (motors with high inertia loads).

NOTE

Input supply must be fused with a fast HRC ceramic F6.3A fuse.

- The AUXOP01-B provides an interface between the Vehicle Junction Box and tilt motor assembly (P00625 and CB181) and is located on the vehicle chassis.

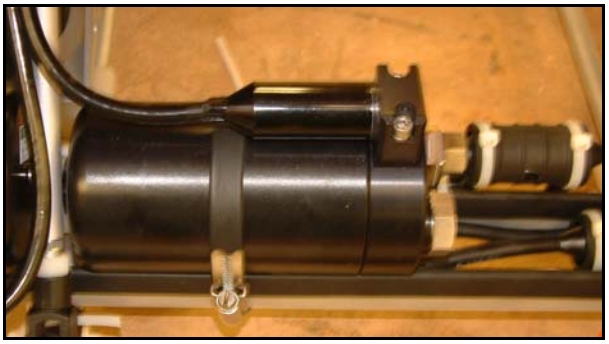


Fig. 39. SI-AUXOP01-B Assembly

- The AUXOP01 provides an interface between the Vehicle Junction Box and single function manipulator.

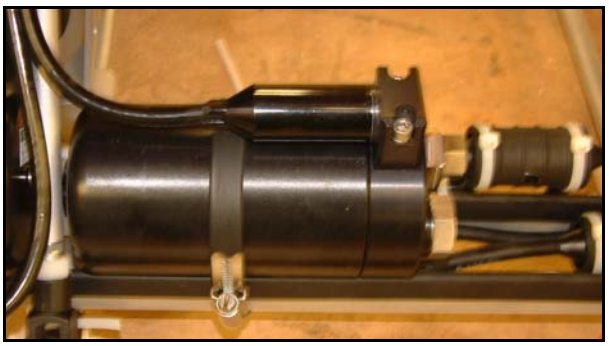


Fig. 40. SI-AUXOP01 Assembly

- The AUXOP02-1000-A provides an interface between the Vehicle Junction Box and sonar.

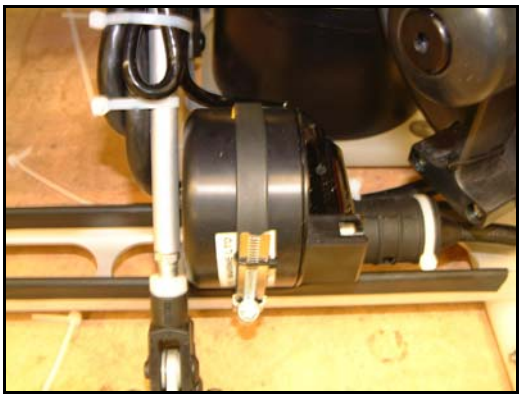


Fig. 41. SI-AUXOP02-1000-A Assembly

- The SI-HIDIF02-2000 provides an interface between the Vehicle Junction Box and the HID lamps.

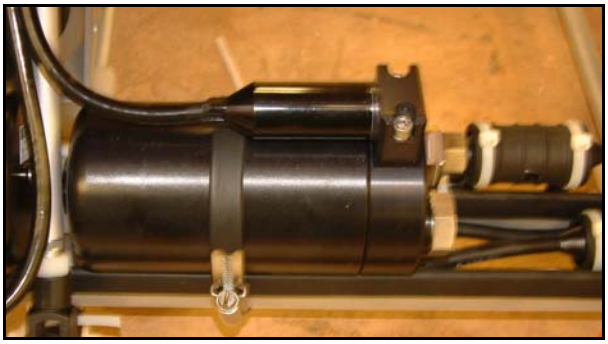


Fig. 42. SI-HIDIF02-2000 Assembly

1.12 Connector Wiring Convention

Wire Numbers comply with The International Standard Resistor Colour Code:

Wire Number Coding	
Colour	**Number**
BLACK	0
BROWN	1
RED	2
ORANGE	3
YELLOW	4
GREEN	5
BLUE	6
VIOLET	7
GRAY	8
WHITE	9
BLACK (With Marker)	10
BROWN (With Marker)	11
RED (With Marker)	12

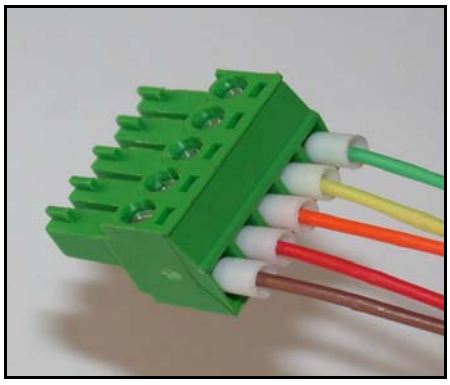


Fig. 43. Typical Node Connector & Wiring

1.13 System Specifications

Surface Power Supply Unit SI-PSU04		
Dimensions	Length	465 mm
	Width	485 mm
	Height	270 mm
Weight		44.5 Kg
Electrical Requirements	Input	Single or dual phase, 50/60 Hz, 110/115/120/240/380/415/440 VAC
Surface Control Unit SI-SCU07		
Dimensions	Length	254 mm
	Width	443 mm
	Height	87 mm
Weight		3.47 Kg
Hand Control Unit SI-HCU01-2		
Dimensions	Length	280 mm
	Width	180 mm
	Height	145 mm
Weight		2.31 kg
Monitor		
MON-15-TFT Monitor		15 inch TFT
Weight		6.95 kg + 1.1 kg for Monitor PSU

Table. 12. Surface Unit Specifications

Falcon DR Vehicle Serial Number 1290	
Length	1000 mm
Width	600 mm
Height	628 mm (to top of lifting point)
Weight	132.85 kg (un-ballasted) 138 kg (ballasted)
Depth rating	1000 m
Forward thrust	50 kg
Lateral thrust	25 kg
Vertical thrust	14 kg
Lighting	2 x 75 W quartz 2 x HID Lamps
Cameras	CAM04N Colour Camera
Manipulators	Single function GRIPSTICK02 5-Function Hydro-lek System
Sonar	Imagenex 881A Sonar Head
Depth sensor	EAF 500. Accuracy ± 0.5 FSD
Compass	Flux Gate. Accuracy ± 1º
Autopilot	Heading and depth hold

Table. 13. Vehicle Specification

1.14 Associated Documentation

- Vehicle Records.
- QA Documentation.
- Monitor Handbook.
- 5-Function Hydro-lek Manipulator Handbook.
- Imagenex Sonar Handbook.

CHAPTER 2

CONTROLS AND OPERATION

Contents

Figures

Tables

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2. CONTROLS AND OPERATION

This Chapter provides a description of unit controls and indicators for easy reference.

2.1 Introduction

The controls and indicators for the ROV system are located on the front panels of the Surface Power Supply Unit (SI-PSU), Hand Control Unit (SI-HCU) and Manipulator Hand Control Unit (SI-HYDSCU01). Refer to Figures 1, 2 and 3 for locations of the controls as they are described.

2.2 Surface Power Supply Unit Controls and Indicators

The Input Trip Circuit Breaker is located on the top left of the Surface Power Supply Unit (PSU) front panel. The normal position is 'up'. If the breaker trips to the down position, a fault may be apparent and should be investigated.

The Input Breaker is located below the Input Trip Circuit Breaker. Turn clockwise to the 'I' position to power the system up. The overlay text is displayed on the monitor. The Output Indicator will illuminate and power is available to the outlets at the rear of the unit. Turn the Input Breaker anticlockwise to the 'O' position to switch off the system power.

The Vehicle ON/OFF switches 110 VAC or 240 VAC, (depending on the selected voltage option), via the umbilical to the ROV. The Output Voltage Meter will indicate between 500 and 600 Volts and the Output Current Meter indicates the current consumption of the system.

The Line Insulation Monitor (LIM) is located on the top centre of the front panel. This is a circuit breaker that monitors isolation from earth in the high voltage areas of the system. In the event of a fault in the tether or the Vehicle Power Supply, the LIM will trip and the Output LIM Fail indicator will illuminate. Output power to the umbilical/vehicle will be shutdown and rendered safe.

The Output Adjust control is factory set and is used to compensate for power loss in the tether cable.

CONTROL/INDICATOR	FUNCTION
INPUT TRIP	Provides protection of the input supply. Set to the up position.
INPUT BREAKER switch	When set to I, switches the main input supply to the PSU. When set to O, switches off the main input supply.
OUTPUT ON indicator	Illuminates orange when the power supply is switched ON. 110 VAC or 240 VAC is available at the rear power outlets. Power outlet voltage will be the same as the power input voltage.
VEHICLE ON/OFF switch	When set to ON this energises the 500V DC supply to the tether and the vehicle will become operational. A green indicator on the switch will illuminate to indicate the umbilical is energised.
OUTPUT LIM FAIL Indicator	Illuminates red when the Line Insulation Monitor detects that isolation from earth is unsatisfactory.
Line Insulation Monitor	Monitors the insulation resistance of the DC lines. A full overview is described in Appendix 1, 'A-Isometer' Data Sheet.
OUTPUT VOLTAGE indication	Indicates the DC output voltage.
OUTPUT CURRENT indication	Indicates the DC output current.
OUTPUT ADJUST	Provides adjustment of the DC output voltage to compensation for voltage drop between the surface equipment and sub-sea ROV.

Table 1. SI-PSU Controls and Indicators

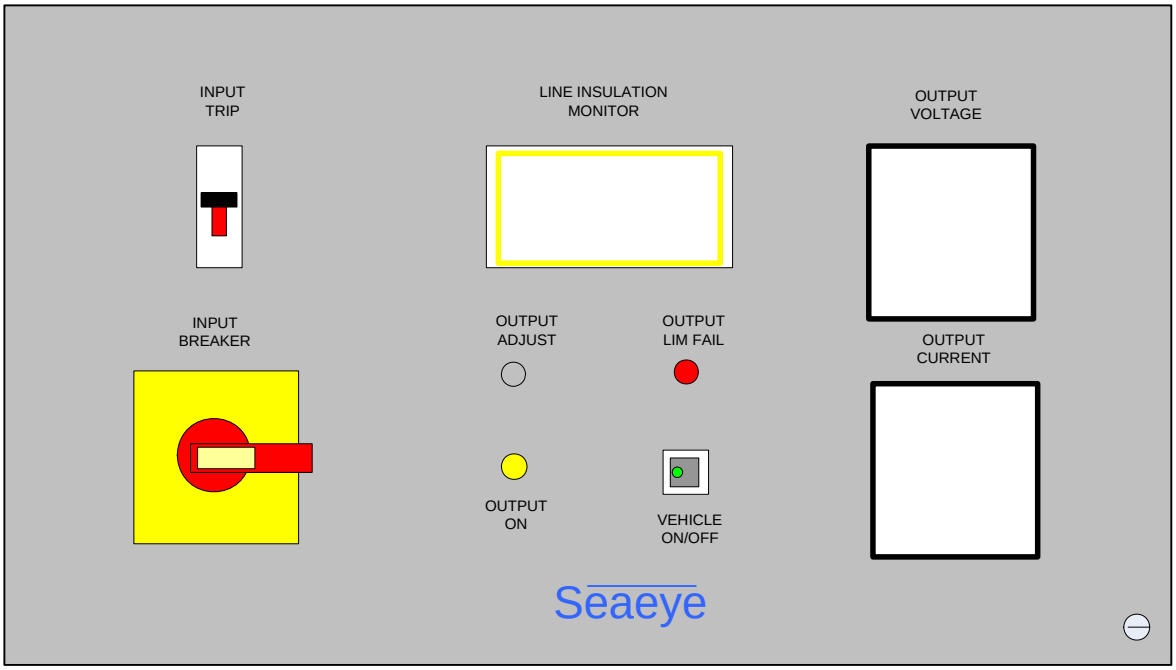

Fig. 1. Power Supply Unit Switch and Indicator Layout

2.3 Hand Control Unit Controls and Indicators

The Hand Control Unit (SI-HCU) is plugged into the socket on the front of the Surface Control Unit with a locking waterproof connector. To release the plug, grasp the outer barrel of the plug and pull. DO NOT pull on the cable, as this may damage the equipment.

The HCU controls and indicators are described below. The Tilt and Auto Depth controls are 'roller' type controls. These have both a positive detent and a marking at the centre point to give positive tactile and visual indication that the controls are centralized.

- **SI-HCU 'ON' Indicator (Green)** - Lit when the HCU is powered on.

- **Thruster Switch** - Switch to the 'Enabled' position to turn on the thrusters. The 'OFF' position ensures the thrusters safe to protect against personal injury and should always be off (except whilst testing the thrusters) when the ROV is out of the water. If the switch is in the 'Enabled' position when the surface equipment is switched on, for safety reasons the thrusters will remain disabled until the switch is toggled OFF/Enabled.

- **Thruster Min/Max Switch** - Switch to MIN to operate the thrusters at the pre-selected speed as defined in the system configuration setup. Switch to MAX to operate the thrusters up to 100% power.

- **Thruster Indicator** – This is located below the Thruster Switch and illuminates when the thruster switch is in the 'Enabled' position. Note that it does not indicate that the thrusters are operating.

- **Tilt Control** – The left hand 'roller' control is used to control the camera tilt position. Move up from its centre position to tilt the camera up and move down from its centre position to tilt the camera down. The angle attained is proportional to the deviation of the control from its centre position.

- **Vertical Controls** - The right hand 'roller' control is moved up from its centre position to ascend and down to descend the vehicle. The speed is proportional to the amount that it is moved from the centre position. Two pushbuttons (marked 'VERT') override the vertical 'roller' control. These provide full ascent or descent speed while pressed.

- **Auto Depth Button** - Push the AUTO DEPTH button to engage the Auto Depth system. This will allow the vehicle to maintain its current depth automatically. This is confirmed by the key symbol next to the depth reading displayed on the monitor. Toggle the AUTO DEPTH button to disengage. While engaged the depth maintained can be temporarily overridden by operating the vertical control roller to beyond 10% or operating the VERT up/down buttons. Returning the vertical control roller to less than 10% or releasing the VERT up/down buttons will return control to the Auto Depth system and the original depth will be maintained. To permanently change the depth, disengage the Auto Depth system, change the depth and then engage Auto Depth system.

- **Joystick Control** - A 3-axis joystick is used to control the horizontal movement of the vehicle. Push the joystick forwards to go forwards. The vehicle speed increases the further forward that the joystick is pushed. Pull the joystick back to go backwards. The vehicle speed increases the further the joystick is pulled back. Lateral movement is controlled by moving the joystick to the left or right, this again has a proportional speed control. Rotating the joystick will rotate the ROV in the direction in which the joystick is turned. All joystick functions are spring loaded so that the ROV's horizontal thrusters will stop if the joystick is released.

- **Auto Head Button** - Pushing the AUTO HEAD button engages the Auto Head system. This is confirmed by the key symbol next to the head reading displayed on the monitor. Push the AUTO HEAD button again to disengage. While engaged, the heading maintained can be temporarily overridden by operating the turn control on the joystick to beyond 10%. Returning the joystick control to less than 10% will return control to the Auto Head system and the original heading will be maintained. To permanently change the heading, disengage the Auto Head system, change the heading and then engage Auto Head system.

- **Light Controls** - Select LIGHTS switch to 'ON' to turn the lights on. Their intensity is controlled the 'LOW/HIGH' potentiometer switch. Clockwise = brighter, anticlockwise = dimmer.

- **Camera Switch** – Switch the CAMERA switch to position '1' or '2' to display the respective camera output on the monitor at the surface. To select the colour video camera, ensure the switch is in the '1' position. To select the monochrome navigator camera, ensure the switch is in the '2' position.

- **Manipulator Controls** - Pressing the 'OPEN' MANIP button will open the jaws of the manipulator. Releasing the MANIP button will maintain the current position of the jaws. Pressing the 'CLOSE MANIP button will close the jaws of the manipulator. Releasing the button will maintain the current position of the jaws.

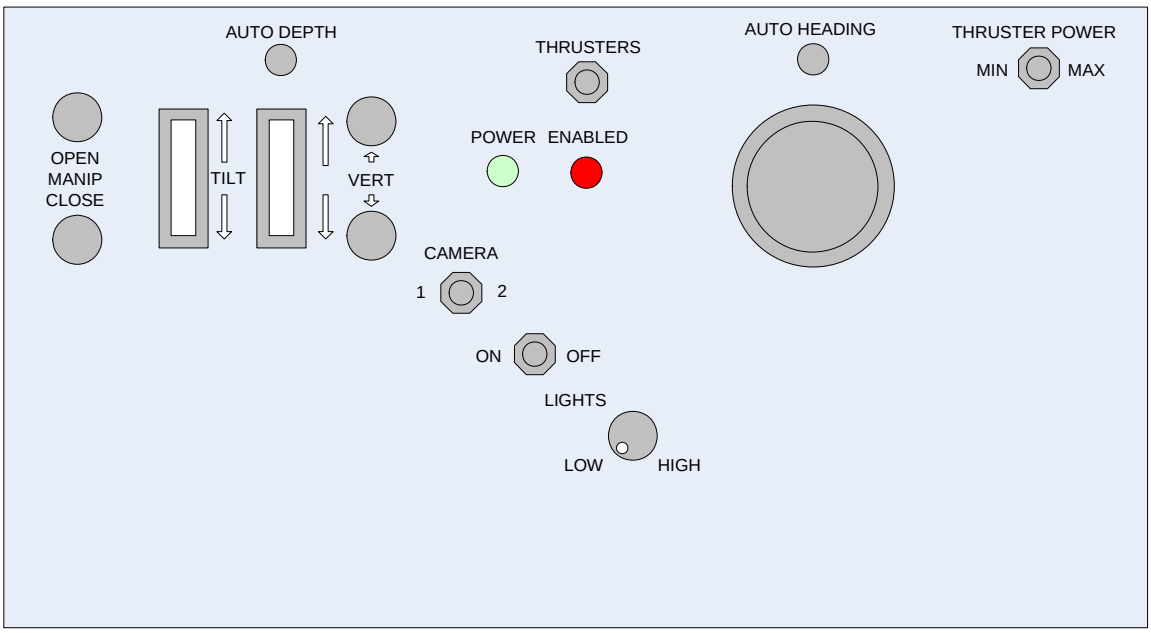

Fig. 2. SI-HCU Switch and Indicator Layout

CONTROL/INDICATOR	FUNCTION
JOYSTICK	Controls movement of the vehicle as follows: • Forward and reverse motion is achieved by pushing and pulling the joystick respectively. • Lateral movement is achieved by moving the joystick to port or starboard. • Rotating the joystick either clockwise or anticlockwise turns the vehicle to starboard or port respectively.
VERTICAL control	Rotating the control clockwise or anticlockwise causes the vehicle to ascend or descend respectively.
VERT UP/DOWN pushbuttons	Operating these controls provides maximum vertical thrust for ascending or descending in an emergency.
AUTO DEPTH push button switch	When operated, engages the depth autopilot and operates the vertical thrusters as required to keep the vehicle at current depth, the autopilot status is displayed on the system monitor. Operating the switch again disengages the autopilot. NOTE. Operating the UP and DOWN switches or rotating the VERT SET control beyond 10% overrides the autopilot until the control is less than 10%.
AUTO HEADING push button switch	When operated engages the heading autopilot and maintains the vehicle on current course, the autopilot status is displayed on the system monitor. Operating the switch again disengages the autopilot. NOTE: Rotating the control beyond 10% overrides the autopilot until it is returned to less than 10%.
LIGHTS potentiometer control	Rotating the control clockwise increases light intensity, and anticlockwise dims the lights until they switch off.
LIGHTS toggle switch	Selects the lights on or off.
CAMERA toggle switch	Selects the required camera for transmission from the ROV.
THRUSTER toggle switch	When set to ON enables the thruster motors. When set to OFF disables the thrusters from becoming operational. WARNING.  POSSIBLE DANGER TO PERSONNEL. THE THRUSTER ENABLE SWITCH IS NOT AN INTERLOCK. SETTING THE SWITCH TO THE OFF POSITION DOES NOT ISOLATE THE SUPPLY TO THE THRUSTER MOTORS.
THRUSTER MIN/MAX switch	When selected to MIN, operates the thrusters at the pre-defined setting speed (selected in the Configuration setup). When selected to MAX, operates the thrusters up to 100% speed.
SI-HCU LED indicator	Illuminates green when the SI-HCU supply is available.

Table 2. SI-HCU Controls and Indicators

2.4 Manipulator Hand Control Unit

The SI-HYDSCU01 is plugged into the Surface Control Unit. The SI-HYDSCU01 controls and indicators are described below.

- **POWER Indicator (Green)** – Hand Controller is running.
- **LINK Indicator (Orange)** – Communication has been established with Surface Unit.
- **POWER Switch** – Enables the pump.
- **JAW Joystick** – Controls the manipulator jaws.
- **ARM Joystick** – Controls the manipulator ARM section (see Fig. 4).
- **SLEW Joystick** – Controls the manipulator SLEW section (see Fig. 4).

Fig. 3. SI-HYDSCU01 Switch and Indicator Layout

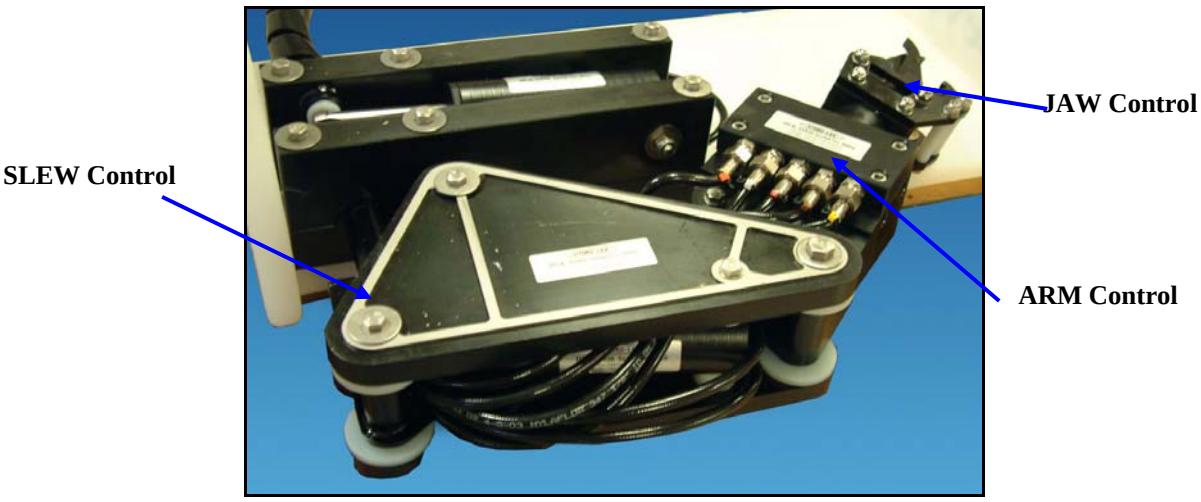

Fig. 4. Manipulator Controlled Parts

CONTROL/INDICATOR	FUNCTION
POWER Indicator	Indicates that the Hand Controller is running.
PUMP Switch	Switch to ON to enable the pump.
LINK Indicator	Indicates that communication has been established with the Surface Unit.
JAW Joystick	Controls the manipulator jaws as follows: • Joystick left rotates the manipulator jaws clockwise. • Joystick right rotates the manipulator jaws anticlockwise. • Joystick to CL closes the manipulator jaws. • Joystick to OP opens the manipulator jaws. NOTE: The manipulator jaws have a cutter incorporated. To use the jaws as a cutter, OPEN the jaws to cut.
ARM Joystick	Controls the movement of the Arm section of the manipulator as follows: • Joystick to U extends the arm outwards from the vehicle. • Joystick to A retracts the arm towards the vehicle.
SLEW Joystick	Controls the movement of the SLEW section of the manipulator as follows: • Joystick left rotates the slew section of the manipulator clockwise. • Joystick right rotates the slew section of the manipulator anticlockwise. • Joystick to L extends the slew section of the manipulator outwards from the vehicle to “lengthen” the arm. • Joystick to A retracts the slew section of the manipulator towards the vehicle to “shorten” the arm.

Table 3. SI-HYDSCU01 Controls and Indicators

The Zoom/Focus camera can also be controlled from the system keyboard. These controls can be used when the Auxiliary HCU SI-VIDHCU01 is disconnected from the SU so that the manipulator Hand Control Unit can be connected.

The keyboard zoom/focus control are:

Keypress	Action	Camera
UP ARROW	Zoom telescopically	1
DOWN ARROW	Zoom wide	1
LEFT ARROW	Focus near	1
RIGHT ARROW	Focus far	1
a	Auxiliary relay open	1
A	Auxiliary relay close	1
k	Camera control on	1
K	Camera control on	2
l (lower-case L)	Camera control off	1
L	Camera control off	2
y	Zoom telescopically	1
Y	Zoom telescopically	2
x	Zoom wide	1
X	Zoom wide	2
n	Focus near	1
N	Focus near	2
f	Focus far	1
F	Focus far	2
1	Toggle auto-focus	1
2	Toggle auto-focus	2

NOTE

The upper-case characters are created by either holding the shift key or selecting caps lock.

CHAPTER 3

ASSEMBLY AND INSTALLATION

Contents

Figures

Tables

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3. ASSEMBLY AND INSTALLATION

This Chapter instructions the operator/installer on how to assemble, install, configure and operate the system.

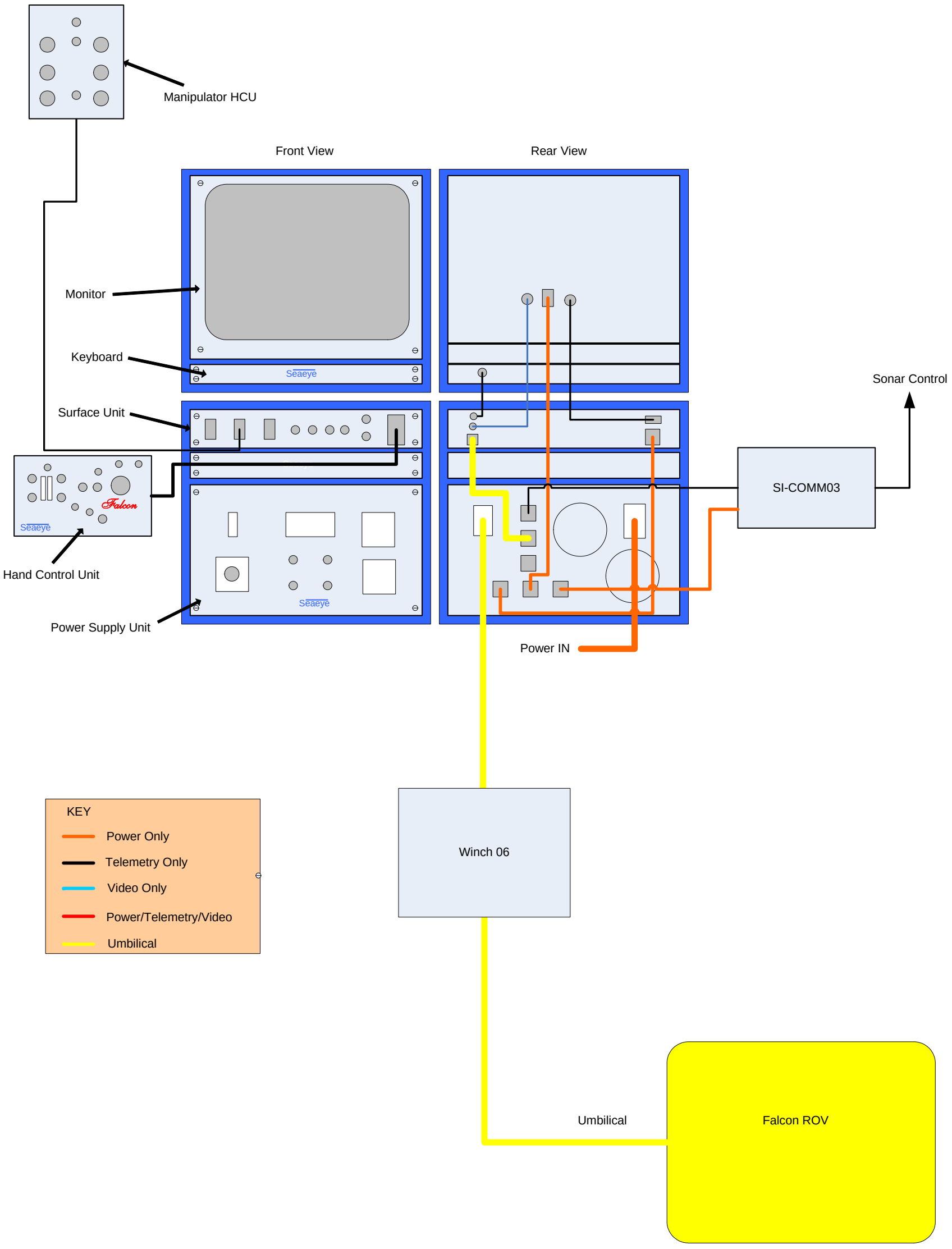

Fig. 1. Falcon Surface Equipment Layout with Twisted Pair Setup

Falcon DR System 1290

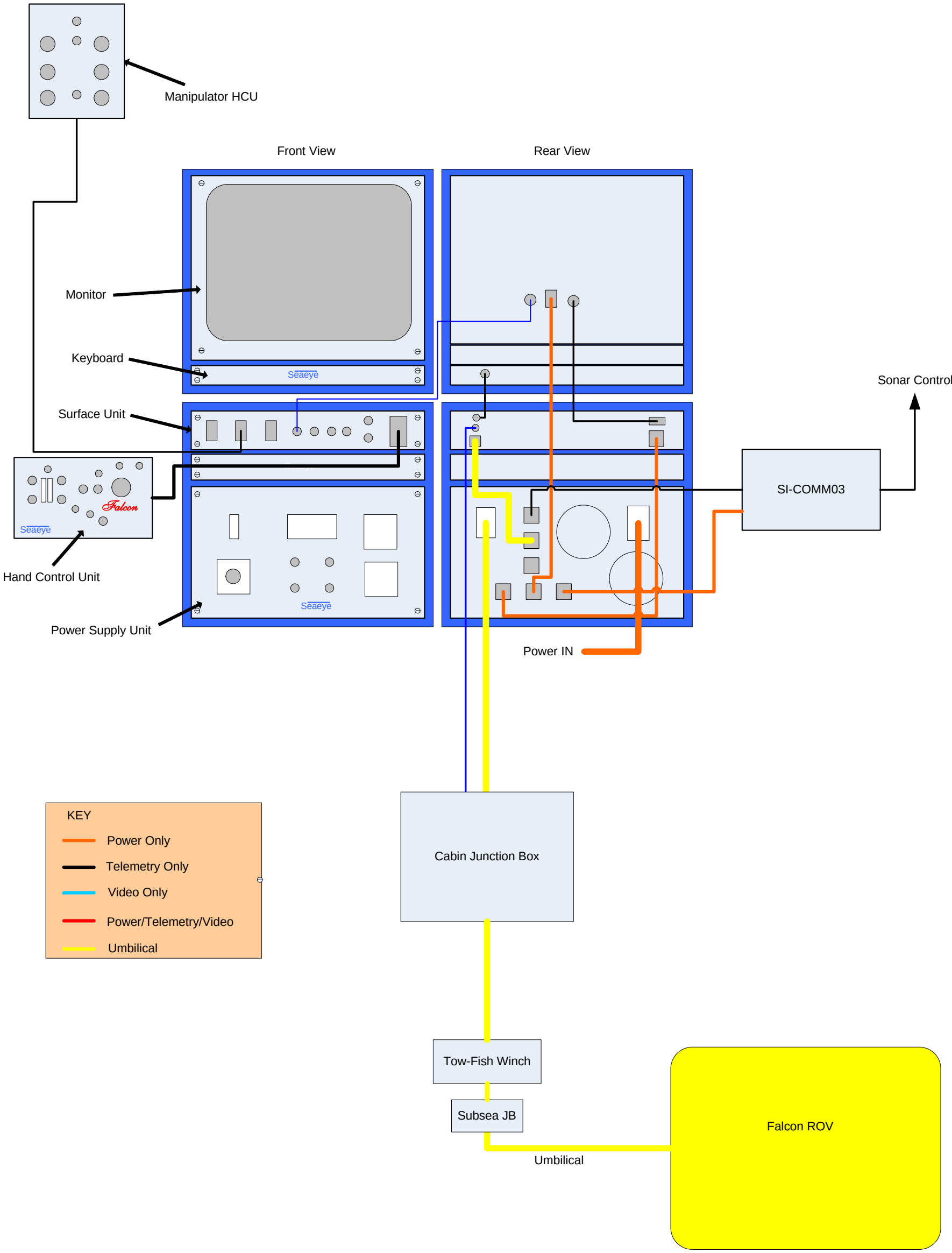

Fig. 2. Falcon Surface Equipment Layout with Fibre Optic Setup

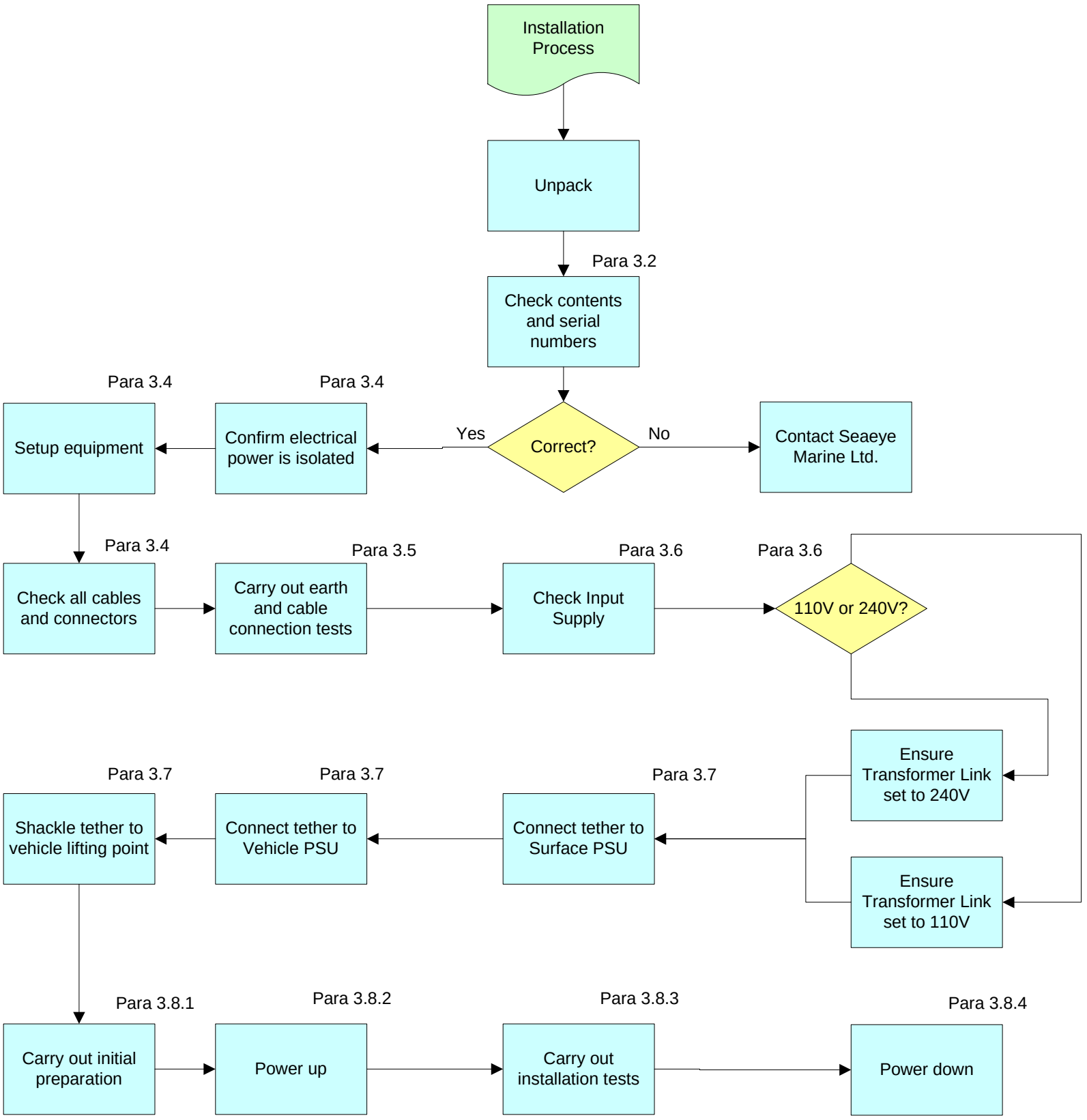

Fig. 3. Falcon Installation Process

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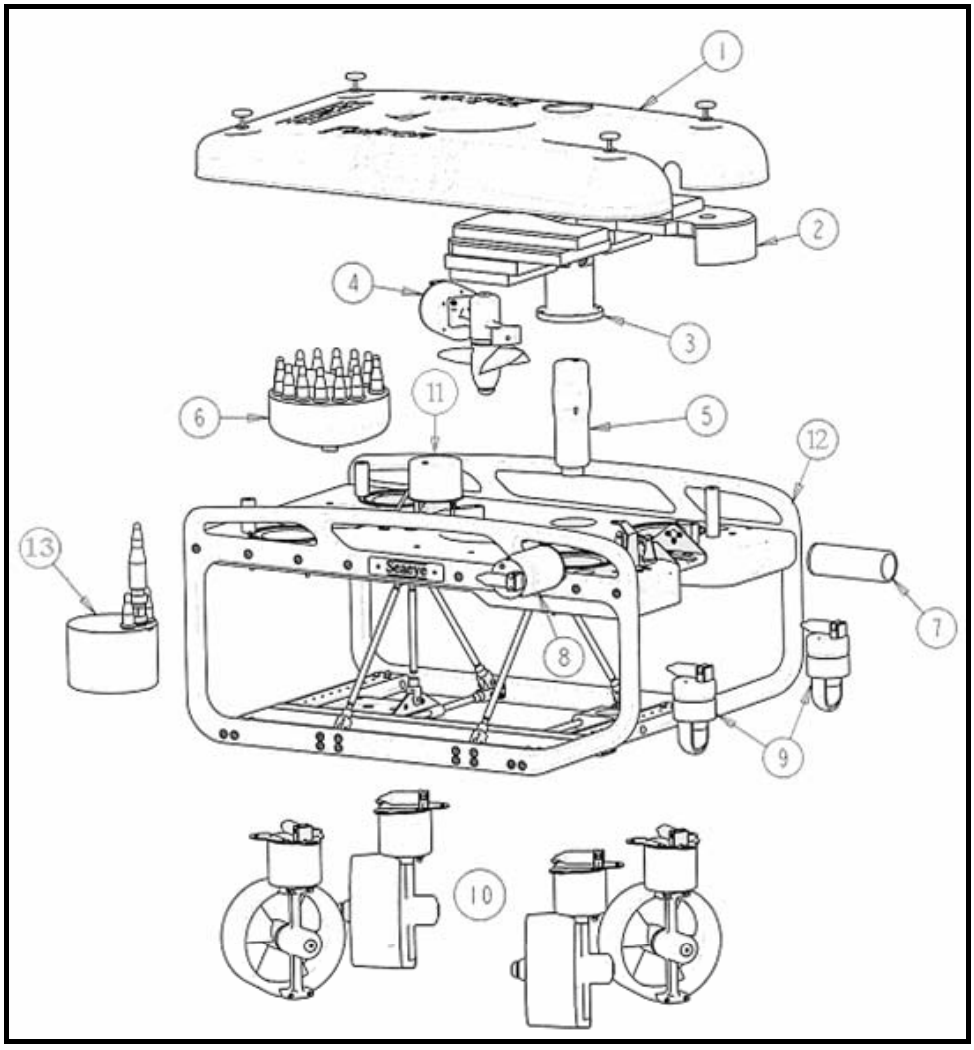

Fig. 4. Exploded View of Standard Vehicle

Ref	Description	Ref	Description
1	Fairing	2	Buoyancy Module
3	Sonar Guard	4	Vertical Thruster
5	Sonar	6	Junction Box
7	Camera	8	Tilt Unit
9	Lights	10	Horizontal Thrusters
11	Navigation Unit	12	Chassis
13	Vehicle Power Supply Unit		

Table 1. Reference for Exploded View

3.1 Introduction

This chapter details the instructions for receipt and installation of the ROV system. An overview of the installation process is shown in Fig. 2 flow chart. On completion of installation a series of tests must be carried out prior to the vehicles first operational dive. The installation tests ensure that the system is working correctly and makes the operator familiar with the configuration units and controls.

The system has been set up for the equipment supplied, however after repair or maintenance the system may require setting up, compensating or reconfiguring. The installation and installation tests are to be carried out whenever the system is relocated or the input supply changed.

Before and after the vehicle is dived, the Pre and Post Operational Checks are to be carried out and are considered **MANDATORY.** The Pre Operational checks ensure that before diving the vehicle is ready in all respects to dive. The Post Operational Checks are designed to detect any defects or damage that may have been incurred during operational use, allowing the operator to rectify them ensuring the vehicle can be stored operational and ready for its next dive.

3.2 Receipt

Unpack the system in a dry clean environment and check the contents and serial numbers against the delivery note. Should there be any discrepancy contact SEAEYE MARINE LTD immediately.

Prior to dispatch a stringent Quality Control Inspection is carried out. A copy is contained with the vehicles record document, however it is recommended that the contents be examined for any damage that may have occurred during transit. Refer to the Warranty information contained in the preliminary pages of this publication.

It is recommended that all packaging and packing cases be retained for subsequent storage, transportation or return-to-works.

3.3 Adverse Effects of Extreme Climactic Conditions

Seaeye Marine Ltd. Technical Department advises that extremes of temperature and climate can adversely affect the performance of all systems in the Seaeye Fleets. In some cases, extreme climatic conditions can cause irreparable damage to sensitive electronic components.

At particular risk is the equipment housed in black anodised enclosures, which if left exposed to direct sunlight (especially in equatorial latitudes and the tropics) may experience destructive temperatures.

Operators should also be aware of the risk of condensation when moving equipment from cold areas into warmer locations.

Operators are therefore advised to provide adequate protection against extremes of climate. When equipment is to be left exposed to direct sunlight, shade is to be provided (by means of tarpaulin covers or shelters, for example) and consideration should be given to frequent temperature monitoring and the provision of artificial cooling if necessary. In freezing conditions, subsea equipment is to be protected from prolonged exposure and if possible stowed "indoors" to prevent excessive "icing".

CAUTION

Irreparable damage can occur to equipment exposed to extremes of climate. Do not expose to direct sunlight for prolonged periods. Do not expose to freezing conditions for prolonged periods. If equipment is to be stowed exposed to the elements, always provide adequate covering/shelter/shade.

3.4 Installation

Prior to system connection a series of tests are required to ensure the input supply is correctly earthed and the AC input voltages are correct for system operation.

CAUTION

Danger of damage to equipment. If installing in extreme heat conditions, remove the vent plugs from the electronics pods, nodes and cameras to prevent excessive pressure build up when the system is not in use.

The equipment is to be set up in the area where the system is to be operated, in a dry and clean environment.

- Position the all surface units and monitors on a stable, clean and dry platform.
- Check all leads and cables for damage and bent pins.
- Confirm the external electrical supply to be used with the system is disconnected and isolated.

Connect the following cables and leads to their respective units taking care not to damage their pins (see Fig. 1 or Fig. 2). (The system can be setup for Twisted Pair or Fibre Optic video transmission. However, the correct umbilical must be fitted and the correct system units also fitted. Refer to Chapter 6 for setting up the Twisted Pair and Fibre Optic options).

- All equipment power cables.
- Keyboard.
- Hand Control Unit lead and Manipulator Hand Control Unit lead.
- All system video equipment, computers and monitors, power and video leads.

- All other equipment communication leads and power leads that are used with the system.
- Visually examine the vehicle to ensure all equipment is secure and undamaged.
- Visually examine vehicle lamps, and ensure lamp covers are undamaged.

3.5 Earth and Cable Connection Tests

Ensure the external supply is isolated, using a continuity meter check the continuity resistance between the ships structure and the input supply earth. The resistance must be less than 0.05 ohms.

In cases where the tether has not been supplied or terminated by SEAEYE MARINE Ltd. it is advised that the cables are checked against the drawings for insulation and continuity to ensure correct termination. When carrying out insulation tests, the cables are to be disconnected at both ends to prevent damage to system electronics. It is recommended that the insulation and continuity resistance readings be recorded for future comparison to identify any progressive deterioration of the cables.

3.6 Voltage Check

With the input supply disconnected but available and taking precautions against electric shock, measure and take note of the input supply voltage.

NOTE: Unless otherwise stated the transformer tapings are factory set to match a single-phase supply voltage of 110 VAC. To change see figures below.

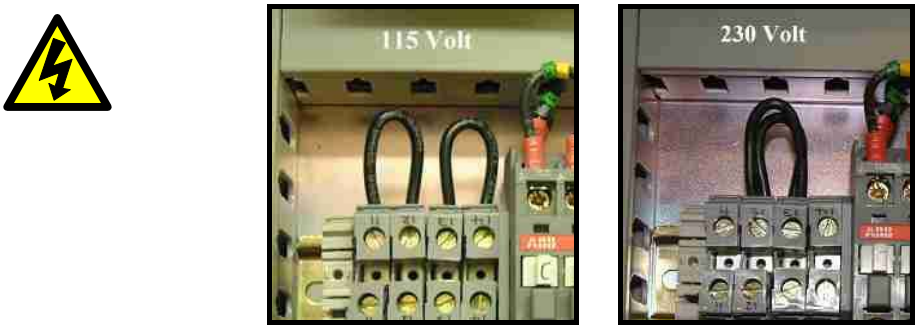

Fig. 5. Transformer Tapings

3.7 Tether Connection

Connect the surface end of the tether to the Surface Power Supply Unit. Thread the subsea end of the tether through the entry hole in the fairing (Fig 6). Remove the blanking cap from the connector and pass the connector through the access hole just in front of the Junction Box (see Fig 7).

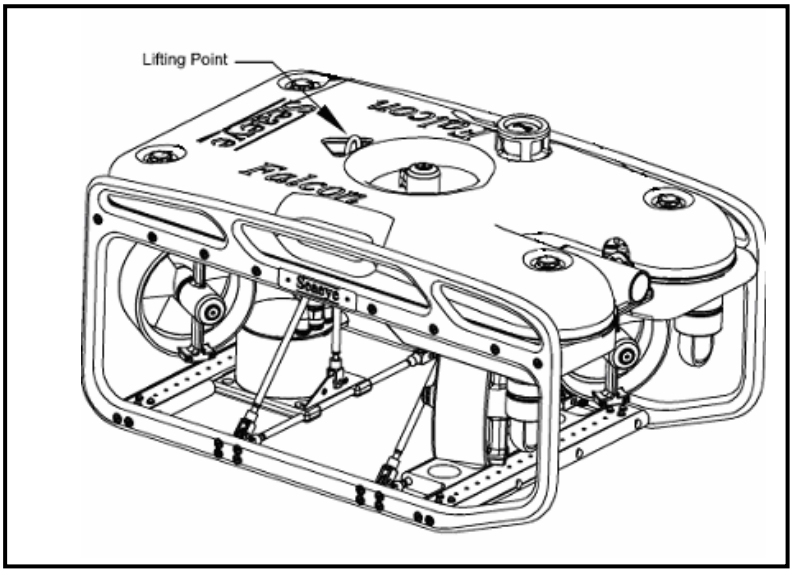

Fig. 6. Tether Entry Hole and Vehicle Lifting Point

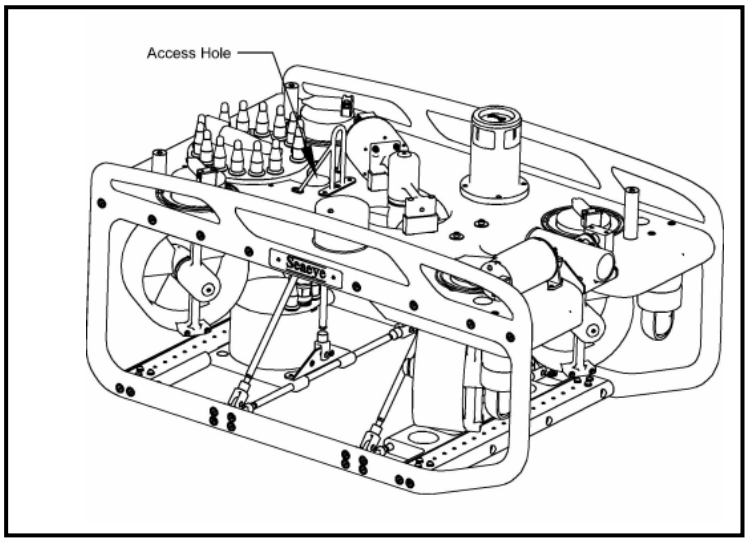

Fig. 7. Location of the Access Hole (Top Fairing removed for clarity)

Remove the blanking cap from the Vehicle Power Supply Unit and connect the tether.

Screw the two blanking caps together and retain. Always refit the blanking caps when the tether is disconnected from the vehicle.

Shackle the kellams grip to the ROV Lifting Point. The shackle should be secured using locking wire for additional security.

Fig. 8. Umbilical

Pre-stretch the kellams grip over the umbilical, ensuring a slight slack in the cable between the grip and the ROV as shown in Fig. 8, such that the load is taken by the kellams grip and not the cable.

3.8 Installation Tests

3.8.1 Initial Preparation

Before connecting to the external supply, set the switch and controls as follows:

PSU:

- Input Breaker — Set to OFF
- Vehicle On/Off — Set to OFF
- Input Trip — Set to UP

HCU:

- TILT control — Centre position
- VERTICAL control — Centre position
- THRUSTER ENABLE — Set to OFF
- THRUSTER POWER — Set to MAX
- LIGHTS control — Fully anticlockwise
- LIGHTS Switch — Set to OFF
- CAMERA switch — Set to CAM 1

❑ Joystick	Operate in all axes and ensure joystick returns to the centre position on release

Manipulator HCU:

❑ POWER	Set to OFF
❑ JAW control	Mid position
❑ ARM ROTATE control	Mid position
❑ SLEW control	Mid position

3.8.2 Powering Up

Connect and switch on the external power supply. Set the PSU control switches as follows:

PSU:

❑ Power Input Breaker	Operate to ON
❑ Vehicle Power Switch	Operate to ON
❑ System Video Monitor	Confirm operational and showing Video Overlay

3.8.3 Installation System Tests

NOTE: The system is supplied fully configured, however, if any equipment is subsequently changed, it is necessary to carry out a system configuration.

1. Confirm the system monitor displays video overlay and that the SI-HCU Power indicator on the SI-HCU is illuminated.

2. Remove the vehicle camera lens cap(s).

NOTE: Confirm the SI-HCU camera switch is switched to the required camera.

3. Confirm the system monitor displays images received from the camera with video overlay.

4. Select each camera in turn and operate in accordance with the manufacturers' handbook to check image display. Ensure that the respective image is displayed on the associated monitor. (Selection is via the SI-HCU Camera 1/2 Switch). Check camera zoom/focus operations for fitted zoom/focus cameras using the Auxiliary Hand Control Unit.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT. THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE VEHICLE IS CLEAR OF ANY OBSTRUCTION AND PERSONNEL PRIOR TO ENERGISING THE DC SUPPLY.

CAUTIONS

1. **Possible damage to Thruster motor: Thrusters must not be operated for longer than one minute in air, damage to the water lubricated bearing may occur.**

2. **Possible damage to lamps: Vehicle lamps must not be operated for longer than 10 seconds in air.**

5. Set the following unit switch and control settings on the SI-HCU:

HCU:

❑ TILT control	Operate over full range and confirm vehicle tilt platform operates through its full range and its movement is unobstructed.

NOTE

The Tilt Platform movement needs to be configured for the operational setup as follows:

When the ROV is used WITH the supplied Tooling Skid, with NO camera mounted onto the second platform and the second platform interconnecting mechanical link disconnected and stowed, the movement may be configured for maximum 90° movement up and down.

When the ROV is used WITHOUT the supplied Tooling Skid, with NO camera mounted onto the second platform and the second platform interconnecting mechanical link disconnected and stowed, the movement should be configured for maximum 90° movement up and down.

When the ROV is used WITHOUT the supplied Tooling Skid, and a camera is mounted onto the second platform and the second platform interconnecting mechanical link connected, the movement should be configured for maximum 40° movement up and down.

To configure the Tilt Platform, refer to the configuration menu description detailed in Chapter 4.

❑ THRUSTER ENABLE switch	Set to ON.
❑ VERTICAL Control	Operate over full range and confirm that the vertical thruster responds.
❑ JOYSTICK	Operate in all axes and confirm thrusters respond to joystick demand.
❑ THRUSTER POWER switch	Set to MIN
❑ VERTICAL Control	Operate over full range and confirm that the vertical thruster responds at the reduced power setting (MIN set in the software configuration setup).
❑ JOYSTICK	Operate in all axes and confirm thrusters respond to joystick demand at the reduced power setting (MIN set in the software configuration setup).
❑ LIGHT Control/Switch	Operate switch to ON position and confirm that the lights respond to the LIGHTS control.
❑ THRUSTER POWER switch	Set to MAX
❑ THRUSTER ENABLE switch	Set to OFF.

6. The following tests require the vehicle to be suspended. Care must be taken when swinging the vehicle to prevent damage from surrounding structures.

7. Slowly rotate the suspended vehicle and confirm that the compass' digital display responds to vehicle movement.

8. Confirm depth and CP (if fitted) indication is displayed as overlay on the system monitor.

9. Set the following unit switch and control settings on the SI-HCU:

HCU:

WARNING

TAKE EXTREME CARE TO AVOID CONTACT WITH THE THRUSTER MOTORS

❑ THRUSTER ENABLE switch	Set to ON.

❑ AUTO HEADING switch	Operate and confirm key symbol is displayed next to the heading on the overlay on the system monitor.
❑ Vehicle	Rotate the vehicle and ensure the thrusters oppose rotation.
❑ AUTO HEADING switch	Operate the switch again and confirm the key symbol is no longer displayed.
❑ AUTO DEPTH switch	Operate and confirm key symbol is displayed next to the depth on the overlay on the system monitor.
❑ Vehicle	Observe that after a short period of time the vertical thruster will begin to operate.
❑ AUTO DEPTH switch	Operate the switch again and confirm the key symbol is no longer displayed.

10. With the vehicle suspended, sharply rotate the vehicle, by a few degrees only, to confirm that the gyro responds by momentarily ‘driving’ the thrusters to test heading compensation.

❑ THRUSTER ENABLE switch	Set to OFF.

11. Lower the vehicle.

If a single function manipulator is fitted:

12. To test the operation of the single function manipulator, operate the following push button switches of the SI-HCU.

HCU:

❑ OPEN Push Button Switch	Press and confirm that the jaws open.

NOTE

If the jaws are stiff this may take a number of presses.

❑ CLOSE Push Button Switch	Press and confirm that the jaws close.

5-Function Manipulator HCU:

❑ PUMP Switch	Select to ON position.

NOTE

Although the PUMP switch has been selected ON, the pump will only operate when a manipulator function is selected.

❑ JAW Joystick	Operate to rotate the jaws clockwise and anticlockwise.
❑ JAW Joystick	Operate to OPEN and CLOSE the jaws.
❑ ARM Joystick	Operate to move the elbow forward and aft.
❑ SLEW Joystick	Operate to rotate the manipulator clockwise and anticlockwise.
❑ SLEW Joystick	Operate to move the manipulator outwards and inwards.

3.8.4 Powering Down

Set the following unit switch and control settings:

5-Function Manipulator HCU:

❑ POWER	Set to OFF
❑ JAW control	Mid position
❑ ARM ROTATE control	Mid position
❑ SLEW control	Mid position

HCU:

❑ TILT control	Centre position
❑ VERTICAL control	Centre position
❑ THRUSTER ENABLE	Set to OFF
❑ THRUSTER POWER	Set to MAX
❑ LIGHTS control	Fully anticlockwise
❑ LIGHTS Switch	Set to OFF
❑ CAMERA switch	Set to CAM 1

PSU:

- Vehicle On/Off — Set to OFF
- Input Breaker — Set to OFF

Switch off and isolate the external power supply and replace the vehicle lens cap(s).

3.9 System Set Up, Compensation and Configuration

The system has been factory set for the equipment supplied, however when certain equipment is replaced or modified the system may require setting up, compensating or re-configuring. Full instructions on how and when to carry out the various procedures are given in the chapters covering maintenance. The following maintenance tasks may be required to be done depending on the equipment supplied:

- Power Supply Unit compensation (Chapter 6).
- Video compensation (Chapter 6).
- System Configuration (Chapters 4 & 6).

3.10 Ballast and Trim

CAUTIONS

1. Possible damage to equipment. Ensure that all vent plugs are fitted securely and shut prior to immersing the vehicle in water. See Pre-Dive Checks (Chapter 6, Task 1) for location of vent plugs.

2. Possible poor ROV handling. Incorrect trim will cause poor ROV handling and performance.

The vehicle is factory trimmed in fresh water and requires additional ballast for seawater use. The vehicle is given an even trim with slight positive buoyancy such that the yellow fairing is just visible above the surface of the water.

The lead ingots provided are to be secured to the vehicle chassis to give the vehicle a trim and ballast depending on operator requirement.

Any additional equipment fitted or removed must be compensated for and the vehicle trimmed to the new weights.

3.11 First Dive

On completion of this chapter the vehicle is ready to be operated. It is advised however, that the operator should familiarise himself with the rest of this manual paying particular attention to the Pre and Post dive checklists detailed in the maintenance chapter of the manual. Fig. 9 provides an overview of the operational dive process when launching, operating and recovering a vehicle.

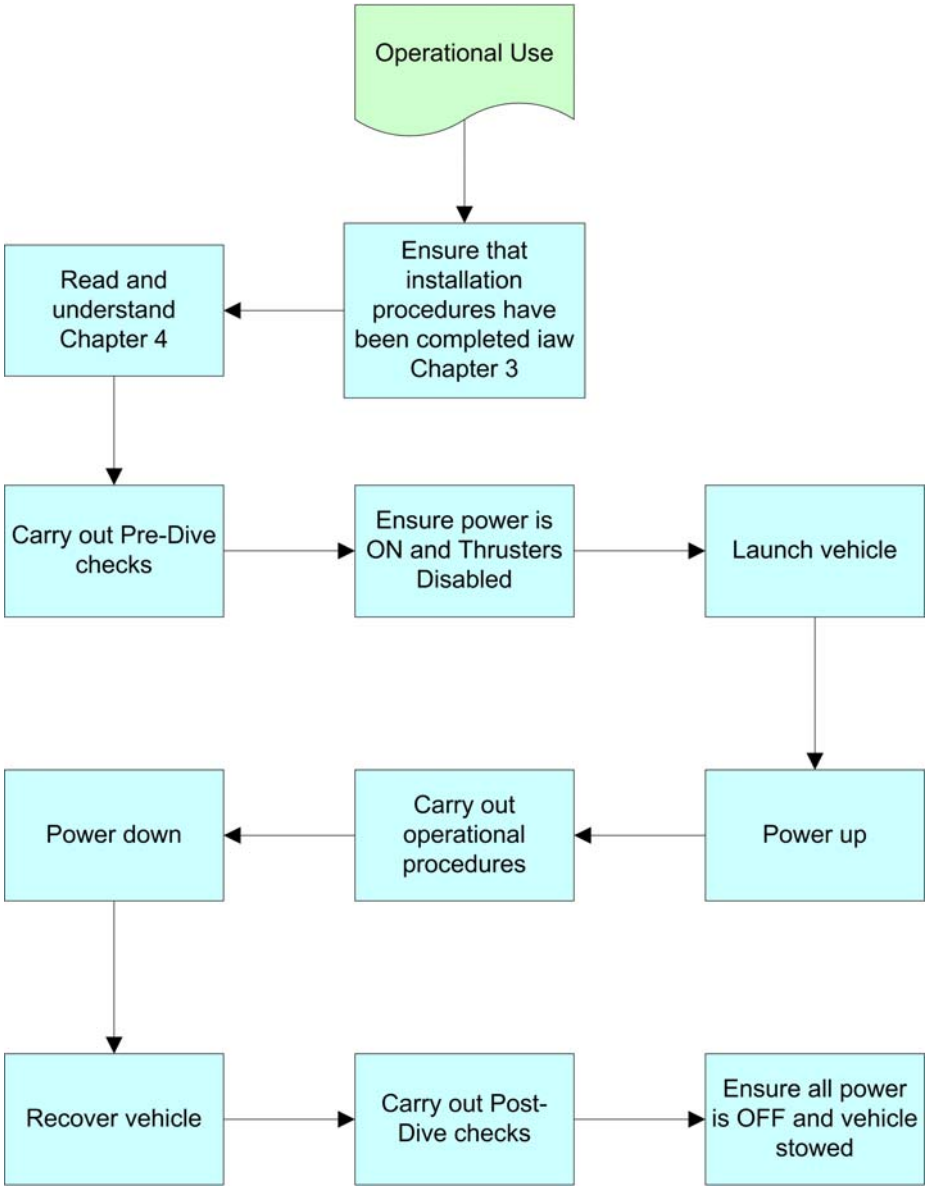

Fig. 9. Falcon Operational Dive Process

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CHAPTER 4

OPERATIONAL USE

Contents

Figures

Tables

4. OPERATIONAL USE

This Chapter provides basic information on the operation of the Seaeye Falcon DR System Serial Number 1290.

4.1 Introduction

The Falcon System uses a distributed control system, which allows components to be added and removed with minimal effort. A proprietary protocol is used over an RS485 multi-drop network, implemented with a master node in the surface unit and many slave nodes. Each node is connected to the network with five connections, 2 power, 2 telemetry and earth. Within each node a micro controller communicates with the master node over the network and that interfaces to the application, interrogating or operating the device.

The master node interrogates the user input devices (joystick, potentiometers and switches etc), processes the data from them and transmits relevant information to each node. The master node initiates all communication sequences with the slave nodes instructing nodes such as thrusters, lights, tilt and interrogating nodes such as compass, depth and gyro sensors. The data received back from the nodes is processed, formatted and displayed on the overlay screen. This sequence of events allows the operator to control the vehicle whilst monitoring data from the various sensors. Additionally the data gathered from the Navigation node is used in the operation of Auto Head and Auto Depth.

The overlay is controlled with a node but this is on a separate network located locally to the processor board, this should allow video and messages to inform the operator even in the event of a subsea (Umbilical, Tether or Vehicle) failure.

An optional VGA monitor may be connected at the rear of the Surface Control Unit to display additional diagnostic information during normal operation and facilitate the use of some of the more advanced features of the system. The vehicle is fully operational without the VGA monitor however.

4.2 Surface Control Unit

The Surface Control Unit (SCU) consists of a PC in a PC104 format PCB. An additional IO card is used to read in analogue and digital signals from the hand controller. A third PCB (6100P Video Overlay PCB) in conjunction with the processor PCB is used to provide CMOS battery backup*, speaker, video overlay insertion and interconnection between the PC104 "stack" and the SCU front and rear panel connectors. A compact draw mounted PC keyboard, connected to the rear of the SCU, provides access to additional functions and to more advanced features of the system.

Like all PCs, the PC104 stack has a BIOS* (Built In Operating System or Basic Input/Output System). The BIOS settings in the PC are factory set but if the 50-way cable from the 6100P Video Overlay PCB is disconnected from the processor board, the settings will be lost.

* TB486 CPU only

To restore the required settings a VGA monitor must be connected to the SCU. On power up the **F2** key should be held down, this enables access to the BIOS settings. There are a considerable number of entries in the BIOS settings, anyone of which, if incorrectly set, may cause incorrect operation of the system. It is beyond the scope of this manual to describe each setting (contact SEAEYE MARINES Ltd. if you require information). However the following should be set in order to allow the system to operate normally.

Under the section “Main” the “Diskette A” option should be set as below:

```
Diskette A    [Not Installed]
```

Under “Boot Options” Page of “Main”, disable all settings for improved boot up time and set “Boot Sequence” as shown below:

```
Boot Sequence [C: Only]
```

Finally go to the Exit page and select 'Save Changes and Exit'.

4.3 Program Operation

The surface processor operating system is DOS based which automatically executes a program called **`master.`** Once initialised, the user is presented with the video display and overlaid text.

4.3.1 Overlay

The Video Overlay Display will normally show any combination of 10 readouts. These appear at the top of the video display. The entries at the top of the screen are: -

```
[Heading]  [Pitch]  [Depth]                [Date]
[Turns Count]  [Roll]  [Tilt] [CP/Odometer]  [Time]
```

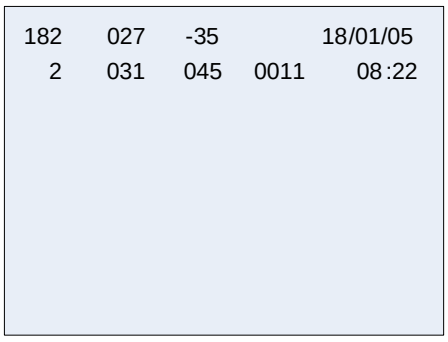


Fig. 1. Sample Video Overlay Display

NOTE

The VGA screen displays this along with other information permanently.

Each of the 8 entries may be switched on and off individually or globally turned on and off via the system keyboard.

Key	Item Affected
O	Toggles all entries
D	Toggles Depth
E	Toggles Tilt
I	Toggles Pitch
R	Toggles Roll
H	Toggles Heading
M	Toggles Odometer
P	Toggles CP
Q	Toggles Date
T	Toggles Turns Count
W	Toggles Time

Table 1. Overlay Keyboard Functions

The overlay entries may also be turned on and off from within the menu and the settings are preserved even when the power has been cycled.

There should be no communication between the SCU and the vehicle and the following message will appear on the lower section of the display:

```
Vehicle Comms lost
```

This is normal until the vehicle is switched on. Once power is applied to the vehicle and telemetry has been established, this message will disappear.

The “Vehicle Comms Lost” message appears when five attempts to communicate with the vehicle are made and none of the nodes reply, this would indicate Vehicle power is off or a major fault has occurred.

4.3.2 Commands

Other than the standard controls on the HCU, additional commands are available from the keyboard.

Z	Zeros Depth
U	Resets Turns Count
K	Resets Odometer
Page Up *	Tooling Thruster Demand + 10%
Page Down *	Tooling Thruster Demand - 10%
Space Bar *	Tooling Thruster Stop Demand 0%

Table 2. Keyboard Commands

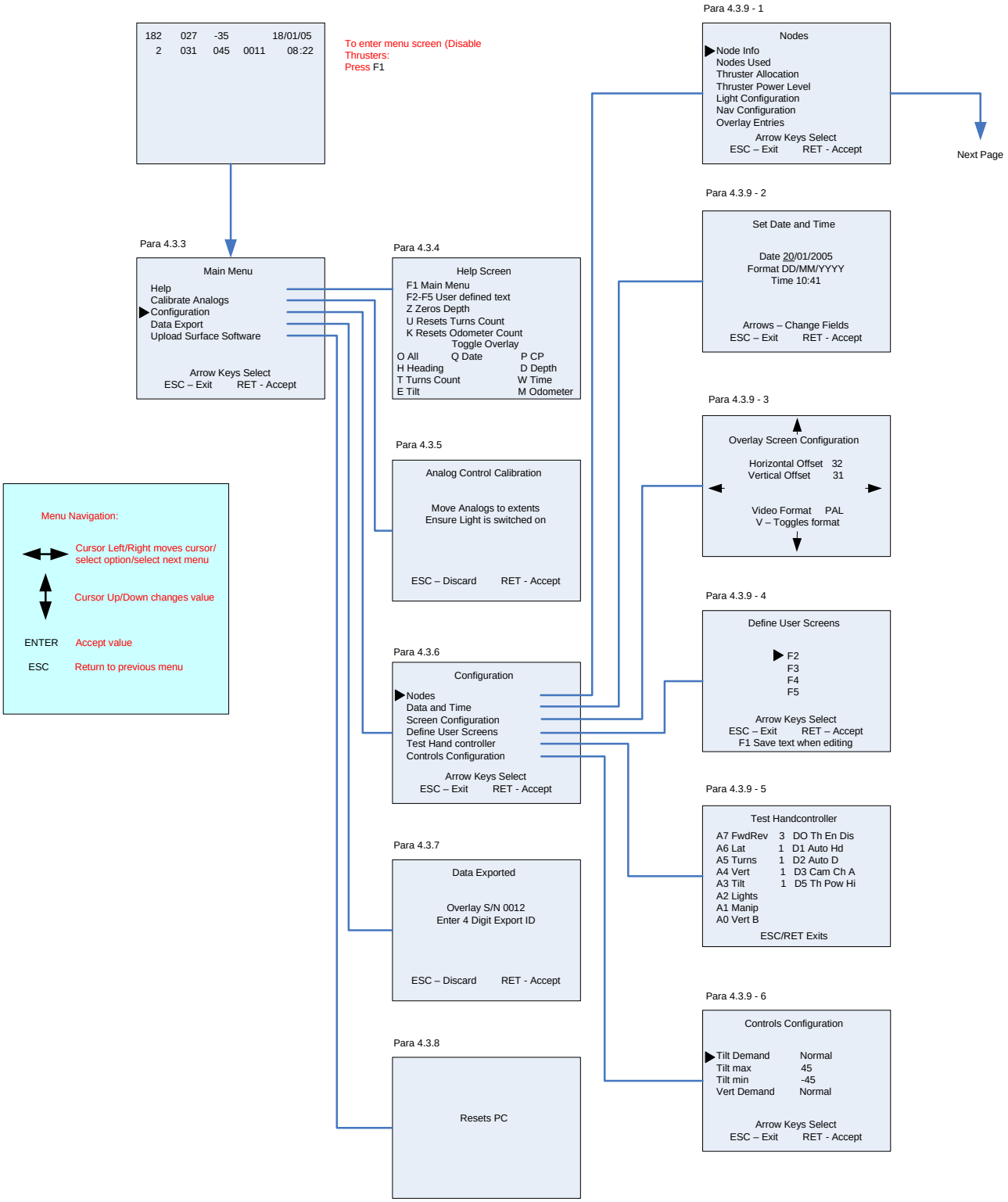


Fig. 2. Menu Navigation – 1 of 2

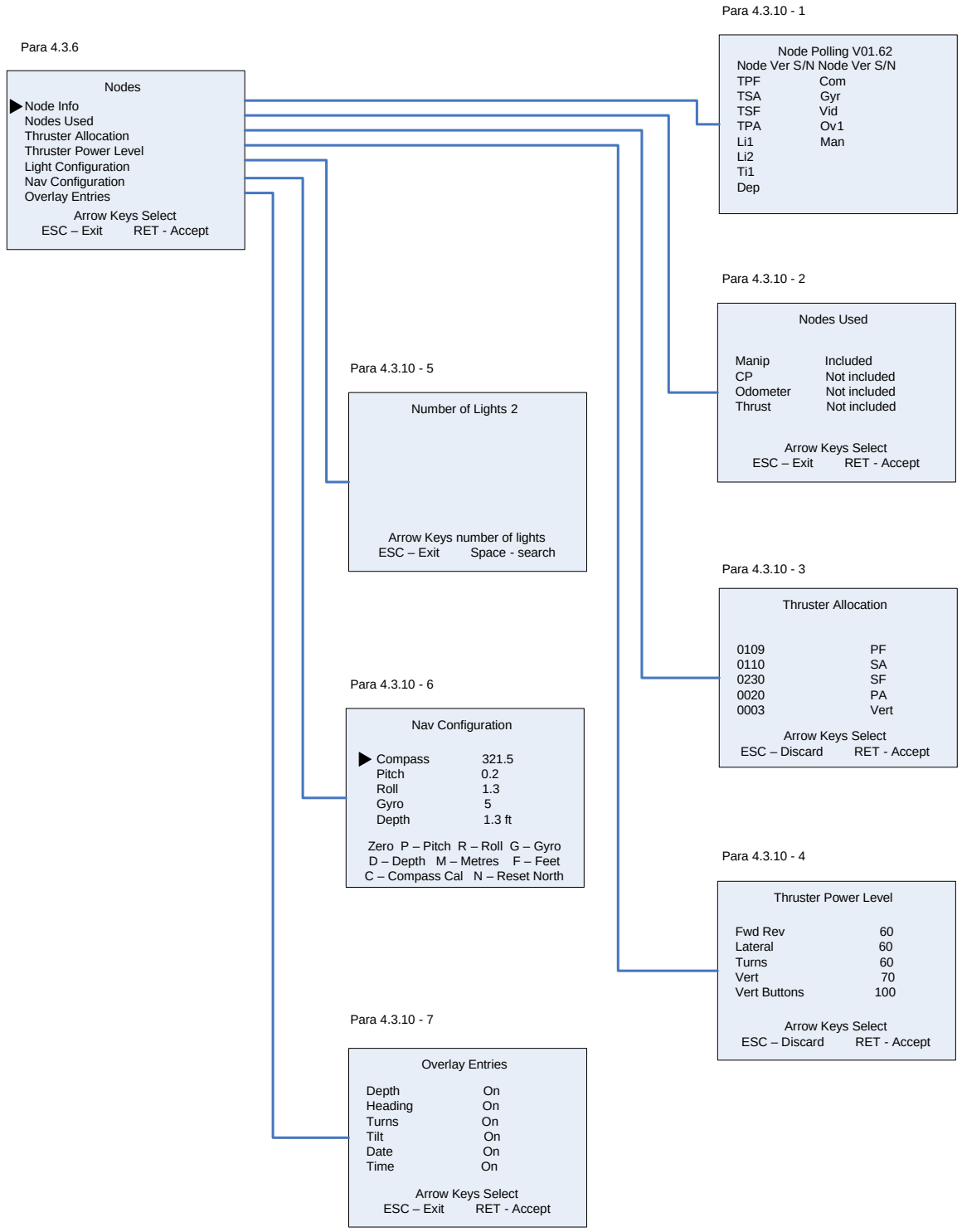
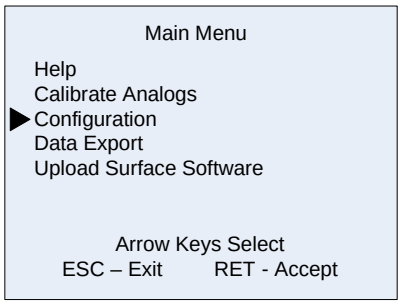


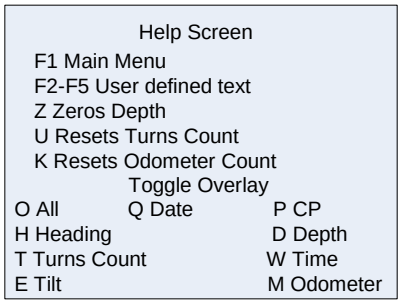
Fig. 3. Menu Navigation – 2 of 2

4.3.3 Main Menu



The main menu may ONLY be activated when the thrusters are DISABLED and will activate by pressing **F1**. The monitor will replace the 'overlay' text with the 'main menu' text. Also, the 'main menu' will appear as a pop up box within the 'master' diagnostics program, displayed on the VGA monitor (if fitted). Use the keyboard *'cursor'* keys to navigate the menus and press the *'enter'* key to select the required entry. To exit out of the menu and return to normal operation press the *'Esc'* key. For menu navigation, refer to Figs 2 and 3.

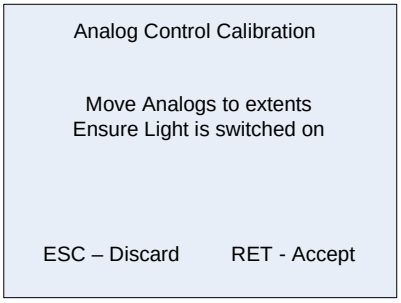
4.3.4 Help



This shows the basic keystroke functions operated from the keyboard. No operations are performed from within this screen.

For example, pressing the **D** key on the keyboard when the overlay text is displayed will remove the depth display option from the overlay screen text. Pressing the **D** key again will display the depth option again.

4.3.5 Calibrate Analogues



This routine calibrates the variable controls on the HCU:

- Joystick.
- Vertical control.
- Tilt control.
- Lights control.

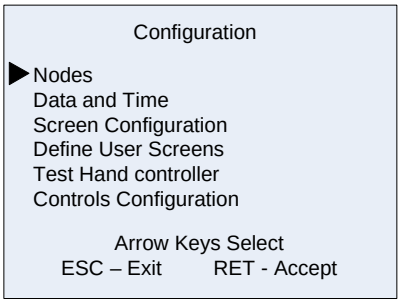
To calibrate the analogues proceed as follows:

1. Gain access to the 'Analog Control Calibration' menu screen.
2. Select the Lights switch to ON (the lights will not illuminate whilst in the menu mode).
3. Move the Joystick, Vertical control, Tilt control and Lights control to their maximum and minimum extents.
4. Press the RETURN key to accept the settings. The next analog menu is displayed.
5. Return each control to its mid (centre) position.
6. Press the RETURN key to accept the settings.

7. Select the Lights switch to OFF.

8. Exit the ‘Analog Control Calibration’ menu by pressing the ESC key.

4.3.6 Configuration

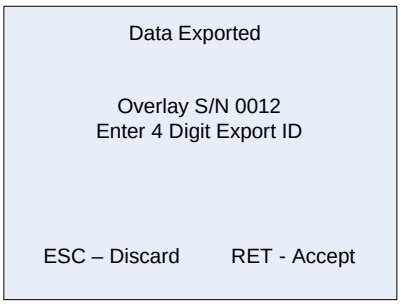


Selects the configuration sub menus described in Chapter 4.3.9.

The sub-menus consist of:

- Nodes.
- Date and Time.
- Screen Configuration.
- Define User Screens.
- Test Hand Controller.
- Controls Configuration.

4.3.7 Data Export (Optional)



Allows depth, heading, tilt, pitch & roll and CP data to be exported to external devices. **A four digit ID is required to activate this option and is supplied by SEAEYE MARINE Ltd**. if this option is purchased. ID entry and configuration are performed under:

`Main Menu > Data Export`

On entering the 'Data Export' screen, parts of the data export can be turned on or off. Aux 'Com A' communication port is used for uploading software and exporting data. Data conforms to NMEA 01.83 using the following settings:

Baud 4800 8 bits No parity one stop bit 1Hz.

1. Depth

"$DBS,XXXX.X,u,CRLF"	DBS	Depth Below Surface
	XXXX.X	depth value (zero filled)
	u	units f = feet, M = metres
	CR	carriage return
	LF	line feed

1. Heading

"$HCC,XXX.XCRLF"	HCC	Heading Compass
	XXX.X	heading value 0 to 359 degrees
	CR	carriage return
	LF	line feed

1. CP

"$PCICP,XXXX,mCRLF"	PCP	Proprietary Seaeye
	XXXX	CP value (zero filled)
	m	units milliVolts
	CR	carriage return
	LF	line feed

Tilt

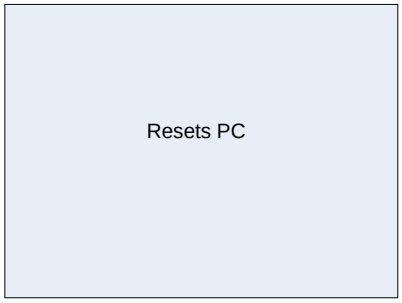
"$PCIT,XXX,CRLF"	PCI	Proprietary Seaeye
	T	Tilt
	xxx	Tilt angle in degrees
	CR	carriage return
	LF	line feed

Pitch & Roll

"$PCIPR,XXX,YYY,CRLF"	PCI	Proprietary Seaeye
	PR	Pitch & Roll
	xxx	Pitch angle in degrees
	yyy	Roll angle in degrees
	CR	carriage return
	LF	line feed

The up and down cursor keys are used to select the data to be exported and the left and right cursor keys are used to turn the entry export on and off. All entries can be turned off.

4.3.8 Upload Surface Software



1. With the vehicle on deck, set the Surface Unit main breaker to ON, but leave the vehicle power set to OFF.

2. At the rear of the SCU, connect the serial port **COM A** to an IBM compatible PC serial port using the Null/Modem Cable (Part no. CS00179 provided with the system) using the 9 pin D-Type connector.

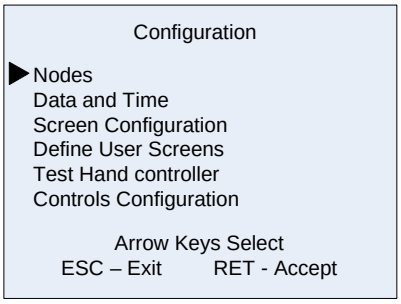
3. On the PC, insert the 3 ½" floppy disc and access the attached file; "send_master.bat". Double click or press enter and the status should read, "Waiting for receiver…"

4. Data transmission from the PC should begin.

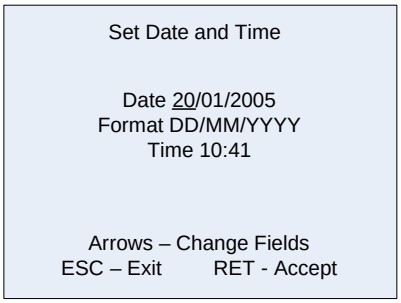
5. On the SCU press F1 on the keyboard to display the "Main Menu" options screen. Scroll down using the "↓" key to "Upload Surface Software". Press enter.

6. Once the upload is complete, the SCU will reboot to the new version of master software and default to the operator overlay screen.

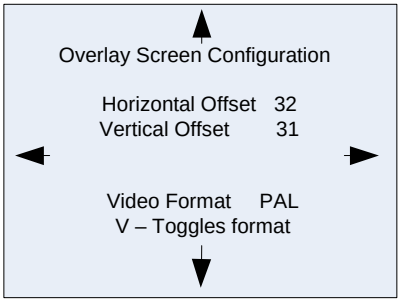
4.3.9 Configuration Menu



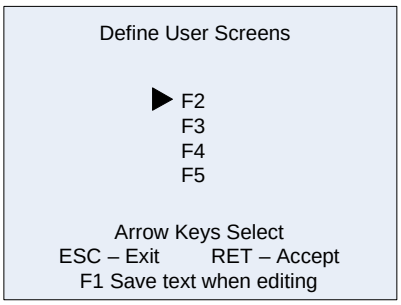
1. **Nodes:** Selects the nodes sub menu (see para 4.3.10).



2. **Date and Time:** This screen allows the user to set the time and date. The date and time entries are selected using the left and right cursor keys and changed with the up or down cursor keys. To discard these settings press the 'Esc' key and to accept these setting press the 'Enter' key. Accepting the settings sets the real time clock of the PC, which is preserved by battery.

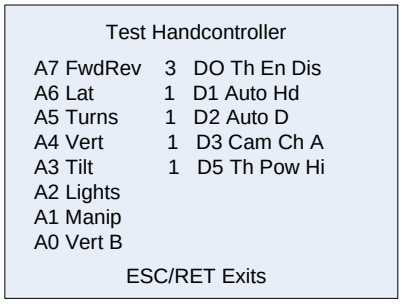


3. **Screen Configuration:** This screen allows the user to adjust the overlaid text position within the video camera image. The corresponding cursor keys move the overlay horizontally and vertically. Also the ability to toggle between NTSC and PAL cameras is available if required. These settings are preserved on exit.

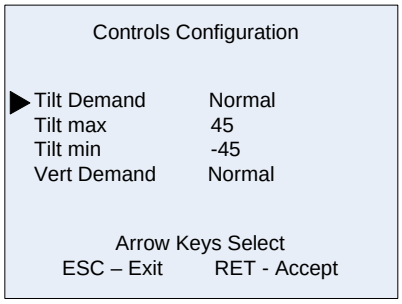


4. **Define User Screens:** Up to four different 'user defined text screens' can be created by the operator. The up and down cursor keys are used to select the user screen key (F2 to F5). To edit the screen press the 'Enter' key. The cursor controls the curser and standard keys enter text, characters may be deleted using the backspace key. To save the text press F1, this saves the screen to a file called 'Fn.txt' where n is the function key number being used (2 to 5).

5. **Test Hand Controller:** Useful for hand controller diagnostics as raw data values from the input devices on the hand controller can be examined. The program continuously reads data from the IO devices. To the left of the display are the Analogue input data and the right the Digital input data. To escape from this screen press 'Esc' or 'Enter'.



6. **Controls Configuration:** Allows the user to customise some of the controls on the hand controller.



- Tilt - In 'Normal' mode when the tilt wheel is turned away from the user, the camera platform tilts down. 'Tilt max' and 'Tilt min' overrides the +/- 90° angle limit which is useful for restricting the movement of the tilt platform if any extra equipment is fitted to the vehicle. Even when the tilt demand is inverted the max limit is always in the upper '+' region and the min limit is always in the lower '-' region.

NOTE:

The Falcon 1290 is fitted with an auxiliary tilt platform which is mechanically linked to the main tile platform. The auxiliary tilt platform's range of movement is 40 Deg up and 40 Deg down. This is factory set for Tilt max to 40; Tilt min to -40.

If the operator wishes to use the ROV without the auxiliary tilt (as per initial dispatch: twisted pair variant with single camera), it can be stowed as follows in order to achieve the full range of tilt for the single camera platform

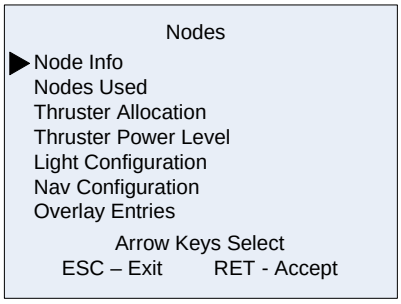
1. **The 'coupling strap' can be disconnected at the main tilt motor and stowed in a safe position (cable tie or tighten down pivot bolt).**

2. **The auxiliary tilt platform can be immobilised by tightening down the two bolts on which it pivots.**

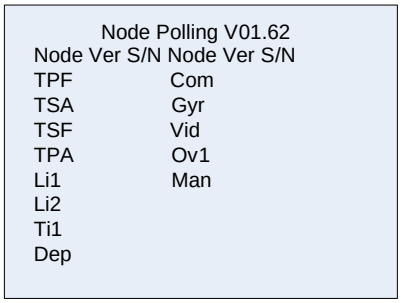
- Vertical Thruster Demand - In 'Normal' mode when the vertical wheel is turned away from the user, the vehicle will move down. If set to 'Invert' the vehicle will move up (instead of down) when the vertical wheel is turned away from the user.

4.3.10 Nodes – Sub Menu

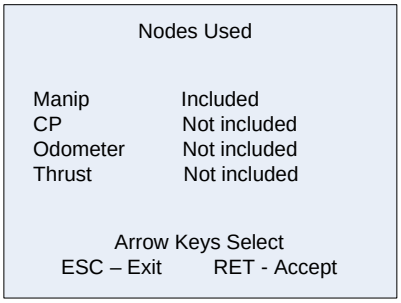
The Nodes sub-menu displays the following options:



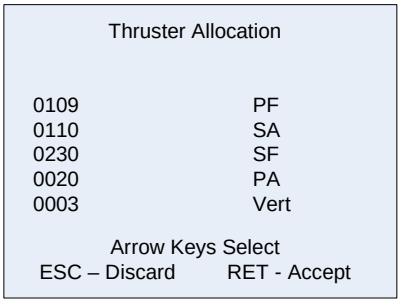
1. **Node Polling:** This screen is useful for vehicle diagnostics as it displays all the nodes connected to the SCU master node. Each node is polled for its Version and Serial number and displayed on the screen. If there is no node connected or powered, then there will be no reply and a blank space is displayed where the version and serial number should be. The nodes used on the network are reflected in the nodes shown, i.e. if the manip node is configured to be used but not the CP then only the manip node will appear in the list of polled nodes. If the vehicle is not powered the overlay node should still reply as this is connected via a different power and network. The version number of the surface software is displayed at the top of the screen. To escape from this screen press 'Esc'.



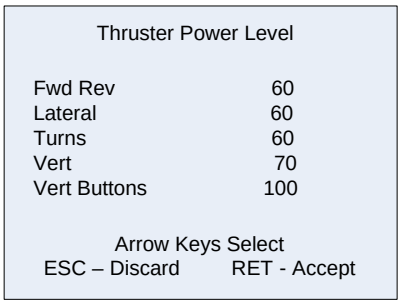
2. **Nodes Used:** Lists the optional nodes that may be connected to the vehicle. The nodes are selected with the arrow by using the up and down cursor keys and selected or deselected with the left or right cursor keys as appropriate. To discard these settings press the 'Esc' key and to accept these setting press the 'Enter' key. Accepting the settings preserves the values in a file called 'kit.ini'. The Thrust node refers to an extra thruster motor that may be fitted to the vehicle, i.e. for use with a brush system.



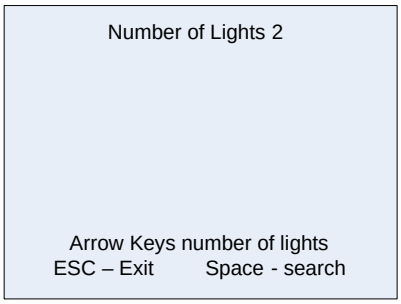
3. **Thruster Allocation**: This screen allows thruster addresses to be allocated and is used after a thruster has been replaced or its position on the vehicle swapped. Each thruster has an address set, on which it responds, this is '1' by default set at the manufacturing stage. If five new thrusters were to be fitted to the vehicle, their address would have to be set to the appropriate value. The 'Thruster Allocation' routine communicates to the thrusters using the extended address, which is in fact the device serial number. This ensures each node can be individually addressed. The user is then presented with the serial numbers and must select their position on the vehicle. To set the address, press the 'Space Bar'. Duplication of thruster allocation is then checked before reprogramming.



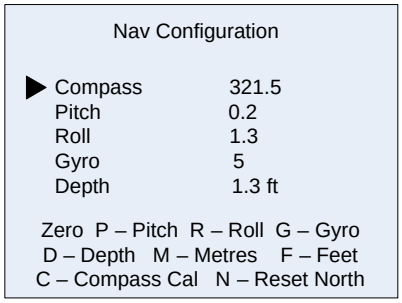
4. **Thruster Power Level**: A switch on the hand controller controls the level of power developed from the thrusters. This allows normal -100% to 100% demand from the joystick and vertical demand when set at 'Full' and -60% to 60% when set at 'Reduced' (i.e. full forward demand on the joystick will only produce 60% demand from the thrusters). The level of reduced power can be varied on the 'Thruster Power Level' screen. The power level is shown, this can be increased or decreased using the up and down cursor keys respectively. The increments and decrements are in 10 percent steps allowing from 10% to 100%. To discard these settings press the 'Esc' key and to accept the setting press the 'Enter' key.



5. **Light Configuration**: This screen allows a third or forth light to be configured and light addresses to be allocated, this is used after a light has been replaced. The number of lights used is displayed, this can be increased using the up arrow key or decreased using the down arrow key. Similar to the thrusters, as more than one node of the same type is fitted the address must be set to allow individual control of the node. As all lights are operated using the same demand their position and actual address are not important as long as they have different addresses. When the light allocation is entered a search is performed using extended addressing to find a light node. When the lights are found their addresses are automatically set and displayed. If no light nodes or only one is found the user is prompted with an appropriate message.



6. **Nav Configuration**: This screen is used to change:



- The depth units used. To select the depth unit, press M for metres and F for feet. The value shown will then be displayed in the unit selected.

- Zero the pitch, roll, gyro and depth. To zero the pitch, roll, gyro and depth, press the respective keyboard key, P – Pitch, R – Roll, G – Gyro, D - Depth.

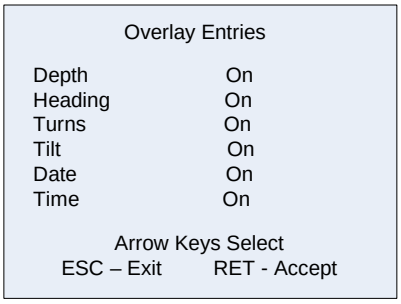
- Calibrate the compass. Press C to calibrate the compass. Slowly move the compass through its pitch, roll and heading axis's ensuring that full movement is obtained. This should be done very slowly taking approximately one minute for full travel.

- Reset the north. Resets the north value to where the vehicle is pointing when selected.

CAUTION

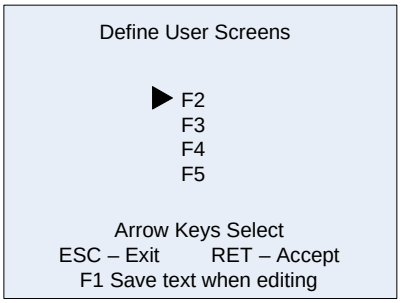
Calibration of the compass and resetting the North value should only be carried out after contacting Seaeye Marine.

7. **Overlay Entries**: This screen lists the various overlay entries and allows them to be turned on or off. The settings made on this screen are not lost when the power is cycled unlike the changes made in Overlay program operation. The entries are selected with the arrow by using the up and down cursor keys and turned on or off with the left or right cursor keys as appropriate. To discard these settings press the 'Esc' key and to accept the settings press the 'Enter' key.



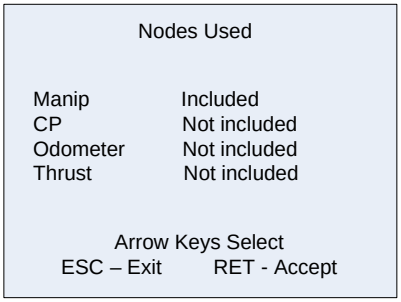
4.3.11 User defined Text Screens (F2 - F5)

Function keys F2 to F5 (refer to paragraph 4.3.9 item 4 for defining screen text) allow user defined screens to be displayed on the overlay, the user text can be displayed whilst flying the vehicle, although instrumentation data is not displayed. When F2 key is pressed a file named 'f2.txt' is read from the C: drive. If this file does not exist a blank screen is displayed. Similarly for F3 file 'f3.txt', F4 file 'f4.txt and F5 file 'f5.txt'. To return to the normal overlay, the same Function key is pressed.



4.3.12 Tooling Thruster

An optional tooling thruster can be fitted to the vehicle. To control the tooling thruster the node must be enabled via 'Nodes Used' menu entry (F1, Configuration, Nodes, Nodes Use [refer to paragraph 4.3.10 item 2]). Once included, the demand is displayed on the VGA screen and control of the thruster is achieved using the keyboard. As mentioned in Table 2 'Page Up' and 'Page Down' control the demand of the thruster and the 'Space Bar' stops the demand by setting it to zero. The tooling thruster also follows the 'Thruster Enable' switch on the Hand controller, so if thrusters are disabled the operator will not be able to set any demand. The address of the thruster should be set to 6 and must be set using Handc (see 'Handc User Guide').



4.4 Operational Use

THE FOLLOWING WARNINGS MUST BE READ AND UNDERSTOOD BEFORE OPERATING THE FALCON ROV SYSTEM IN OPEN WATER.

WARNING: SAFETY

1. **KEEP FINGERS, LOOSE CLOTHING, ROPES ETC. AWAY FROM THE THRUSTERS WHEN THE ROV IS POWERED UP.**

2. **DO NOT OPERATE THE ROV, WITH UNGUARDED THRUSTERS, NEAR SWIMMERS OR DIVERS. THE PROPELLERS ARE POWERFUL ENOUGH TO CAUSE SERIOUS HARM.**

3. **ALWAYS COMPLETE PRE-DIVE CHECKS BEFORE A DIVE, AND POST DIVE CHECKS AFTER A DIVE. THESE CHECKS ARE LISTED IN MAINTENANCE CHAPTER 6.**

CAUTIONS: Maintenance Overview

1. **Do not operate the thrusters when the ROV is out of the water. The propeller bearings rely on the surrounding water for lubrication. When doing pre-dive checks, simply move the joystick away from the centre position and allow it to self-centre immediately. This will give sufficient movement of the thrusters to check direction of rotation.**

2. **After a dive, power to the vehicle should be switched off before the ROV is removed from the water, or as soon as possible afterwards.**

3. **Do not use the lights when the ROV is out of the water for more than 10 seconds, because the element will overheat. When doing surface pre-dive checks switch on the lights, check they illuminate then switch off immediately.**

4. **Keep all O-rings and seal faces clean and free from grit or other matter. Lightly grease with silicone grease before assembly.**

5. **Ensure the umbilical connectors are clean and dry before connecting. Protect connectors from physical damage and dirt when not in use, replace protective caps when disconnected.**

6. **Never connect or disconnect cables to or from either the surface unit or the vehicle when the cables are live. This practice is both potentially dangerous and it reduces connector life through arcing.**

7. **Ensure that the Surface Unit is set up for the correct supply voltage.**

8. **Never use the system with an underpowered generator.**

9. **Never allow the generator to run out of fuel.**

10. **Never run the ROV head-on into an obstacle.**
11. **Always protect the ROV from being struck by or swept into boat hulls, docksides or other hazards, especially during launch and recovery.**
12. **Never operate the ROV near moving ships propellers.**
13. **Always check the security, suitability and condition of all lifting equipment.**

4.4.1 Pilot Skill

Falcon is a flying machine in the sense that it can move freely in three dimensions. In order to move the vehicle smoothly through the water the pilot needs to use smooth well co-ordinated movements of the joystick, whilst at the same time operating other system controls and monitoring information from the video overlay, power supply and SI-HCU.

Like any other skill, practice increases proficiency. This is especially true for flying an ROV because the pilot receives no motion cues directly but only via the picture and data, such as depth and heading, that is presented to him. It takes time and experience to close the gap between the pilot and machine and to get some way towards the feeling of "telepresence" that is the hallmark of a skilled and experienced ROV pilot. SEAEYE MARINE Ltd. and most Falcon distributors can provide contacts for Pilot Technician training courses.

4.4.2 Seamanship

Good knowledge and practice of basic seamanship is a definite advantage when operating an ROV. This includes simple rope work, the effects of wind, tide, weather, mental calculation of position and course to steer from speed and bearing information.

Where operations are being conducted from small boats, an experienced skipper who is used to the deployment and recovery of equipment over the side is a valuable asset. Remember most seamen are not in the habit of stopping and anchoring their vessels in the open sea and then dangling cables in the water where they might get entangled with the ships propellers.

Attention should be drawn to the relevant sections (Part C) of the International Regulations for Preventing Collisions at Sea, for the correct lights and shapes to fly for vessels restricted in their ability to manoeuvre due to being engaged in dredging, underwater operations, or diving operations.

4.4.3 Umbilical Management and Vehicle Trim

When an ROV moves underwater its thrusters have to overcome a number of forces which act upon the vehicle including:

- Residual hydrostatic forces: whether it has a natural tendency to float or sink with its present equipment fit and trim weights, and whether operations are taking place in salt or fresh water.

- Hydrodynamic drag forces: caused by its motion through the water or holding station against a current.

- Tension forces: transmitted from the umbilical cable, which are similarly made up of hydrostatic (is the cable a sinker or floater) and hydro-dynamic (drag forces induced by fluid flow past the cable) forces.

These forces act together to define the ultimate performance capabilities of an ROV, coupled with the length of cable available for deployment.

The operator can affect the achievable performance of the ROV in three ways:

- The initial trim of the vehicle.

- The trim of the umbilical.

- The amount of umbilical paid out.

It is recommended that the vehicle be trimmed to be slightly positively buoyant. This makes the vehicles easier to manage on the surface and helps with preserving visibility when manoeuvring close to the seabed. This also means that in the event of power failure, the vehicle will float to the surface.

There is a difference in weight required to achieve the same state of trim, between fresh and salt water. It should also be remembered that removal or installation of cameras or accessories between dives would alter the trim of the vehicle.

REMEMBER: The trim of the vehicle acts as a static offset on the thrust capabilities of the vehicle, which cannot be used for other purposes. If the vehicle is 5 Kgs (11 lbs) heavy, then in order to hang motionless in the water the vertical thrusters have to supply a constant up thrust of 5 Kgs (11 lbs) just to keep the vehicle stationary. Power used in overcoming a badly trimmed machine is power wasted and reduces the performance of the vehicle.

The standard umbilical cable supplied with the Falcon vehicle is slightly negatively buoyant in water, i.e. it has a tendency to sink. As discussed later, the cable can be trimmed in various ways (by attaching weights, floats or a floating line to the cable) to suit different operating conditions but before this a number of basic principles should be understood.

When there is no current, cable weight or buoyancy acts in the same way as vehicle trim – a buoyant cable tries to lift the vehicle; a heavy cable to sink it. The vehicle thrusters have to overcome these constant offsets. When operating in zero current the cable should be trimmed to be nearly as neutrally buoyant (neither floating or sinking) as possible.

Referring to Fig. 11. When a free-ended tether (i.e. no vehicle attached) is deployed into a current, the hydrostatic and hydrodynamic forces acting on the tether define the angle at which it lies in the water. The extreme cases shown are firstly that an infinitely heavy tether or if there is zero current, the tether will hang vertically down in the water. Secondly, a cable will lay directly down-stream in line with the current if it is neutrally buoyant.

Also shown is a typical angle at which a slightly heavy tether might sit when subjected to a modest current. REMEMBER: If the current changes the angle will too and it can be dramatic as the drag forces on the cable are proportional to the square of the current speed.

Fig 4 shows the similar effect that can be achieved by attaching a weight to a neutral (or positively buoyant) tether. The difference is that point loads applied to a cable system like this generate curved shape whereas uniformly applied loads generate straight lines.

When a vehicle, with all its thrusters switched off is attached to the end of the cable it will tend to hang at the end of the cable at its equilibrium angle. In order to move freely the vehicle has to pull the cable away from its equilibrium position. The further from the equilibrium the vehicle has to pull the cable, the harder it has to work, until eventually the vehicle is running flat out to just overcome its own hydrostatic and hydrodynamic forces and the tensions in the cable. The vehicle then ceases to make further headway. Fig 7 demonstrates this for a neutral and a heavy cable.

For a given set of conditions, i.e. current speed, vehicle trim, cable trim, depth of operation and horizontal excursion from the launch point, there is a theoretical optimum length of cable which will minimise the tensions in the cable. The vehicle then ceases to make further headway. Fig 7 demonstrates this for a neutral and a heavy cable.

For a given set of conditions, i.e. current speed, vehicle trim, cable trim, depth of operation and horizontal excursion from the launch point, there is a theoretical optimum length of cable which will minimise the tensions transmitted from the cable to the vehicle.

For example, if the vehicle is at the very limit of its capabilities going at full thrust and is motionless at a certain position exactly balancing the forces applied to it, with precisely the “correct” amount of umbilical deployed then any attempt to change the deployed length will increase the applied forces on the vehicle and cause it to be driven back by the current. If additional cable is paid out drag forces rise. If cable is pulled in, this pull is transmitted directly to the vehicle and seen as an increase in tension (see Fig 8).

NOTE

Even with neutral cables quite substantial tension forces can be generated at the surface end. With heavy or weighted cables these forces are correspondingly greater. When deploying cable, especially by hand. DO NOT be tempted to keep paying out cable just because it is pulling. You may well end up with it all paid out and loops lying all over the seabed! Decide what you think is a reasonable length for the current speed prevalent and tie off at that length. Further small adjustments in or out (eg: 1, 5 or 10 metres depending on depth etc) should be made under instruction from the pilot.

If the length deployed of Umbilical needs to be recorded then it is recommended that it is marked with adhesive tape. The recommended code is as follows:

1 Blue Band	10m	2 Blue Bands	20m
3 Blue Bands	30m	4 Blue Bands	40m
1 Red Band	50m	1 Red & 1 Blue Band	60m
1 Red & 2 Blue Bands	70m	1 Red & 3 Blue Bands	80m
1 Red & 4 Blue Bands	90m	2 Red Bands	100m
2 Red & 1 Blue Band	110m	2 Red & 2 Blue Bands	120m
2 Red & 3 Blue Bands	130m	2 Red & 4 Blue Bands	140m
3 Red Bands	150m	3 Red & 1 Blue Band	160m
3 Red & 2 Blue Bands	170m	3 Red & 3 Blue Bands	180m
3 Red & 4 Blue Bands	190m	4 Red Bands	200m
4 Red & 1 Blue Band	210m	4 Red & 2 Blue Bands	220m
4 Red & 3 Blue Bands	230m	4 Red & 4 Blue Bands	240m
5 Red Bands	250m	5 Red & 1 Blue Band	260m
5 Red & 2 Blue Bands	270m	5 Red & 3 Blue Bands	280m
5 Red & 4 Blue Bands	290m	6 Red Bands	300m
6 Red & 1 Blue Band	310m	6 Red & 2 Blue Bands	320m
6 Red & 3 Blue Bands	330m	6 Red & 4 Blue Bands	340m
7 Red Bands	350m	7 Red & 1 Blue Band	360m
7 Red & 2 Blue Bands	370m	7 Red & 3 Blue Bands	380m
7 Red & 4 Blue Bands	390m	8 Red Bands	400m

By considering the above a number of useful conclusions can be drawn.

- A heavy cable or a weight attached to a neutrally buoyant cable can help an ROV to achieve greater depth in a current.
- In a current always try to launch an ROV upstream of the target. BUT approach a potential snagging obstruction with the vehicle from downstream.
- For most applications Falcon should be trimmed to be slightly positive buoyant.
- Operational considerations should be addressed and planned for before the vehicle is deployed, e.g. cable trim and amount to be paid out.

Unfortunately, it is not possible to give firm recommendations on exactly how to trim the vehicle, how to trim the umbilical and how much to pay out for every circumstance. This is due to the large number of variable factors involved, the difficultly of exactly quantifying these factors (what is the exact current speed?, how does it change through the water column?, how far away is the vehicle from the launch point?) and the fact that these conditions can vary quite substantially over relatively short periods. For example, tidal currents can change direction very rapidly and movement of the boat from which the vehicle is streamed will have a marked effect on the umbilical catenary.

However, some general guidelines are given in the section on care and trimming of the umbilical. Like many activities proficiency in flying and operating an ROV, although not inherently difficult, requires practice and experience.

This practice and experience should be gained by starting in good conditions from a fixed launch position with easy access to the water, good visibility, no current, shallow water and no mid-water or seabed obstructions to entangle the machine or umbilical. Later, one can progress to night dives in deep water with significant current and operating from a "live" boat (not anchored).

If you try to do too much too soon you will probably not be pleased with the results and may risk losing the vehicle!

4.4.4 Planning and Procedures

It is strongly recommended that a structured and disciplined approach to operating the ROV be adopted. This might include the following:

Plan the dive taking account of such factors as:

1. Weather forecast, tidal currents, visibility, bottom conditions, estimated duration of dive and likely depth of operations.

2. Launch site position and facilities available, including size, power availability, shelter, access to water and location relative to the likely position of the target.

3. Personnel requirements for piloting, umbilical tending, observing and log keeping, maintenance etc.

4. Use the documentation provided to assist in the operation i.e.

    - Pre/Post Dive Check List. To ensure that all necessary actions have been taken prior to launch, and after recovery.

    - Dive Log. This preferably should be completed by an observer and be as comprehensive as possible. For example, if the vehicle's umbilical becomes entangled, a detailed record of depth, course and times can be invaluable for "untying the knot".

    - Video/Stills Log. This documents the information gathered during each dive.

    - Maintenance Log. This should record all recommended maintenance activities and provide a complete service history of the vehicle over its lifetime.

4.4.5 Care and Trimming of the Umbilical

The umbilical is the component used in an ROV system that is most prone to damage. This may be caused by contact with sharp or rough objects underwater, which is sometimes unavoidable, or it may be caused by operator abuse.

Damage to the umbilical can be hazardous for the vehicle and to its operators (although Line Insulation Monitors have been built into the system to minimise this danger).

The cable MUST be inspected for damage before and after every dive. Although damage is most likely to occur near the vehicle, the whole cable should be examined for cuts and abraded areas.

If the cable has been worn, abraded, scratched, scraped or otherwise damaged, but the outer sheath is still continuous over the strain member and internal cores then a running repair can be effected by taping over the damaged area with self-amalgamating, insulting or similar protective tapes.

If the outer sheath has been cut right though and the strain member of the internal cores are visible the cable must be replaced completely or cut back and reterminated behind the damaged area.

As well as the more obvious external damage, the cable may be easily damaged internally by bending it too tightly or putting twists into it, through incorrect handling. This type of damage will eventually manifest itself as a broken core in the umbilical. If one of the conductors has broken somewhere in the cable then a new cable is normally required.

The most likely location of such breaks is at or near the cable termination (in the absence of obvious damage to the outer sheath).

A reflectometer, or similar instrument, which can pinpoint the position of a broken core, should be used if available: otherwise it will be necessary to progressively cut the cable to find the break.

NOTES. To avoid damaging the cable:

Never bend the cable more sharply than its minimum bend radius of 155 mm. If the cable has to be passed over a sheave, the sheave diameter must be at least 310 mm diameter. Repeated bending of the cable to the minimum radius will cause weakening, and should be avoided.

Avoid attaching floats or weights in such a manner that the cable would be bent sharply by loads applied on either side of the float or weight.

As a general rule, anything, with the exception of the vehicle itself, attached to the umbilical should be secured such that the breaking strength of the attachment is much less than the minimum breaking strength of the umbilical. So for example, if a float becomes entangled in an underwater obstruction and cannot be freed, a sharp tug on the umbilical will part the cable or piece of string used to secure the float and the system can be recovered in the usual way.

Although the small floats normally used for trimming the cable have insufficient buoyancy to kink the cable and can therefore be simply attached using a cable tie or light string, larger floats or weights (heavier than 3 Kgs (10 lbs)) should be attached in such a way as to spread the load along the cable to obtain a good grip on the braided strain member underneath the jacket. If the attachment does not grip sufficiently to mobilise the strain member then "rucking" of the outer jacket with respect to the other components of the umbilical can occur where the cable jacket crumples and walks with respect to the internal components. Another potential cause of "rucking" is running a heavily loaded umbilical over a small diameter sheave, especially where the load and the pull are always applied in the same directions (i.e., the cable doesn't get a change to "ruck" back again).

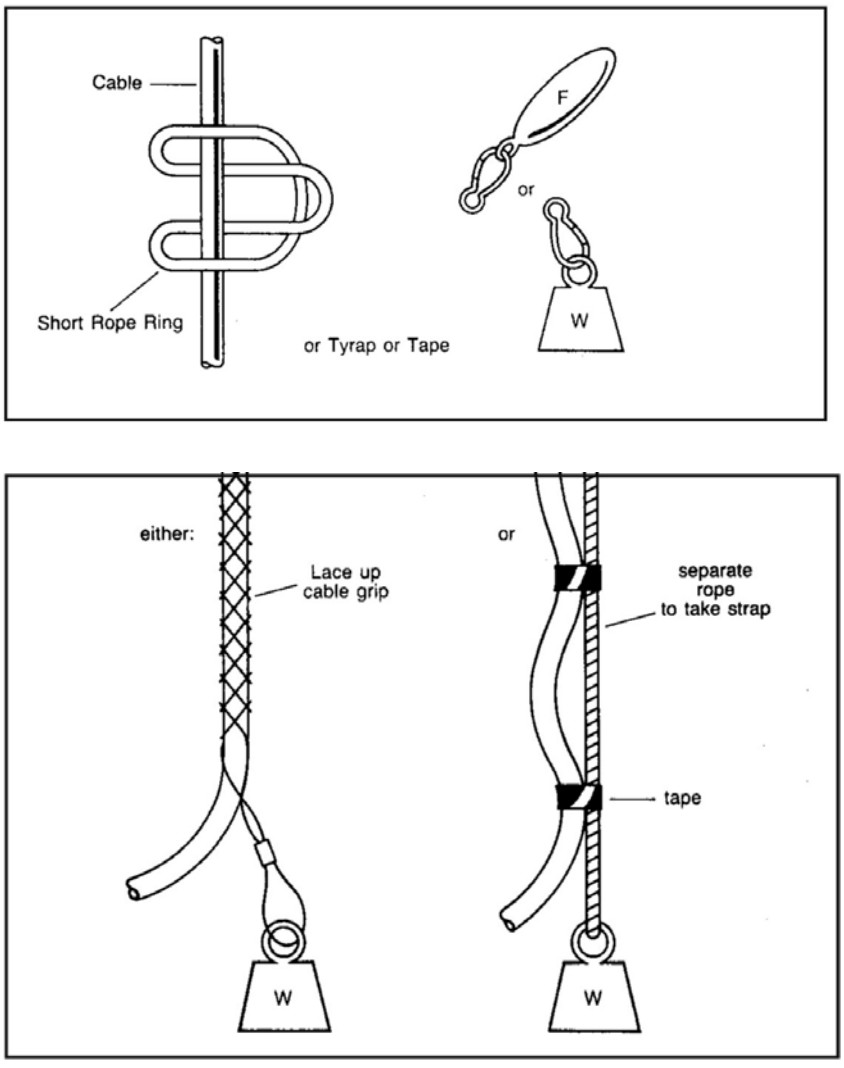


Fig. 4. Methods of Attaching Floats and Weights

Fig 4 above shows recommended methods for attaching floats and weights of various sizes to the cable.

Do not allow turns to build up in the umbilical. When operating the vehicle it will record and display the number of turns that have been put in the umbilical by rotating the vehicle. When first switched on the turns counter registers zero. The maximum number of turns that can be recorded and displayed are +9 in the clockwise direction and –9 in the anti-clockwise direction. With a reasonable length of cable paid out, a modest number of turns in the umbilical is not serious. Before the maximum number of turns has been reached however and certainly before the end of the dive, the vehicle should be rotated in the appropriate direction so as to return the turns counter to zero, leaving no residual twists in the cable.

A second way to put turns in the umbilical is to rotate the launch point about the vehicle. However, in this case the vehicle doesn't move and these turns are not registered on the turns counter. Fig 5 demonstrates this, where a vessel might be rotated by wind, tide or current. Diligent logging of vessel heading in the dive log will help to ascertain if movement has put turns in the umbilical and what action would be required to remove them.

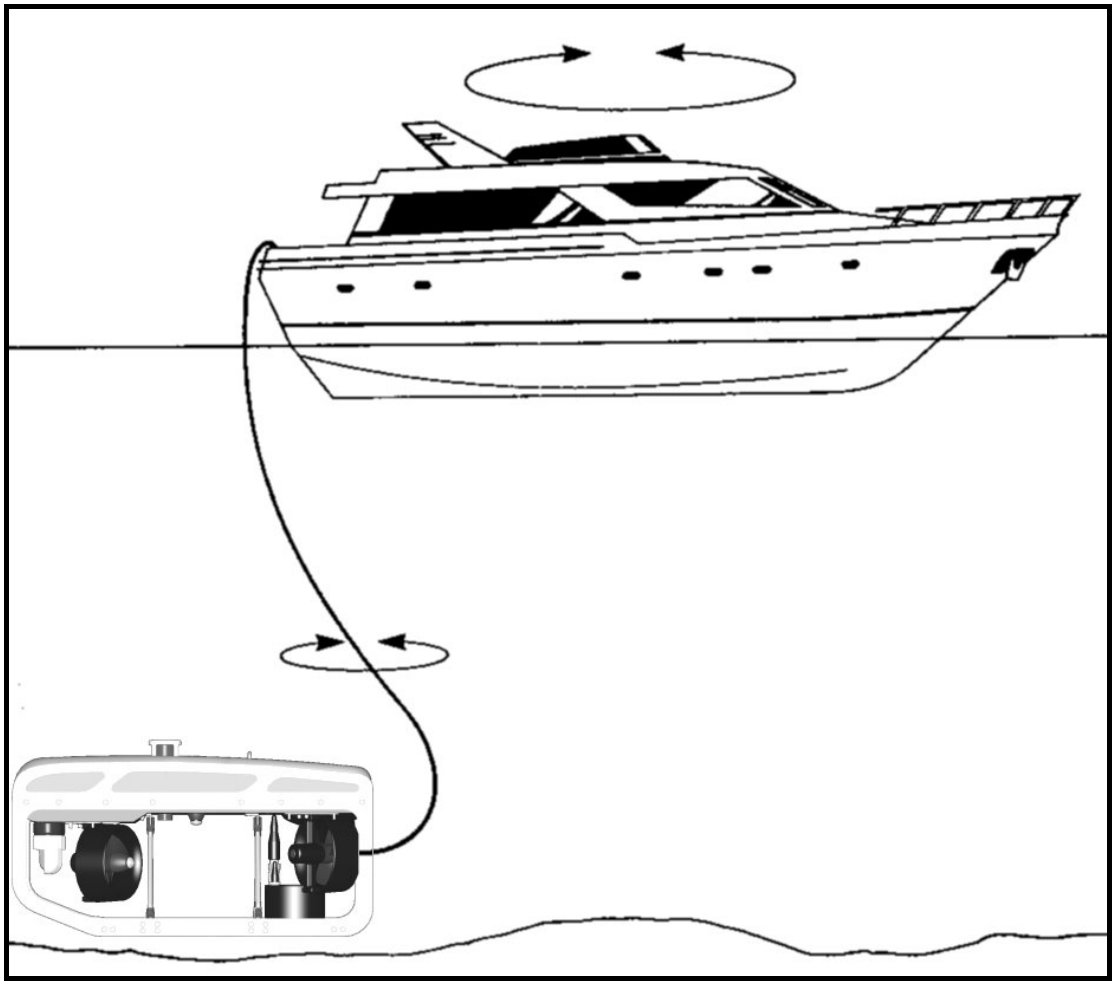


Fig. 5. Turns in the Umbilical

Although the number of turns into the umbilical by movement of the vehicle are clearly displayed and can easily be removed, turns which have been put into the cable by the umbilical handler are not and can build up unnoticed. For this reason the umbilical should always be stored so that it can be easily paid out and hauled in without introducing turns into the cable. The most convenient way of doing this is to store the cable in a figure of eight pattern as shown in Fig 6, storing the cable on each half of the figure of eight BUT in opposite directions. Therefore when the cable is paid out or coiled down there are no residual twists in the umbilical.

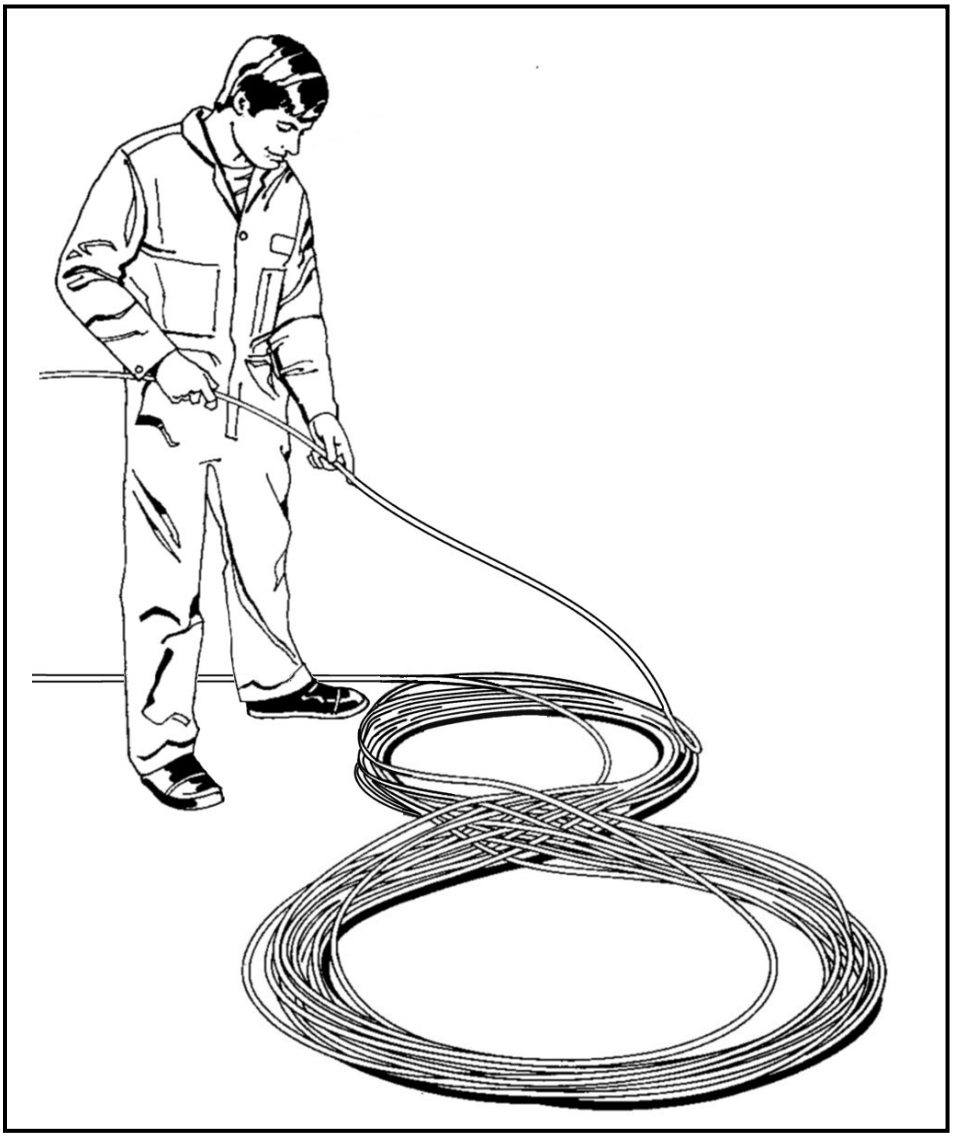


Fig. 6. Coiling Umbilical in Figure of Eight

NOTE: Coiling method only to be used without a Winch.

4.4.6 Umbilical Storage

The umbilical can be stored on a reel only if:

- The reel is equipped with slip rings OR
- Sufficient umbilical for the dive is taken off the reel and laid out alongside BEFORE the system is plugged in.

NOTE

If you notice any tendency for the umbilical to kink during handling or any resistance to taking up turns during coiling of the cable, then twists have been put into the umbilical and should be removed before progressing further.

Trimming the umbilical with varying combinations of float, weight and floating line correcting for various operating conditions helps the vehicle to achieve its best performance, but more importantly should be arranged so that the umbilical is kept clear of the bottom and other obstructions that may entangle it.

4.4.7 Launch and Recovery

CAUTION

Possible Danger of Damage to Equipment. Because of the positioning of the vertical thruster, the lift point is off centre. Therefore in Launch and Recovery procedures the vehicle has some forward bias. Care must be taken of any equipment protruding from the front of the vehicle, e.g. CP Probe / Manipulator.

4.4.8 By Hand

Where access to water is readily available, such as from a small boat with low freeboard or from a pontoon or low dockside Falcon is most easily launched by hand. Ideally, two people should pick up the vehicle by the frame and gently lower it into the water.

DO NOT DROP THE VEHICLE INTO THE WATER FROM ANY HEIGHT AS THIS MAY DISTURB ALIGNMENT OF THE CAMERAS.

4.4.9 From a Davit

From a larger vessel, or in other situations where the height of the launch platform could cause the vehicle to be damaged against a dock wall or other structure as it enters the water, Falcon may be suspended by its umbilical from a sheave attached to a davit or boom and gently lowered into the water. The sheave should have a minimum diameter of at least 310 mm. Use of a small diameter sheave may cause permanent damage to the umbilical.

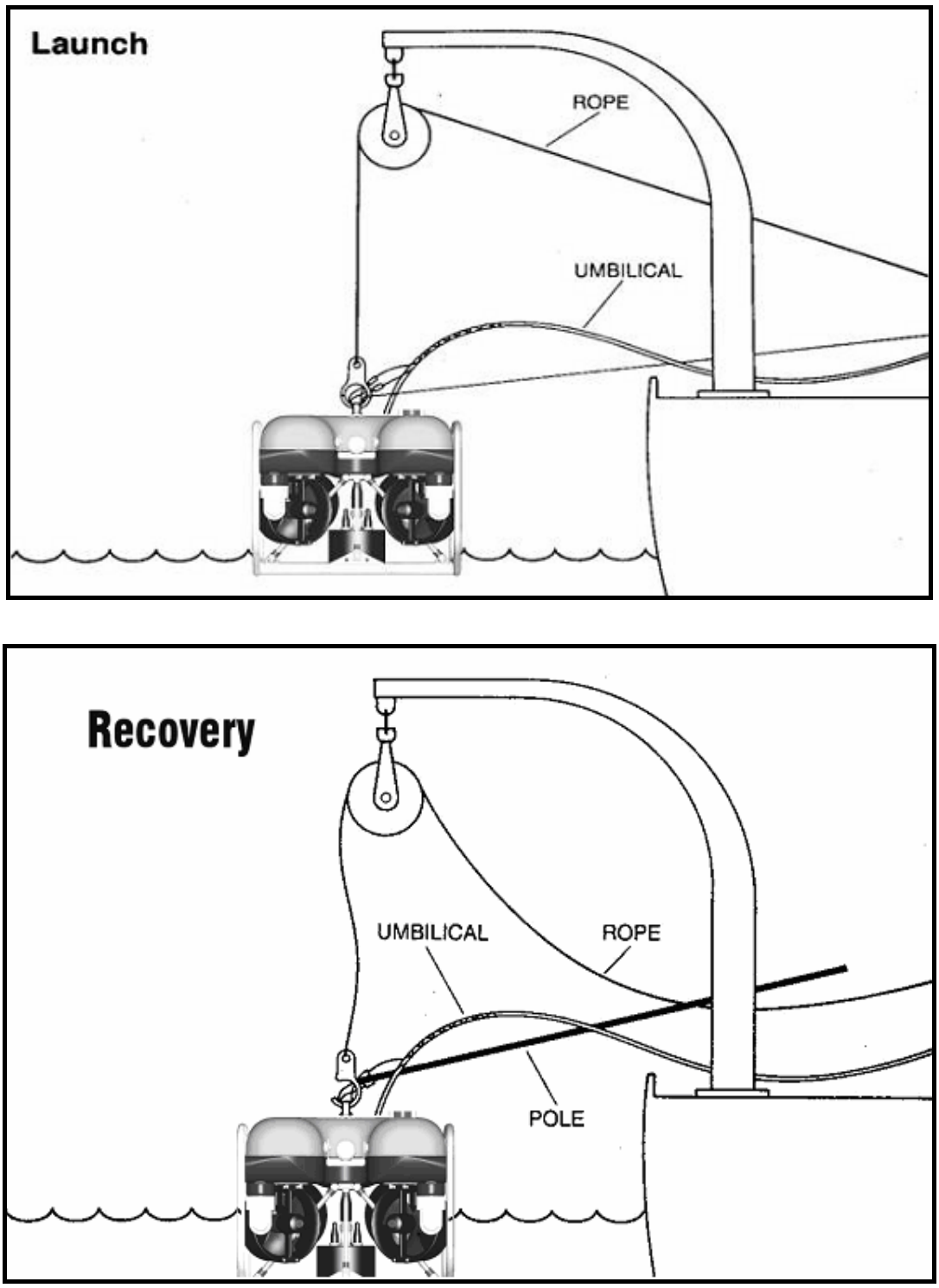


Fig. 7. Davit Launch and Recovery

Alternatively, a rope and quick release shackle can be used (see Fig 7) which reduces forces in the umbilical and frees it for the fitment of floats or weights.

4.4.10 Power

Power to the vehicle should be switched off while launching, but the surface unit should be set up and switched on so that the moment the vehicle is in the water it may be powered up and driven away from the potential hazards around the launch site.

WARNING

FALCON IS AT ITS MOST VULNERABLE DURING LAUNCH AND RECOVERY OPERATIONS. DO NOT LAUNCH IN WEATHER CONDITIONS THAT ARE LIKELY TO CAUSE THE VEHICLE TO BE SWEPT INTO A DOCKSIDE OR VESSEL HULL. NEVER LAUNCH OR OPERATE FALCON NEAR SHIPS PROPELLERS OR THRUSTERS. WHEN LAUNCHING FROM A VESSEL ENSURE THE BOOM OR DAVIT IS OF ADEQUATE LENGTH TO AVOID FALCON BEING DAMAGED AGAINST THE SIDE OF THE VESSEL WHEN ENTERING THE WATER.

4.4.11 Typical Operating Scenarios

The following examples give general guidelines on how to operate the Falcon system in various conditions BUT as stated previously it is not possible to give firm operating instructions that would be appropriate in every situation.

Use these guidelines as a basis for working out your own operating techniques, based on practice and experience, that will be most suited to the specific circumstances only you, the pilot, can appreciate and cater for.

These guidelines apply to operating a Falcon from onshore sites or from small vessels in relatively benign conditions. If the system is to be used “offshore” from large vessels in deep water and inclement weather it is strongly recommended that a deployment system with a ruggedized basket (“basket launch” method) be used.

4.4.12 Low Current/Shallow Water <50m, Fixed Launch Point

1. The umbilical should be trimmed to be **just** floating with the vehicle “pulling down” the umbilical as it descends.

2. If the depth is known prior to deployment of the vehicle, a buoy can be attached to the umbilical at depth plus between 10 and 20 metres to provide a general indication of the whereabouts of the vehicle and assist the cable handler at the launch site.

3. This procedure may be used equally well from a shore site or a moored vessel.

4. Do not make the cable too buoyant or on a deep dive the vehicle may run out of down thrust.

5. If operating from a moored vessel, pay close attention to the relative positions of the vehicle and the vessels mooring lines, not forgetting the tendency for the boat to swing about its mooring under combined effects of wind, wave and tide.

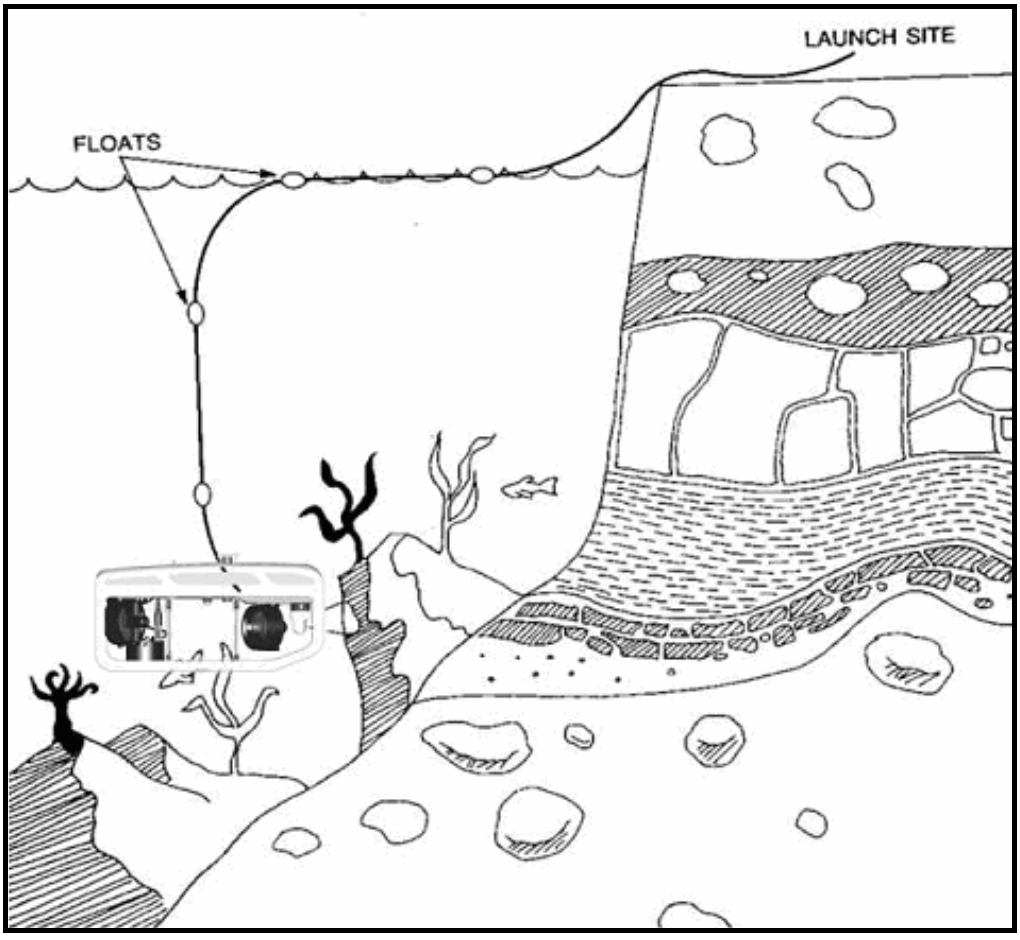


Fig. 8. Shallow Water Deployment Fixed Launch Point

NOTE: Floats not supplied but can be used if required.

4.4.13 Low Current Shallow Water <50m, Moving Vessel

1. Bottom depth should be ascertained either from a chart and tide tables or preferably with an echo sounder at the dive site.

2. If diving on a fixed target (e.g. a shipwreck) the wreck should ideally be found with an echo sounder and marked with a shot line, to provide a surface reference for the skipper of the boat.

3. The skipper of the boat should hold station, between 20 and 30 metres downstream of the shot-line, with the bows of the boat towards the shot-line at all times.

4. Prior to launching the vehicle the umbilical should be trimmed as follows:

   - For a length of cable equivalent to the depth of water plus 10 to 20 metres, a larger buoy should be attached to the cable.

- Extra cable should be trimmed to the buoy such that the umbilical handler can see it at all times lying on the surface between the boat and the surface marker buoy.

- When the vehicle is launched it should be driven up current with the umbilical being kept under sufficient tension to stop it being washed towards the boats propellers. When diving, apply sufficient forward trim so as to just breast the current on the surface.

- When the surface marker buoy has been deployed, the boat skipper should stay downstream of it with the umbilical handler constantly adjusting the amount of cable paid out as the boat moves gently backwards and forwards.

NOTES

This procedure should only be attempted in calm conditions.

As the current changes, the relative positions of boat, surface marker buoy and shot-line should be adjusted.

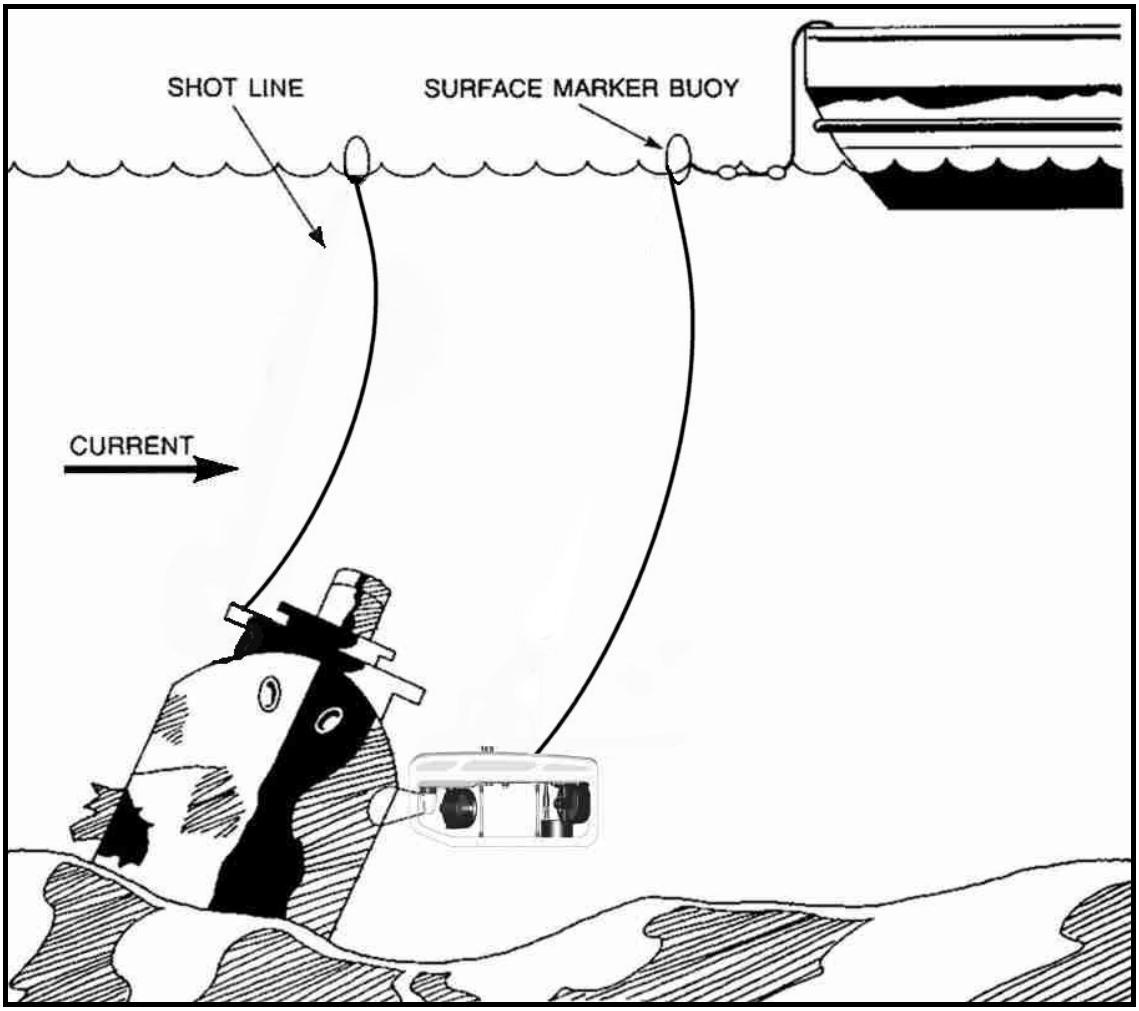


Fig. 9. Shallow Water Deployment (Moving Vessel)

4.4.14 Low Current Deep Water >50m or High Current Shallow Water

As discussed previously when the current increases or more umbilical is deployed then the system becomes more susceptible to current induced forces. Ideally a "basket launch" method should be used in these circumstances. If this is not available then similar techniques as those outlined in previously can be used, but with the addition of a clump weight, to help get the majority of the umbilical towards the bottom.

As long as a separate rope is used to support the weight there is no upper limit to the size of the weight used, remembering that the heavier the weight then the nearer plumb the cable will hang.

In particularly arduous conditions a clump weight of 50 Kg or more might be used as long as adequate means of launch and recovery are available.

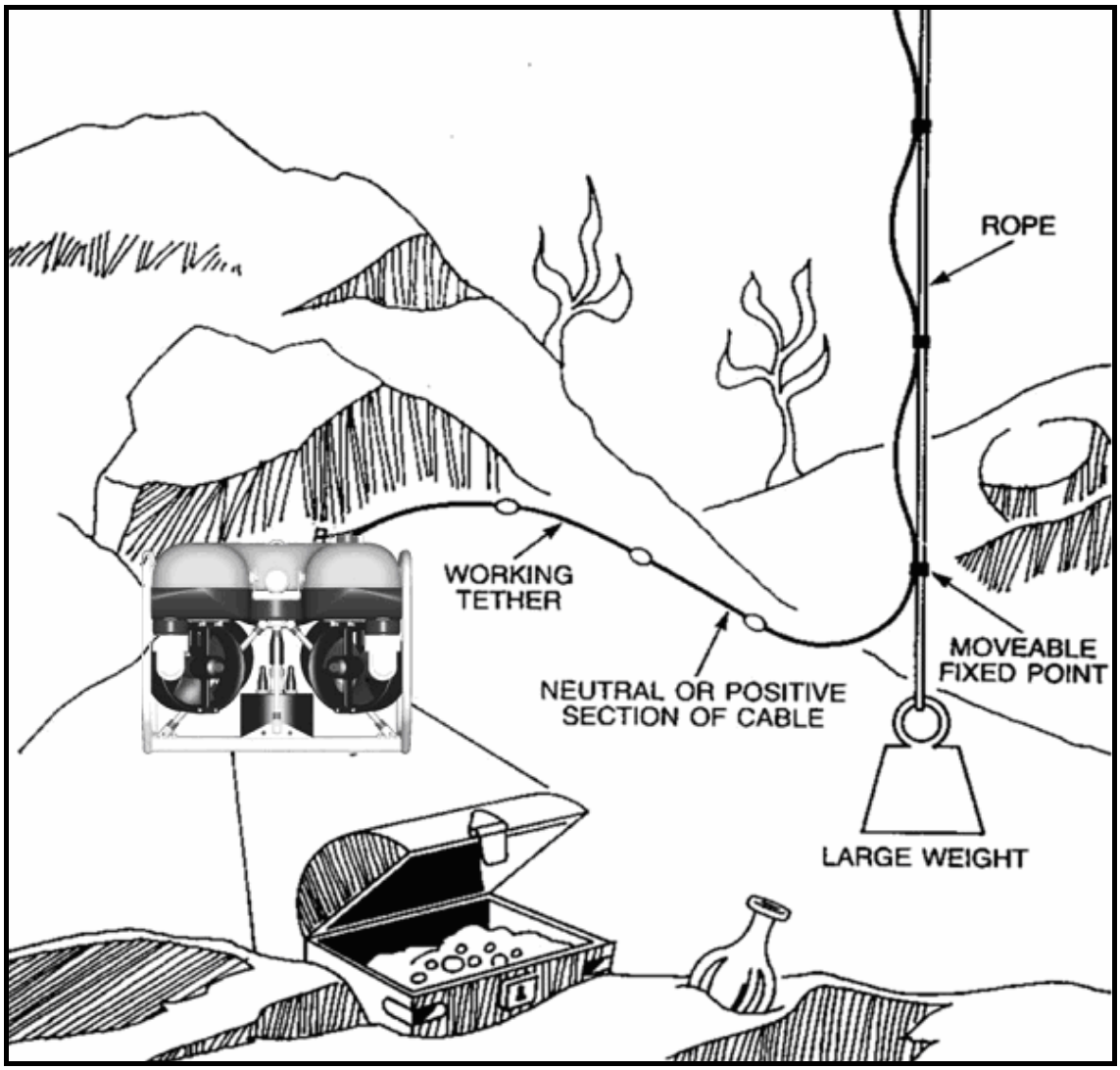


Fig. 10. Deepwater Deployment

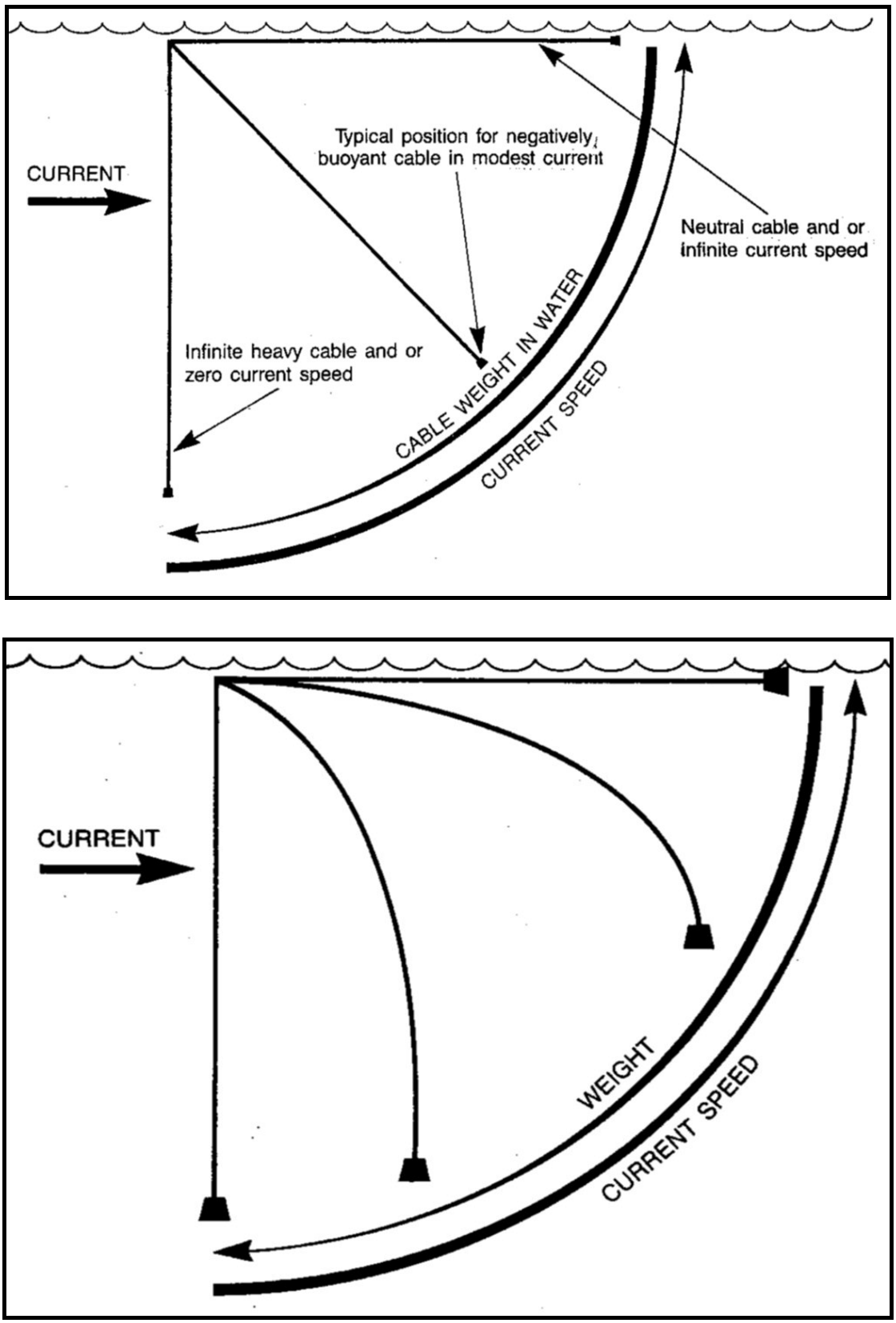


Fig. 11. Effects of Water and Current on Cable

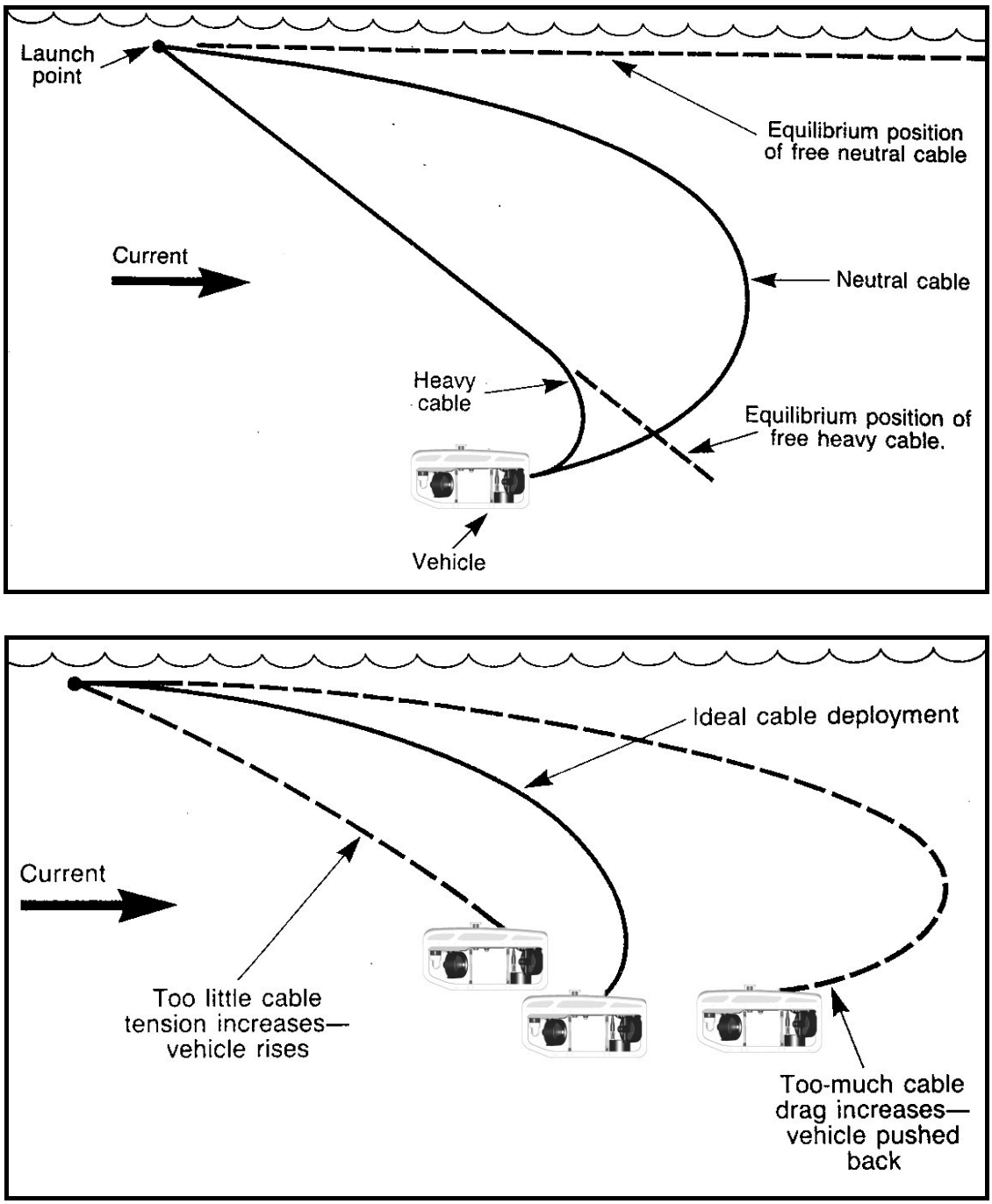


Fig. 12. Effects of Cable Weight and Tension

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CHAPTER 5

FUNCTIONAL DESCRIPTION

Contents

Figures

Tables

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5. FUNCTIONAL DESCRIPTION

This Chapter, with the aid of block diagrams, describes the various functions of the Falcon 1290 system.

5.1 Introduction

The functional descriptions are divided into the following:

- Data Control and Video system.
- Power distribution.

5.2 Surface Control Unit Data Control and Video

Refer to Figs. 1, 2, 3, 5 and 6 and the circuit diagrams in Chapter 6. The Falcon Surface Control Unit (SCU) contains the Master Node used to read input from the user and control the ROV appropriately. Additionally the video signal is processed overlaying text onto the video.

5.2.1 TMS25105C

The TMS25105C 5V 25W power supply is capable of 4.6A and can be run from a 110 VAC or 240 VAC mains supply system. It is fed via a 1A anti surge fuse F1. It provides the +5 V supply for the SCU PCBs.

5.2.2 PCB1 - ICOP 6054VE

This is an embedded 386SX PC in a PC104 format. It is the master node in the Master Slave configuration and runs the software to read in and process the user input. Control is then sent to the ROV comprising of various nodes, the nodes act upon or reply with data accordingly. The master node then processes the returned data and displays the formatted information on the VGA screen and video overlay.

The PC uses standard connections power (+5V), keyboard, VGA and four serial ports.

- COM 1 (J8 RS232) is used to connect to the ROV via the 485F9i Isolated RS232 to RS485 Converter module.
- COM 2 (J11 RS485) is used to communicate with the PCB3 6111P Video Overlay node.
- COM 3 (J15 RS232) is used as an auxiliary serial port to upload new software to the SCU, export navigation/survey information or any future development.
- COM 4 (J16 RS232) is used as a second auxiliary serial port to connect to auxiliary hand controllers.

The telemetry is connected to the RS232 to RS485 isolated converter via a terminal block with three resistors. R1 and R2 are biasing resistors that "pull up" Tele A and "pull down" Tele B, these are fitted to reduce telemetry noise when there is no data being sent or received. R3 is a termination resistor fitted to prevent signal reflections and thereby improve signal quality.

Aux COM A is a 9 way D-type connected directly to COM 3 of the PC. It uses RS232 and is used to upload software, export navigation/survey information or any future development.

Aux COM B is a 15 way D-type with the TX and RX of COM 4 connected as well as the 0V and 5V digital supply. This is used to connect to auxiliary hand controllers or any future development.

Standard VGA and keyboard connectors from the PC are brought out to the back of the surface unit.

5.2.3 PCB2 - ZMM

This is an 8-bit resolution analog and digital I/O board in a PC104 format. The board connects to the PC on the XT expansion bus through the 64way stacking connector. It is used to read all the input from the hand controller via PCB3 which filters and scales the signals. Jumper settings on this board must be set for correct operation, they are : J4 – U, J5 – A & B, J6 – empty, J7 from centre to right side (nearest J3) X 2.

5.2.4 PCB3 - 6111P

Falcon Overlay PCB performs two functions, overlays text onto the video picture and filters and scales the signals from the HCU.

The overlay node is controlled by the PC master node over a RS485 link. The node in turn controls a video overlay chip responsible for overlaying the text. The video signal received on J3 BNC is a standard composite picture from the isolation transformer, after overlay insertion is output on J5 BNC. There is a LED D5 to indicate power to the board and a T500mA fuse to open circuit the 5V input on a over current fault condition.

5.2.5 PCB - 6119P

The Video PCB has a +5V digital supply input supply from the TMS2510C PSU and a video input signal derived from the PCB3 – 6111P J5 tie-piece connector. Video is output on four BNC connectors each with an adjustable potentiometer to allow adjustment of the video gain for each of the outputs, adjustable from 0 to x2 gain.

5.2.6 PCB5 - 6101P

Auxiliary PSU PCB takes the +5V digital supply and via DC to DC converters produces an isolated +12V via filter to supply the video receiver circuit and an isolated +5V for the RS485 side of the data converter. There is a T500mA fuse to open circuit the 5V input on an over current fault condition.

5.2.7 PCB6 - Video Amp / AGC

The video twisted pair signal is connected to the Balanced Video Receiver (PCB6) 10-way connector CN1. The PCB6 converts it into a composite video signal and routes the signal to the 3 way connector CN2. There are two adjustments on this board RV1 (nearest CN1 10 way connector) that is responsible for the video balance and RV2 (opposite end from CN1) that is responsible for the gain. DIP switches allow for different lengths of tether cable connecting the SCU to the ROV. These DIP switches together with the Balance and Gain potentiometers provide compensation adjustment of the video system, detailed in Chapter 6.

If a tether is changed, particularly of a different length, these pots will have to be changed for optimum video quality, see Chapter 6 for setting up procedure.

The video isolation transformer MVT75-75 is used to isolate the ROV video signal from the SCU 0V.

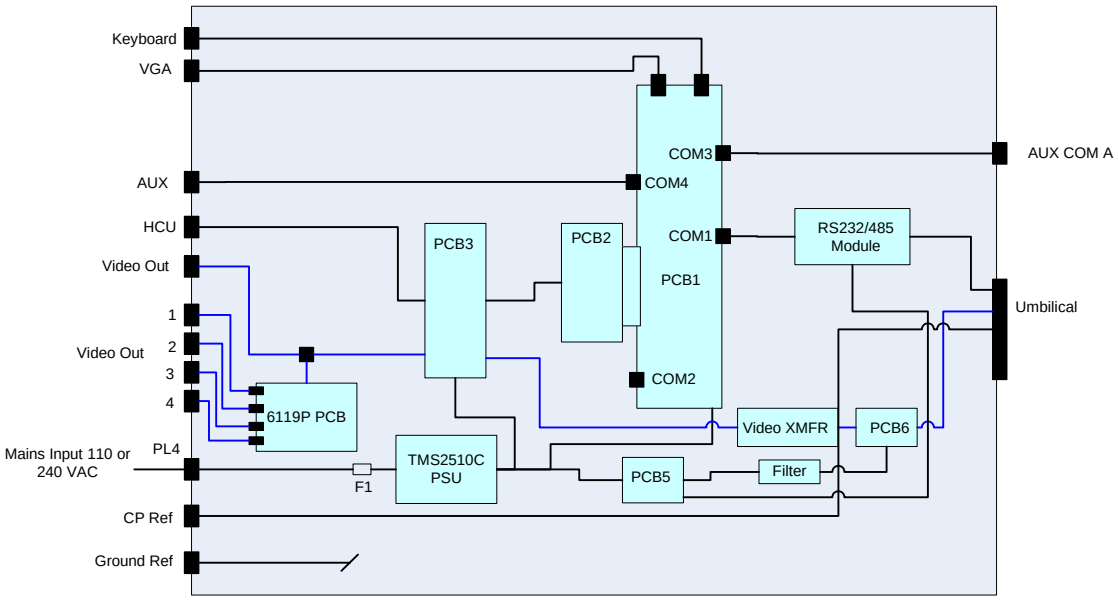

Fig. 1. Surface Control Unit PCBs

5.3 CP and Earth Reference

The CP reference is routed through from the umbilical connection to a 4mm connector at the front of the SCU. An Earth reference 4mm connector at the front of the SCU is connected to the SCU frame.

5.4 Control Functions

The ROV system can be divided into the following control functions:

- Lights control.
- Thruster control.
- Tilt control.
- Navigator control.
- Aux functions.
- Camera control.
- Sonar.

5.4.1 Lights Control

The lights are controlled by a switch and potentiometer. If the LIGHTS switch is on, a voltage is produced proportional to the potentiometer position. The voltage is converted into a digital format by the SCU I/O PCB (PCB2), and processed by the SCU CPU PCB1.

5.4.2 Thruster Control

The control of the thrusters is under three commands, speed, direction and thruster enable or disable. These commands are dictated by the joystick, rotary control and switch positions on the HCU. The thrusters can be enabled or disabled by the THRUSTER ENABLE/DISABLE switch. The switch status is read by the SCU I/O PCB2, and processed by the SCU CPU PCB1.

The I/O PCB interfaces the following controls:

- Vertical.
- Forward/reverse.
- Lateral.
- Turn.
- Speed.

The position of the joystick and potentiometer produce a voltage proportional to the amount of control required which is converted into a digital format by the I/O PCB, processed by the SCU CPU and sent as a digital signal via the RS485 telemetry link to the vehicle.

5.4.3 Tilt Platform Control

Position of the tilt HCU potentiometer produces a voltage proportional to the amount of tilt movement required. The voltage is converted into a digital format by the SCU I/O PCB and processed by the SCU CPU and sent as a digital signal via the RS485 communicating link to the vehicle.

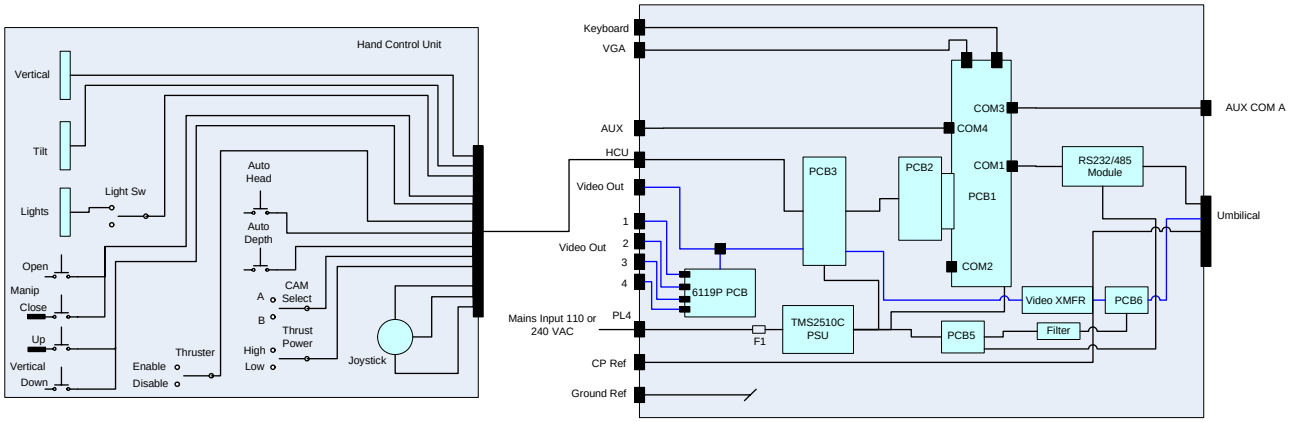

Fig. 2. HCU Functional Connection

5.5 Power

5.5.1 Surface Power Distribution

Refer to Fig. 3 and the circuit diagrams in Chapter 6. The Surface Power Supply Unit (PSU) accepts either 110 VAC or 240 VAC (see Chapter 3). Power in fed to the Input Breaker Switch via the Input Trip Circuit Breaker, which in the operational condition, is normally 'UP'. This CB will trip if a fault occurs. When the Input Breaker is switched to the 'I' position, power is fed to the main transformer and output connectors A, B and C. These output connectors can be used to supply other mains powered ancillary equipment such as the Video Monitors or Sonar units and are protected by 5A fuses FS1, FS2 and FS3. The transformer can be configured to accept either the 110 VAC or 240 VAC input, (see Chapter 3 for the transformer link positions). The Output 'ON' indicator illuminates and the 240 VAC auxiliary output from the transformer is fed to the Vehicle 'ON/OFF' Switch. The secondary output from the transformer is fed to a Thyristor network via a 10A fuse FS4. This network provides the 500 VDC for the vehicle power supply.

The Vehicle 'ON/OFF' switches power to the LIM and if no fault exists contactor 2 operates. Its contacts 51/52 close to energise contactor 1 which switches the 500 VDC supply to the Vehicle Power Supply Unit (VPSU) via the umbilical. The Voltmeter will indicate the output voltage, and the Current Meter the vehicle current consumption. The Line Insulation Monitor (LIM) monitors the following lines for isolation faults:

- Earth – 500 VDC lines.
- 0 VDC lines to Earth.
- 500 VDC to 0 VDC lines.

In the event of a fault in the umbilical or vehicle power supply, the LIM will trip and the Output LIM Fail indicator illuminate. Vehicle supply voltage can be adjusted using the Output Adjust Potentiometer located on the Surface PSU front panel.

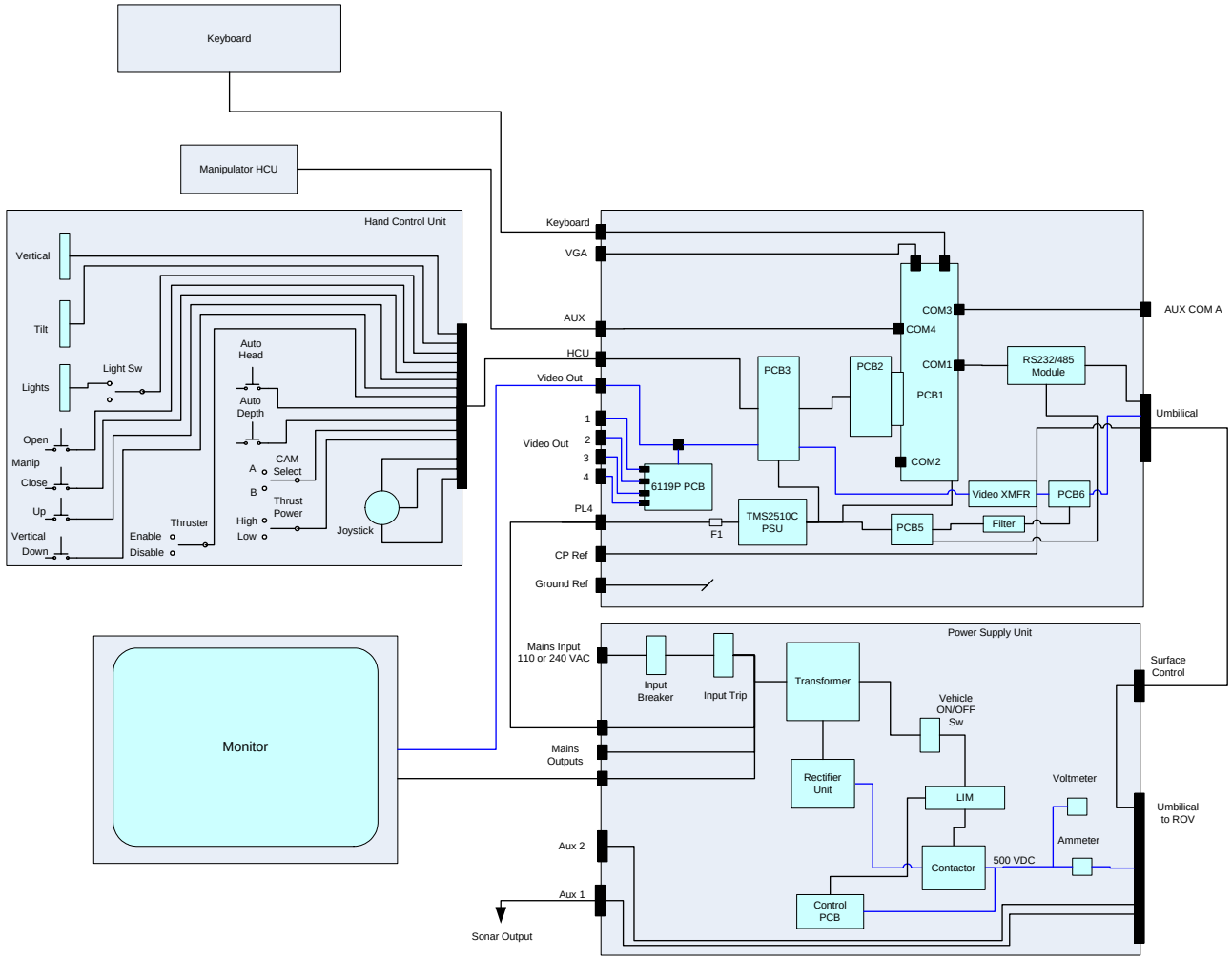

Fig. 3. Surface Power Supply Unit Connection

5.5.2 Vehicle Power Distribution

Refer to Figs. 5 and 6. The VPSU DC-DC Converter converts the 500 VDC input to 48 VDC which is fed to the ROV Junction Box (JB) via a dedicated power cable. The 48 VDC is distributed to the various units fitted to the ROV via individual fuses as follows:

Fuse No.	Rating	Function	Fuse No.	Rating	Function
F1	2A(T)	Sonar	F7	8A(T)	Stbd Forward Thruster
F2	8A(T)	Port Forward Thruster	F8	6.3A(T)	Lights 2
F3	2A(T)	Navigator Unit	F9	8A(T)	Stbd Aft Thruster
F4	2A(T)	Tilt Unit	F10	2A(T)	Auxiliary 2
F5	8A(T)	Port Aft Thruster	F11	8A(T)	Vertical Thruster
F6	6.3A(T)	Lights 1	F12	2A(T)	Auxiliary 1

Table 1. ROV Power Supply Fusing

5.5.3 Vehicle Telemetry Distribution

Telemetry, sonar data and video are distributed from the VPSU via the signals dedicated cable and routed to the ROV JB as follows:

Connector	Pins	Function	Connector	Pins	Function
Sonar	2-3	Sonar Head	Lights 2	2-3	Lamp Unit
NAV	2-3	Navigation Pod	AUX2	2-3	Auxiliary Unit
AUX1	2-3	Auxiliary Unit	Port Fwd	2-3	Port Forward Thruster
Video	2-3	Camera Zoom/Focus	Port Aft	2-3	Port Aft Thruster
	6-7	Camera Video	Stbd Fwd	2-3	Starboard Forward Thruster
Tilt	2-3	Tilt Motor	Stbd Aft	2-3	Starboard Aft Thruster
Lights 1	2-3	Lamp Unit	Vertical	2-3	Vertical Thruster

Table 2. ROV Telemetry Distribution

The ROV JB incorporates a TEST pushbutton switch that allows the power fuses to be checked for serviceability. When pressed, the respective LED will illuminate GREEN if the fuse is serviceable or RED if unserviceable.

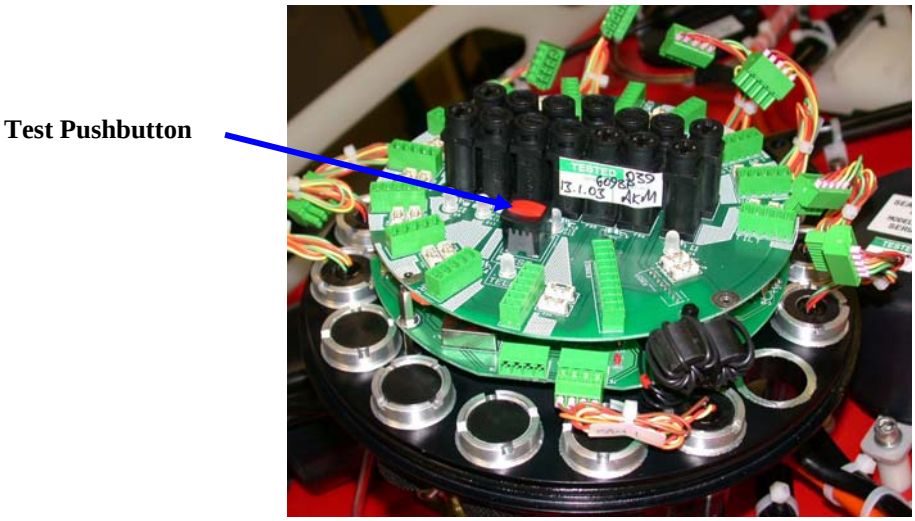

Fig. 4. ROV Junction Box Test Pushbutton

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Falcon DR System 1290

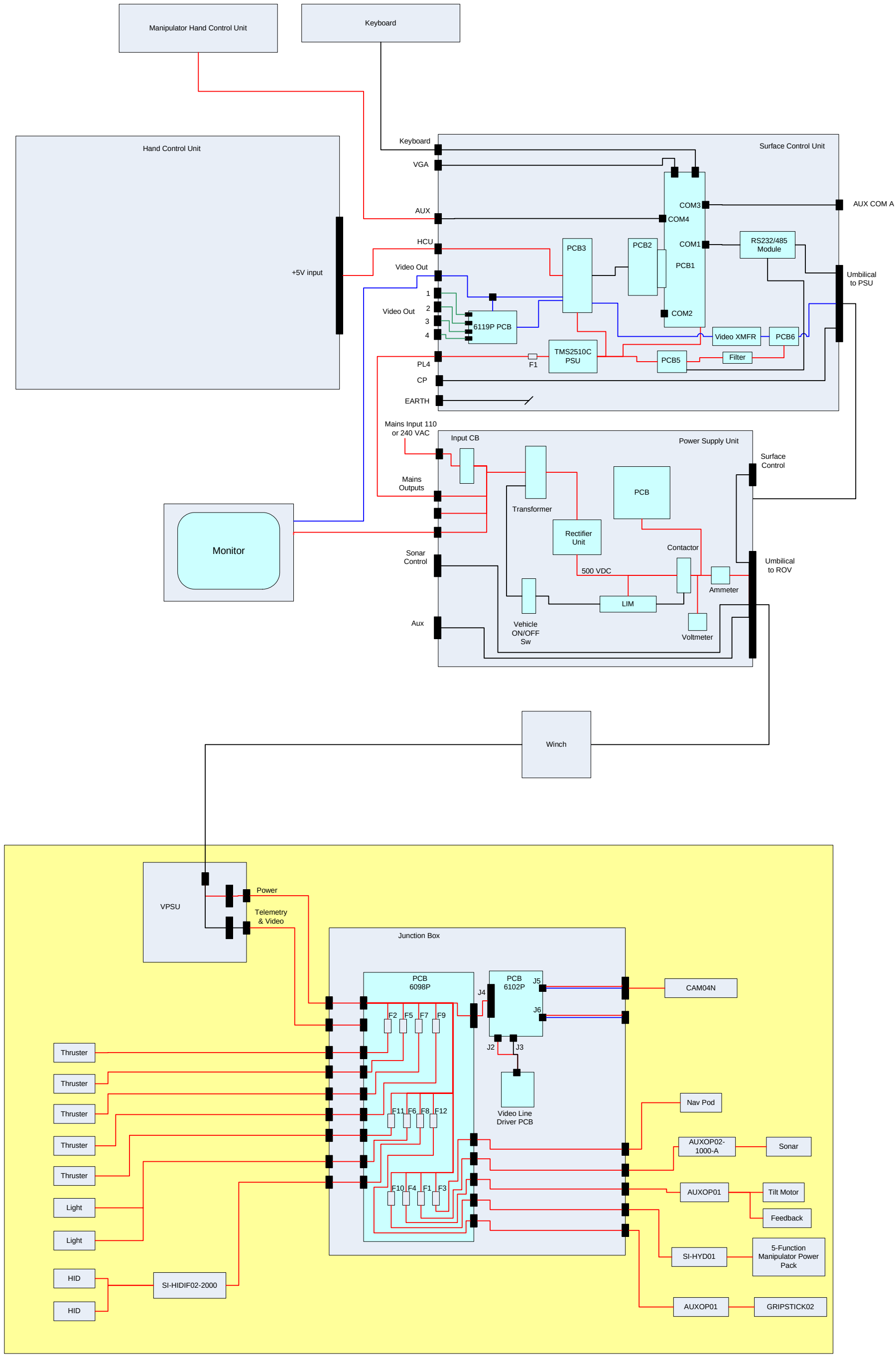

Fig. 5. Power Distribution Twisted Pair Setup

Falcon DR System 1290

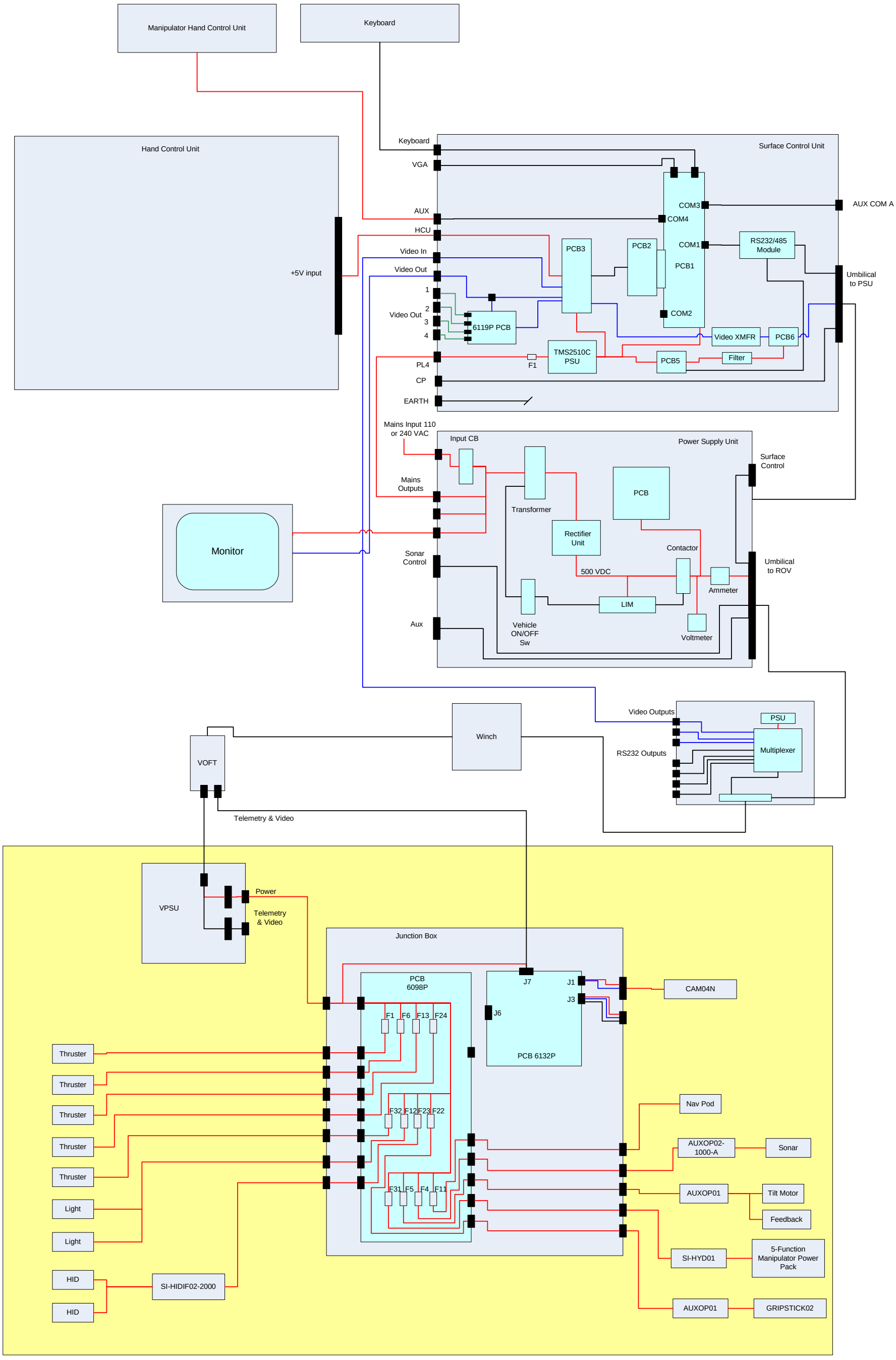

Fig. 6. Power Distribution Fibre Optic Setup

Falcon DR System 1290

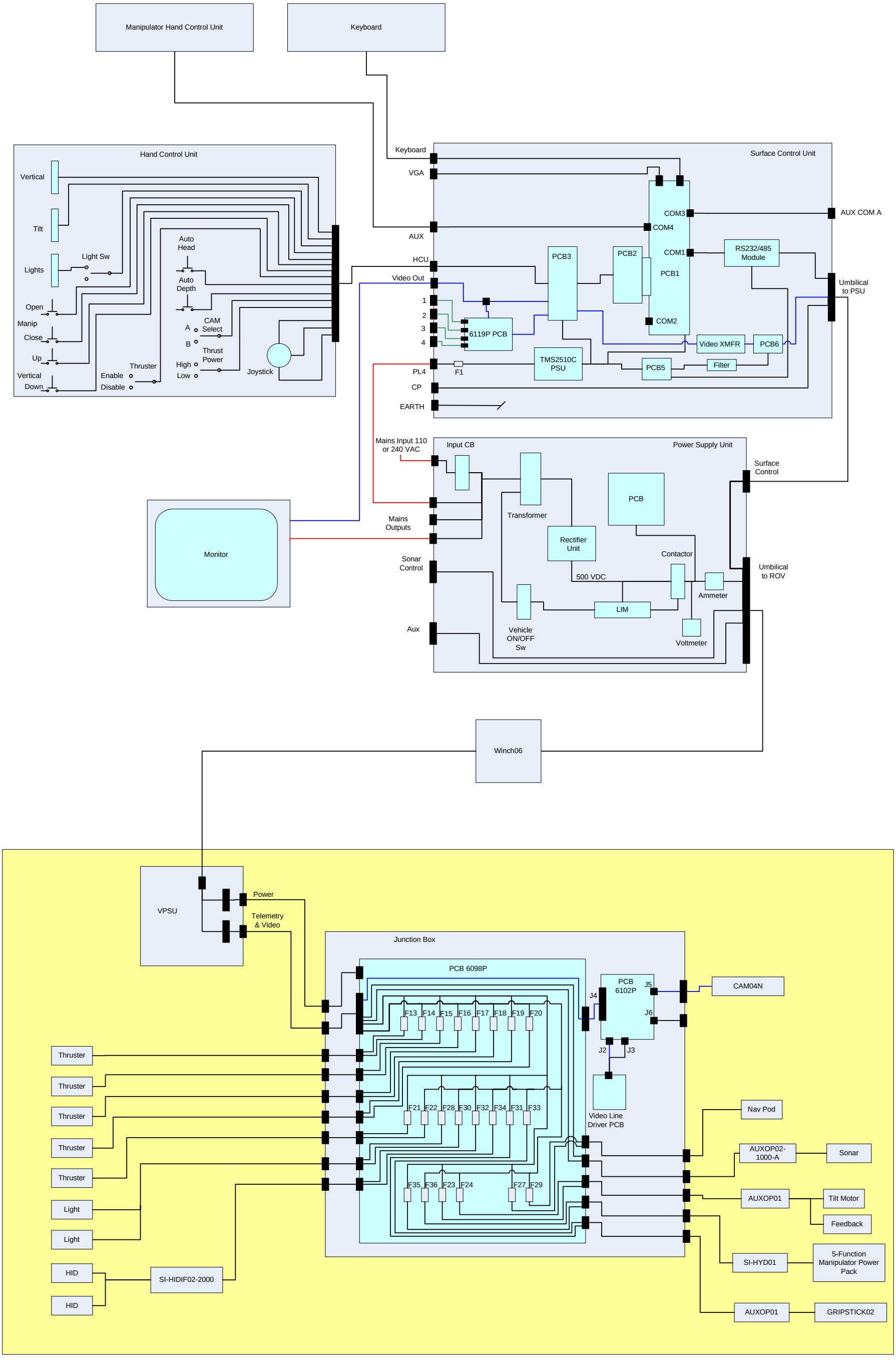

Fig. 7. Data Control and Video Twisted Pair Setup

Falcon DR System 1290

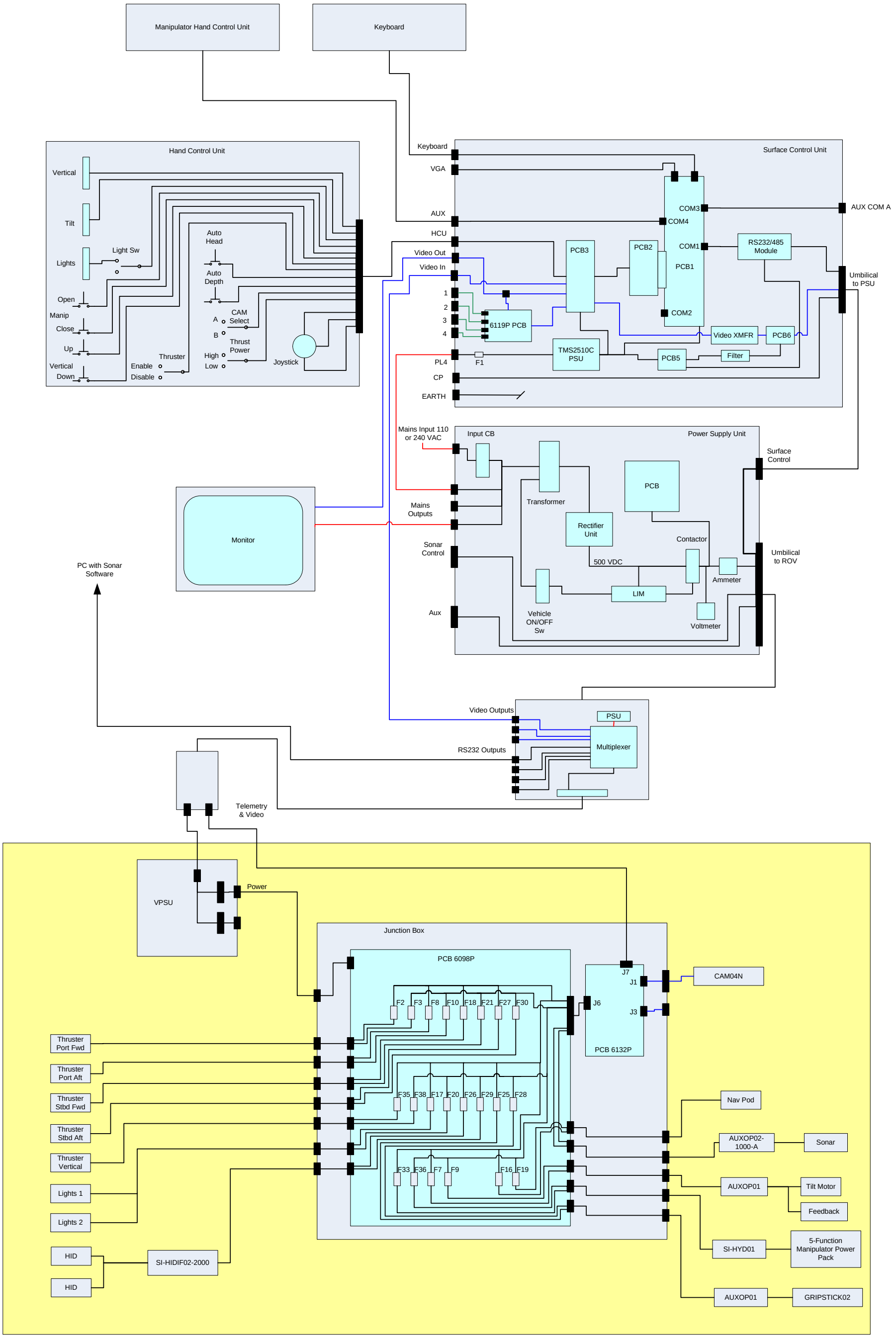

Fig. 8. Data Control and Video Fibre Optic Setup

CHAPTER 6

MAINTENANCE INFORMATION

Contents

Check Sheets

Figures

Tables

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6. MAINTENANCE INFORMATION

This Chapter provides examples of pre-and post-dive checklists, Falcon ROV Dive Log, ROV Equipment Failure Report, Mobilisation Check List, Weekly Maintenance Report, Storage procedures and includes schematic drawings, mechanical drawings and additional information not covered elsewhere in this manual. Instructions on how to replace major vehicle units and system configuration procedures are also included.

6.1 Subsea Unit Replacement

If for any reason a unit connected to the vehicle needs to be replaced, it can simply be disconnected from the junction box and a replacement unit connected in its place.

Each unit has a unique address to identify it. This address is based on what type of unit it is, allowing the surface unit to communicate with one of each type of unit as soon as the vehicle is powered up. Where there are multiple identical units such as lights or thrusters, the remainder of the address uniquely identifies each unit from the others of that type.

During production all units are assigned with a default address of 1. An additional procedure needs to be performed when a non-unique unit is replaced on the vehicle in order to assign a unique address to such units. Units such as Thrusters need to respond to a separately addressed demand from the surface in order to manoeuvre the vehicle correctly. The lights however, are not so obvious, although each light responds identically to the demand made from the surface and each light must be communicated with individually as only one unit can communicate at a time.

6.1.1 Configuration

CAUTION

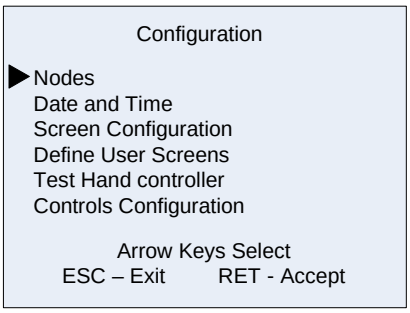
The following procedure requires the use of a powerful utility program that, if operated outside the remit of the procedure, will render units mounted on the vehicle unusable and will require the effected unit(s) to be returned for repair.

WARNING

THE FOLLOWING PROCEDURE REQUIRES THE USE OF A POWERFUL UTILITY PROGRAM THAT, IF OPERATED OUTSIDE THE GUIDELINES MAY CAUSE THRUSTERS TO ROTATE EVEN WHEN THE ENABLE SWITCH IS SET TO THE OFF AND LIGHTS TO OPERATE WITHOUT WARNING.

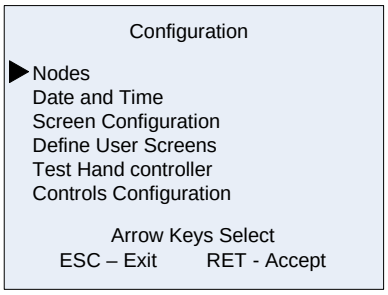
The configuration of the system is fully described in Chapter 4. This section describes only part of the available setup configuration where the operator requires to setup the system nodes when changing, configuring or adding vehicle units.

To enter the configuration setup press **F1** on the system keyboard. **The main menu may ONLY be activated when the thrusters are DISABLED**. The 'main menu' text will replace the 'overlay' text on the monitor display. Also, the 'main menu' will appear as a pop up box within the 'master' diagnostics program, displayed on the VGA monitor (if fitted). Use the keyboard *'cursor'* keys to navigate the menus and press the *'enter'* key to select the required entry. To exit out of the menu and return to normal operation press the *'Esc'* key.

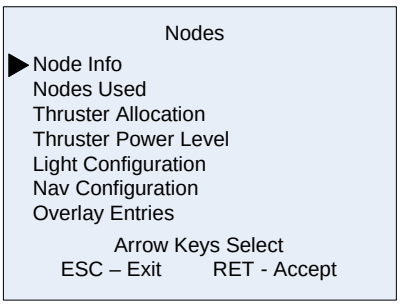


6.1.2 Node Configuration

1. To enter the **Configuration** menu from the Main Menu, move the cursor to the Configuration option and press the **Enter** key. The **Configuration** menu is displayed.

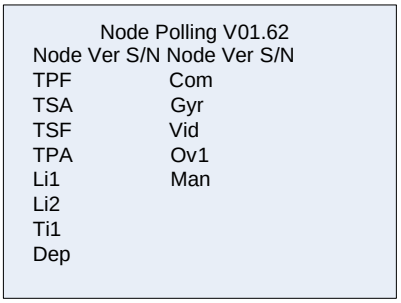


2. Select the **Nodes** sub menu. The **Nodes** menu is displayed.

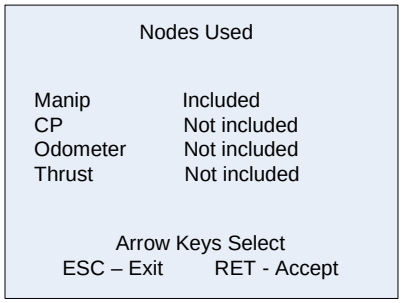


The Nodes sub-menu displays the following options:

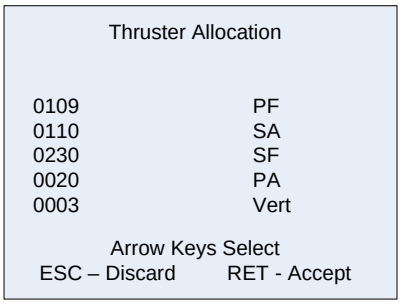
3. **Node Info (Polling):** This screen is useful for vehicle diagnostics as it displays all the nodes connected to the SCU master node. Each node is polled for its Version and Serial number and displayed on the screen. If there is no node connected or powered, then there will be no reply and a blank space is displayed where the version and serial number should be. The nodes used on the network are reflected in the nodes shown, i.e. if the manip node is configured to be used but not the CP then only the manip node will appear in the list of polled nodes. If the vehicle is not powered the overlay node should still reply as this is connected via a different power and network. The version number of the surface software is displayed at the top of the screen. To escape from this screen press 'Esc'.



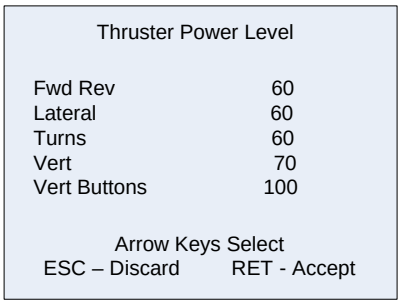
4. **Nodes Used:** Lists the optional nodes that may be connected to the ROV. The nodes are selected with the arrow by using the up and down cursor keys and selected or deselected with the left or right cursor keys as appropriate. To discard these settings press the 'Esc' key and to accept these setting press the 'Enter' key. Accepting the settings preserves the values in a file called 'kit.ini'.



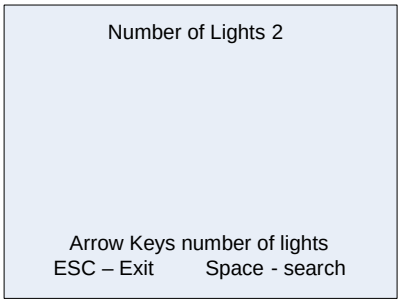
5. **Thruster Allocation**: This screen allows thruster addresses to be allocated and is used after a thruster has been replaced or its position on the vehicle swapped. Each thruster has an address set, on which it responds, this is '1' by default set at the manufacturing stage. If five new thrusters were to be fitted to the vehicle, their address would have to be set to the appropriate value. The 'Thruster Allocation' routine communicates to the thrusters using the extended address, which is in fact the device serial number. This ensures each node can be individually addressed. The user is then presented with the serial numbers and must select their position on the ROV. To set the address, press the 'Space Bar'. Duplication of thruster allocation is then checked before reprogramming.



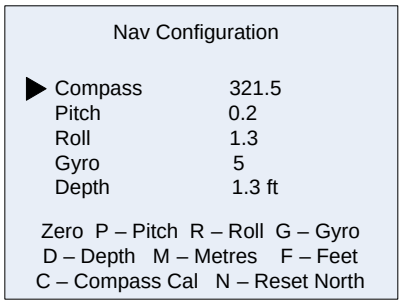
6. **Thruster Power Level**: A switch on the hand controller controls the level of power developed from the thrusters. This allows normal -100% to 100% demand from the joystick and vertical demand when set at 'Full' and -60% to 60% when set at 'Reduced' (i.e. full forward demand on the joystick will only produce 60% demand from the thrusters). The level of reduced power can be varied on the 'Thruster Power Level' screen. The power level is shown, this can be increased or decreased using the up and down cursor keys respectively. The increments and decrements are in 10 percent steps allowing from 10% to 100%. To discard these settings press the 'Esc' key and to accept the setting press the 'Enter' key.



7. **Light Configuration**: This screen allows a third or forth light to be configured and light addresses to be allocated, this is used after a light has been replaced. The number of lights used is displayed, this can be increased using the up arrow key or decreased using the down arrow key. Similar to the thrusters, as more than one node of the same type is fitted the address must be set to allow individual control of the node. As all lights are operated using the same demand their position and actual address are not important as long as they have different addresses. When the light allocation is entered a search is performed using extended addressing to find a light node. When the lights are found their addresses are automatically set and displayed. If no light nodes or only one is found the user is prompted with an appropriate message.



8. **Nav Configuration**: This screen is used to change:

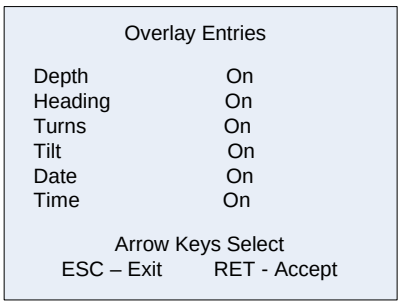


- The depth units used. To select the depth unit, press M for metres and F for feet. The value shown will then be displayed in the unit selected.
- Zero the pitch, roll, gyro and depth. To zero the pitch, roll, gyro and depth, press the respective keyboard key, P – Pitch, R – Roll, G – Gyro, D - Depth.
- Calibrate the compass. Press C to calibrate the compass. Slowly move the compass through its pitch, roll and heading axis's ensuring that full movement is obtained. This should be done very slowly taking approximately one minute for full travel.
- Reset the north. Resets the north value to where the ROV is pointing when selected.

CAUTION

Calibration of the compass and resetting the North value should only be carried out after contacting Seaeye Marine.

9. **Overlay Entries**: This screen lists the various overlay entries and allows them to be turned on or off. The settings made on this screen are not lost when the power is cycled unlike the changes made in Overlay program operation. The entries are selected with the arrow by using the up and down cursor keys and turned on or off with the left or right cursor keys as appropriate. To discard these settings press the 'Esc' key and to accept the settings press the 'Enter' key.



6.2 Handc User Guide

The **HANDC** program is designed for engineering development and may be useful for advance diagnosis by experienced engineers.

If you need to use this program, it is advised that you contact Seaeye Marine Ltd. who will guide you through the fault diagnosis and use of the program. However, this section provides a short guide on how to use the Handc program.

The program polls all the nodes in a continuous loop, allowing nodes to be turned on or off, a delay between nodes and a delay between consecutive loops to be varied and different commands applicable to the various nodes to be performed.

To use the **HANDC** program a VGA monitor must be connected to the surface unit VGA output connector. To obtain the DOS command prompt:

- Hold down the '**F5**' key during the booting up sequence.
- When the C prompt is displayed, press the **RETURN** key to get the C:\ command prompt.
- Run the **HANDC** program by typing in: `handc`

If the version of handc is V2.17 (indicated on the status bar on the top of the screen) or later, the program should configure the serial port settings accordingly. The default is to set the com port for the ROV network.

The screen will display the Handc program and list the nodes.

Handc V2.23

Node	Type	Ad	Tx Data	Tx String	Rx String	Rx Data	Tx Count	D' Count
1	Thruster	1	+0	n16+0			251	0
2	Thruster	2	+0	n26+0			251	0
3	Thruster	3	+0	n36+0			251	0
4	Thruster	4	+0	n46+0			251	0
5	Thruster	5	+0	n56+0			251	0
6	Thruster	6	+0	n66+0			251	251
7	Light	1	0	1150			251	0
8	Light	2	0	1253			251	0
9	Light	3	0	1350			251	251
10	Depth	1	METRES	d16UN			251	0
11	Compass	1	HEADING	c16UN			251	0
12	Gyro	1	DIFF	g15F			251	0
13	Tilt	1	QUERY	t15?			251	0
14	Tilt	2	QUERY	t25?			251	251
15	Overlay	1	REPLY	o150			251	0
16	Overlay	2	REPLY	o250			251	251
17	CP	1	VOLTAGE	n15V			251	251
18	Vid Sw	1	POLL	n16?L			251	0
19	Manip	1	POLL	m14			251	0
20	Odometer	1	Count	q15?			251	251
21	Hand Clr	1	AMQ	h1??AQ			251	0

Fig. 1. Handc Menu Screen

WARNING

HANDC ALLOWS NODES SUCH AS THRUSTERS AND LIGHTS TO BE OPERATED WITHOUT ENABLING ANY SWITCHES (I.E. THE THRUSTERS WILL OPERATE EVEN IF THE ENABLE SWITCH IS IN THE OFF POSITION). OPERATORS USE THIS SOFTWARE AT THEIR OWN RISK.

- **Navigating the menu**: To navigate the various nodes press the *TAB* key, this will move the cyan arrow down the list of nodes, to move up the list hold down *SHIFT* and press *TAB*.
- **Turn On/Off**: *SPACEBAR* toggles the selected node on and off.
- **Exit**: To exit the Handc program, reboot the system by pressing the CTRL/ALT/DEL keys on the keyboard.
- **Standard commands**: The keyboard functions are detailed in the following tables.

NOTE: The standard Falcon software is capable of searching for and configuring thrusters and lights (Thruster V01.52 and lights V01.47) automatically without using handc.

All Nodes

PC	Command	Value	Function	Reply	Notes
S	S		Request serial number	XXXX	4 Figure number
V	V		Request version number	Mmnn	Mm – major number Nn – minor number
Z	Z		Reset Node	-	

Thruster Node

PC	Command	Value	Function	Reply	Notes
PGUP	+	-100% to 100%	Forward demand in 10% increments up to 100%	Ack	Additive
PGDN	-	-100% to 100%	Reverse demand in 10% increments down to -100%	Ack	Additive
↑	+	-100% to 100%	Forward demand in 1% increments up to 100%	Ack	Additive
↓	-	-100% to 100%	Reverse demand in 1% increments down to -100%	Ack	Additive
Home		100%	Max		
End		-100%	Min		
E	E		Emergency stop	Ack	
Ins			Toggles thrust value polarity		
Del			Emergency stop (as per E)		

Light Node

PC	Command	Value	Function	Reply	Notes
PGUP	+	100%	Set light intensity to maximum	Ack	
PGDN	-	-100%	Set light intensity to minimum	Ack	
↑	+	1%	Forward demand in 1% increments up to 100%	Ack	
↓	-	-1%	Reverse demand in 1% increments down to –100%	Ack	

Tilt Node

PC	Command	Value	Function	Reply	Notes
PGUP	+	0 to 90°	Increments absolute demand by 10° up to 90° or 180°		S = Sign N = Value
PGDN	-	0 to 90°	Decrements absolute demand by 10° down to -90° or -180°		S = Sign N = Value
↑	+	0 to 90°	Increments absolute demand by 1° up to 90° or 180°		S = Sign N = Value
↓	-	0 to 90°	Decrements absolute demand by 1° down to -90° or -180°		S = Sign N = Value
R		+90	Max		
C		+0	Centre position		
D	E	-90	Min		

Depth Node

PC	Command	Value	Function	Reply	Notes
R	R		Zero depth		Value stored in Flash

Compass Node

PC	Command	Value	Function	Reply	Notes
R	R		Reset North heading		Ensure vehicle is pointing North. Value stored in Flash
C	C		Toggle Calibration Mode		SI-NAV02 only
O	O		Reset Roll		SI-NAV02 only
P	P		Reset Pitch		SI-NAV02 only

Video Switching Node

PC	Command	Value	Function	Reply	Notes
C	1		Select Camera 1		
D	2		Select Camera 2		

Manipulator Node

PC	Command	Value	Function	Reply	Notes
D	O		Open jaws		
C	C		Close jaws		

6.2.1 Diagnosing Communication Problems

Handc can be useful for identifying communication problems. Run the program as described and ensure only nodes fitted are turned on by selecting the appropriate node using the *TAB* key then pressing the spacebar to toggle the node on or off. When the node name is in light grey and text appears under the "TX Data" and "TX String" columns the node is turned on. When the node is turned on, the value under "TX Count" will increment every time the node is polled. If the node does not reply with valid data in the allowed time, the value under "D' Count" (dropped count) will increment. A valid reply from the node is indicated with cyan coloured text under "RX String" column and white coloured text under "RX Data". To reset both the "TX Count" and "D' Count" press the RETURN key. If left testing, dropped counts can be monitored, a 10% dropped count rate can be tolerated but anything worse should be investigated. Note that if a node is slow in replying the late reply can corrupt the following node communications. In this situation remove suspect nodes in the junction box (**turn power off first**) and turn off in handc one at a time to identify the faulty node.

WARNING

WARNING IF THE ROV IS LEFT POWERED ON IN AIR, EVEN WITHOUT OPERATING THRUSTERS OR LIGHTS, THE VEHICLE POWER SUPPLY MAY OVER HEAT.

6.3 Umbilical, Tether, Leads and Connectors

Falcon systems use a multi-cored surface interconnection lead, deck lead and umbilical. The specification and composition of which will be shown along with all other leads and connections in the applicable drawing at the end of this chapter.

6.3.1 Umbilical

The Falcon 1290 System is delivered with two umbilicals, Type 5823 used for Fibre Optic system set up and Type 5769 used for Twisted Pair system set up. The umbilicals are multi-cored polyurethane umbilical cables used as the electrical communicating medium between the surface electronics and vehicle with the following functions:

- DC power distribution.
- Video Signals.
- Vehicle Telemetry.
- Sonar Telemetry (when fitted).
- CP Reference (when fitted).
- Earth.

When carrying out continuity checks or insulation checks, ensure that BOTH ends of the umbilical/tether are disconnected from the surface unit and ROV.

6.4 Line Insulation Monitor

WARNING

DANGER OF FATAL ELECTRIC SHOCK. AC CURRENT VALUES IN EXCESS OF 10 MA AND DC CURRENT VALUES IN EXCESS OF 40 MA CAN BE FATAL.

The Line Insulation Monitor (LIM) monitors the insulation resistance of the AC and DC circuits.

Within the LIM, a pulsating AC measuring voltage is generated. The positive pole is connected to the system to be monitored via the terminals L1/L2. The negative pole is connected to earth via an electronic circuitry and the terminals ⏚/KE. The connections are monitored continuously. If one of these connections is interrupted, the alarm LEDs flash and the alarm relays switch.

The measuring pulse consists of positive and negative pulses of the same amplitude. The pulse duration depends on the respective leakage capacitances and insulation resistance of the system being monitored.

The measuring circuit is closed via ohmic insulation faults. When the insulation value falls below the pre-set response value, the alarm LEDs “ALARM” illuminates and the alarm replays switch.

The alarm LED “ALARM 1” indicates an “AC earth fault”. The alarm LED “ALARM 2” indicates a “DC earth fault”.

ALARM 1 leakage detector is factory set to x10, ALARM 2 leakage detector is factory set to x20.

Fig. 2. Line Insulation Monitor (LIM)

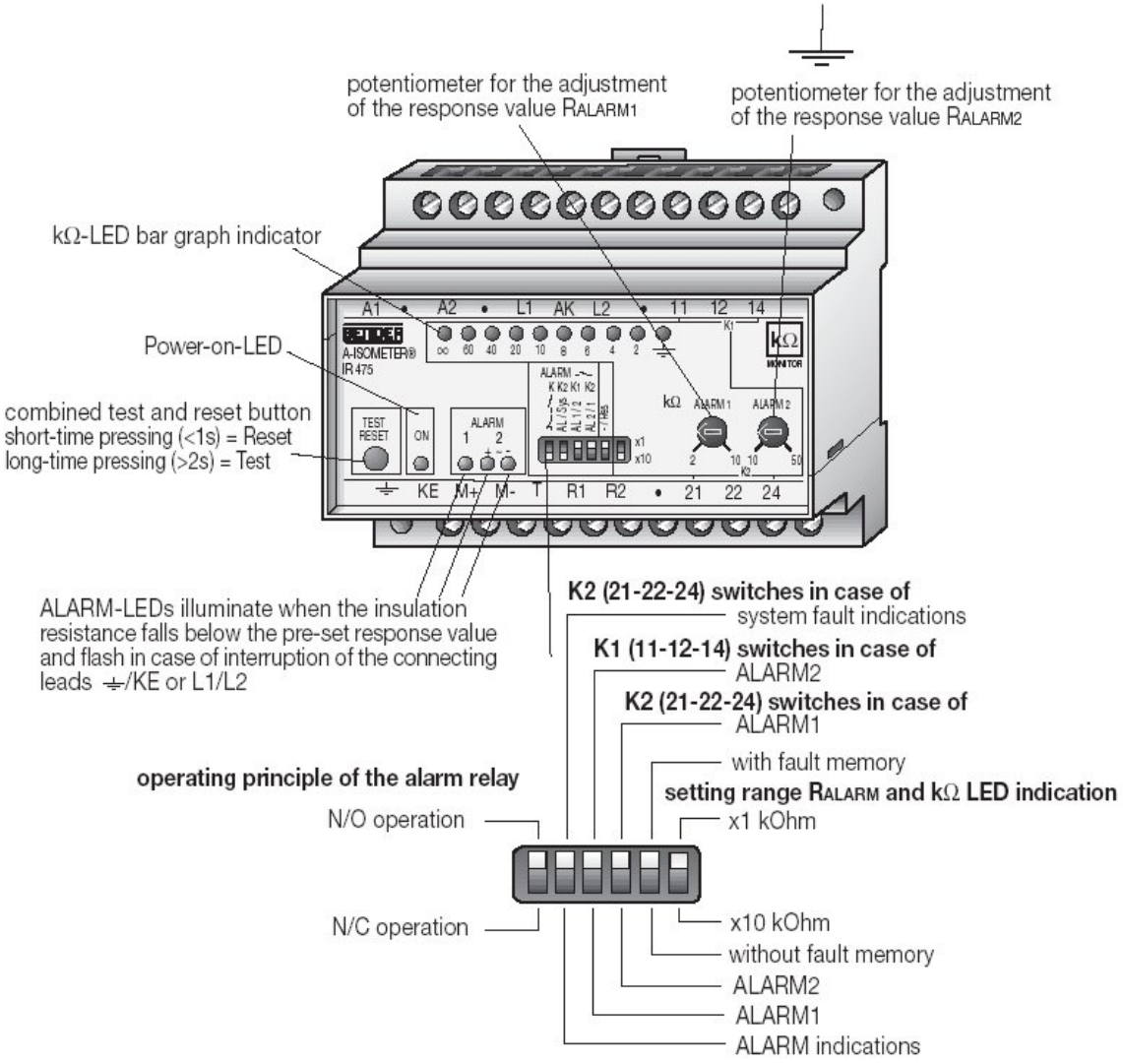


Fig. 3. LIM Functions

The LIM is factory set as follows:

Function	Setting
RALARM1	10
RALARM2	20
NC/NO operation	N/C (down)
ALARM indications DIP Switch	N/C (down)
ALARM1 DIP Switch	N/O (up)
ALARM2 DIP Switch	N/O (up)
Without fault memory DIP Switch	N/O (up)
X10 kOhm DIP Switch	N/C (down)

If a fault occurs, the kΩ-LED bar indicator will illuminate for the respective fault value, the ALARM1 or ALARM2 LED illuminate and the LIM will trip. You can then reset the LIM by pressing the RESET button on the LIM or switch the PSU power OFF and ON.

Should the LIM trip again then the fault must be investigated and rectified.

6.4.1 Setting the Leakage Current Level (The Leakage Impedance)

The IR475 DC leakage detector has an adjustable scale from 10 to 50 Kohm (x1) or 100 to 500 Kohm (x10). This sets the "Preset Response Value, (Rp)" and is used to set the leakage current level. The leakage current level is set as follows:

- Assuming the worst case with both positive and negative supply lines leakage:

$$\text{Leakage Current (mA)} = \frac{\text{Max. Operating Voltage (Volts)} \times 2}{\text{Rp (Kohm)}}$$

For example:

For a leakage current of 5 mA, the maximum operating voltage is 300 volts.

The Rp should be set to 120 Kohm.

6.5 Power Supply Unit Technical Data

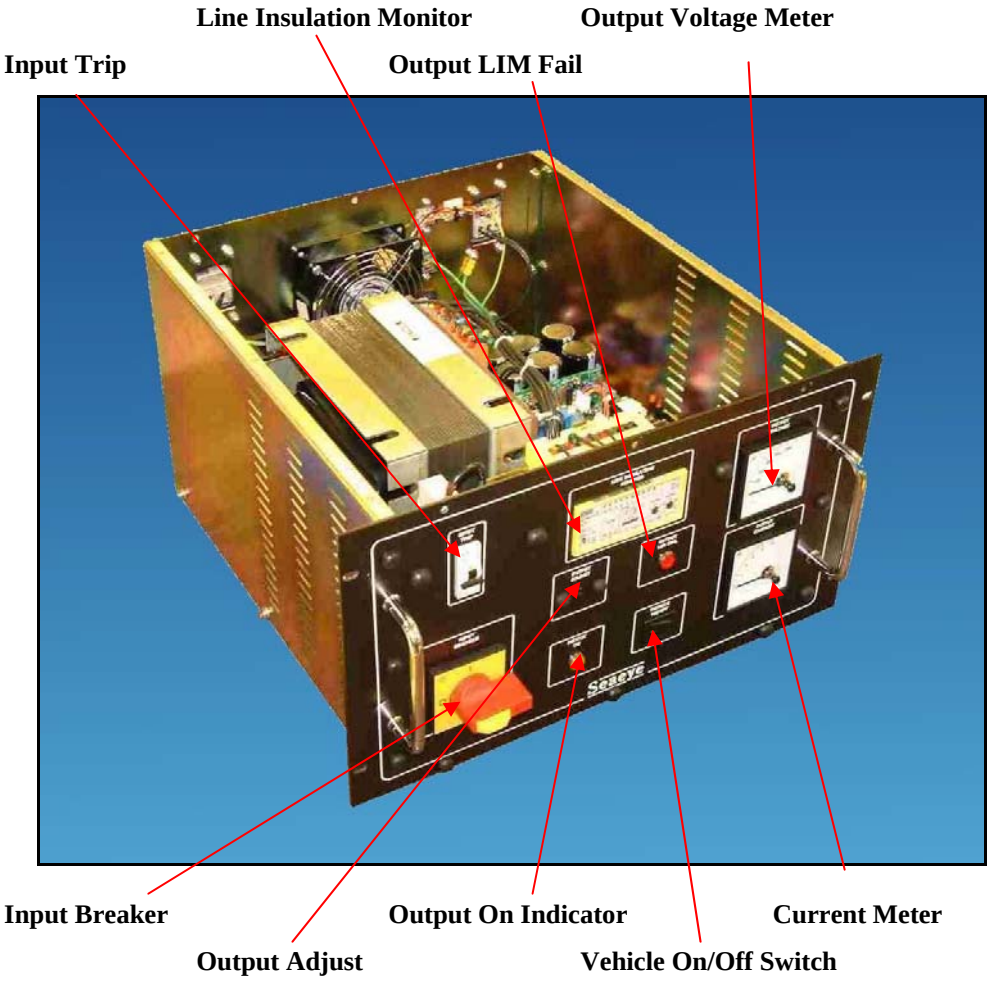


Fig. 4. Power Supply Switch and Indicator Layout

Technical data of the Power Supply Unit are as follows:

Technical Data	
Insulation co-ordination acc. to IEC 644-1 Rated insulation voltage Rated impulse withstand voltage contamination level Test voltage acc. to IEC 60255	 AC 630V 6 kV/3 3.75 kV
Operating range of nominal voltage U_n	AC 0 - 828 V DC 0 - 480 V
Supply voltage U_s	see nameplate
Response value R_{ALARM1} Response value R_{ALARM2} Response time (0.5 x R_{ALARM} / C_E = 1 µF range 6 – 500 kΩ range 2 – 6 kΩ Max. system leakage capacitance	2-10 kΩ / 20-100 kΩ 10-50 kΩ / 100-500 kΩ 8 – 12 sec 8 – 35 sec 20 µF
Internal resistance Impedance at 50 Hz Max. admissible stray DC voltage	200 kΩ 180 kΩ DC 800 V
Switching components Rated contact voltage Limited making capacity Limited breaking capacity AC / DC	2 change over contacts AC 250 V / DC 300 V AC / DC 5 A 2 / 0.2 A
Test of electromagnetic compatibility (EMC) Interferences acc. to EN 50082-2 Emissions acc. to EN 50081-2 (for use in industrial areas)	
Ambient temperature during operation Storage temperature range IR475LYT-4 Climate class acc. to IEC 60721 3K5, except condensation and formation of ice	-10 – 55°C -40 – 70°C -25 – 70°C / -40 – 70°C
Type of connection cable Screw terminals / Aluminium or Copper Temp. range cable Wire cross section Single wire / fine braid Protection class acc. to EN 60529 Internal components / terminals Weight max.	 60°C (18 - 16AWG) – 75°C (14 – 12AWG) 0.2 – 4 mm² 0.2 – 2.5 mm² (24 – 12 AWG) IP30 / IP20 430g

Table 1. PSU Technical Data

6.6 Vehicle Power Supply Unit

As well as distributing the power and telemetry data to the ROV, the VPSU incorporates protection devices so that power faults or overheating faults do not damage the ROV electronics. If one of the protection devices is activated the system will shut down and power to the ROV disconnected. These devices are factory set, and provide protect for under- and over-voltage, over current and a thermal device for the VPSU overheating.

If one of these devices is activated, switch off the Vehicle power and Surface power. For under-/over-voltage faults and over current fault, try to switch the System power and Vehicle power back on. If the fault persists, investigate the fault by carrying out the fault finding procedures detailed in Chapter 7. For an overheating fault, wait until the VPSU has cooled and then power the system up. If further assistance is required contact Seaeye Marine Ltd.

6.7 Maintenance Procedures

The following maintenance procedures are described:

- DC Voltage Compensation (Para. 6.7.1).
- Installing New Software (Para. 6.7.2).
- Thruster Propeller Replacement (Para. 6.7.3).
- Thruster Replacement (Para. 6.7.4).
- Fibre Optic Termination (Para 6.7.5).
- Set-up of Video System (Para. 6.7.6).
- Vent Plug Replacement (Para. 6.7.7).

If you require further maintenance procedures not described in this technical manual, contact SEAEYE MARINE Ltd.

6.7.1 Maintenance Procedure - DC Voltage Compensation

This task adjusts the DC power supply to compensate for losses in the DC power lines between the Surface Power Supply unit and the ROV. The task is in two parts, the first part is to calculate the round trip resistance (Rt), which is used in the second part to calculate the DC compensation required. This maintenance task requires the ROV to be operational.

Frequency of Task

Compensation adjustments should be carried out in the following instances:

- On system installation.
- Umbilical or tether replacement.
- Significant changes to the umbilical or tether length.

Tools Required

The following tools may be required:

- Insulated screwdrivers (rated to 500VDC minimum).
- Insulated trimming tool (rated to 500VDC minimum).
- Digital multi-meter.

- Calculator.
- Shorting link (to carry minimum of 3A).

Parts Required

No parts required.

Procedure

WARNING

DANGER OF FATAL ELECTRIC SHOCK. BEFORE REMOVING OR OBTAINING INTERNAL ACCESS TO THE EQUIPMENT, ISOLATE ALL THE UNITS POWER SUPPLIES.

DANGER OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL. WHEN THE SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ROV SYSTEM IS TO BE UNDERTAKEN ONLY BY PERSONS FULLY AWARE OF THE DANGERS INVOLVED AND HAVE TAKEN ADEQUATE PRECAUTIONS.

POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE ROV SYSTEM, ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENANCE ACTIVITY IS IN OPERATION.

NOTE

During this task, refer to the appropriate umbilical drawing at the end of this chapter.

1. Ensure the ROV system is electrically isolated.
2. Ensure that no person is performing maintenance work on the system or system cabling.
3. Disconnect the umbilical cable from the Surface Power Supply Unit (PSU) umbilical socket and the umbilical from the vehicle junction box.
4. Using a multi-meter, measure the round trip resistance (Rt) between the surface PSU end of the umbilical cable and the vehicle end of the umbilical cable by connecting a multi-meter between pins 6 and 7 on the umbilical vehicle end M3W12F connector, (i.e. refer to the umbilical drawings) and connecting a shorting link to pins B1 and B2 on the umbilical surface PSU end F1-HANKIT01 connector, (i.e. refer to the umbilical drawings).
5. Note the Rt reading.
6. Ensure that all surface PSU and ROV electrical power is switched off.
7. Connect the main power supply to the surface PSU.
8. With the umbilical still disconnected, switch on the main power to the surface PSU.
9. Switch the surface PSU Input Breaker to “I” (on).
10. Switch the surface PSU VEHICLE OUTPUT to “ON”.
11. Ensure that the output voltage is 500VDC (on the Output Voltage Meter). If the voltage is not 500VDC, contact Seaeye Marine who will send the procedure for adjustment. Under no circumstances are you to attempt to carry out the adjustments without prior written notification.

12. Switch the surface PSU VEHICLE OUTPUT to "OFF".
13. Switch the surface PSU Input Breaker to "O" (OFF).
14. Switch the mains input supply to "OFF".
15. Remove the link and multi-meter from the umbilical cable connectors.
16. Reconnect the umbilical to the surface PSU and the vehicle junction box.
17. Electrically connect the system for operational use.
18. Carry out the Pre-operational checks as detailed in Task 1.
19. Launch the ROV into the water in accordance with Chapter 4.
20. Operate the vehicle to give a constant DC current of at least 3 amperes by switching the lamps to full brightness, and the thrusters to full power. If necessary, maneuver the ROV against a solid object such as a wall to allow full thrust whilst carrying out this check. Observe and note the surface PSU ammeter reading.
21. Calculate the surface voltage (Vs) as follows:

    Vs = 500VDC + (DC current x Rt)

22. Whilst maintaining the current noted in (20), adjust the surface PSU Output Adjust potentiometer located on the front panel, until the surface PSU voltmeter indicates Vs as calculated in (21).

CAUTION

Danger of damage to Thruster Motor. Do not operate the Thruster Motor in air for longer than one minute.

NOTE

As the adjustment is made, the DC current will increase, therefore either maintain the current measured initially by decreasing thrust, or repeat paragraphs 20 to 22 until the correct adjustment is achieved.

23. Switch off all power supplies, recover the vehicle and carry out the Post-Operational checks in accordance with Task 2.

6.7.2 Maintenance Procedure - Installing New Software

From time to time, individual units on this vehicle may need replacing or upgrading. This procedure details how to upgrade the Falcon System to include the latest versions of software. It is a requirement that the surface unit software should also be upgraded.

Frequency of Task

The software should be upgraded:

- When a unit is replaced with a difference version or is upgraded.
- When a software fault is diagnosed.

Introduction

The purpose of this procedure is to upload new software.

Tools Required

The following tools may be required:

- Screw drivers (common sizes).

Parts Required

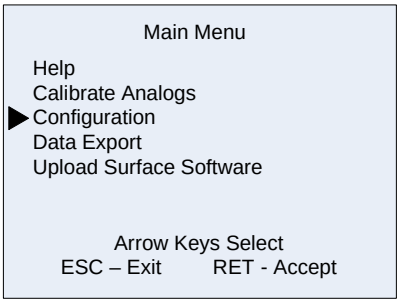
The following parts may be required:

- Latest software Handc and Master Program Floppy Disc.

Procedure

The 3½" floppy disc includes the latest versions of Handc and Master programs. To upload these to the surface unit carry out the following:

1. With the ROV on deck, set the Surface Unit main breaker to ON, but leave the vehicle power set to OFF.
2. At the rear of the SCU, connect the serial port **COM A** to an IBM compatible PC serial port using the Null/Modem Cable (Part no. CS00179 provided with the system) using the 9 pin D-Type connector.
3. On the PC, insert the 3 ½" floppy disc and access the attached file; "send_ master.bat". Double click or press enter and the status should read, "Waiting for receiver…"
4. Data transmission from the PC should begin.
5. On the SCU press F1 on the keyboard to display the "Main Menu" options screen. Scroll down using the "↓" key to "Upload Surface Software". Press enter.
6. Once the upload is complete, the SCU will reboot to the new version of master software and default to the operator overlay screen. If necessary, reboot the complete system.



6.7.3 Maintenance Procedure - Thruster Propeller Replacement

Frequency of Task

The propeller should be checked:

- Pre Dive.
- Post Dive.

The propeller should be replaced when:

- There is obvious damage to propeller.
- Poor ROV performance.

Introduction

The purpose of this check is to ensure that the thruster is working efficiently. Before changing the thruster propeller, ensure that the poor ROV performance was not caused by a 'loose' propeller. The propeller is magnetically coupled, therefore, although rotating it may be slipping due to the loose fitment.

Tools Required

The following tools may be required:

- 'C' Spanners.
- Allen Keys (common sizes).

Parts Required

The following parts may be required:

- Thruster Propeller (Part Number P01780).
- Loctite 222.

Procedure

WARNINGS

DANGER OF FATAL ELECTRIC SHOCK. BEFORE REMOVING OR OBTAINING INTERNAL ACCESS TO THE EQUIPMENT ISOLATE ALL THE UNITS POWER SUPPLIES.

POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE ROV SYSTEM ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENACE ACTIVITY IS IN PROGRESS.

Some early Falcon ROV may have difference types of thrusters fitted, either fitted with thrusters that have 36 mm or 37 mm propeller blades, or even a mixture of the two types. The following details the difference between the two types. Either can be used, however, DO NOT mix the washer or bearing washers between the two types.

How to identify the correct Thruster Propeller Assembly

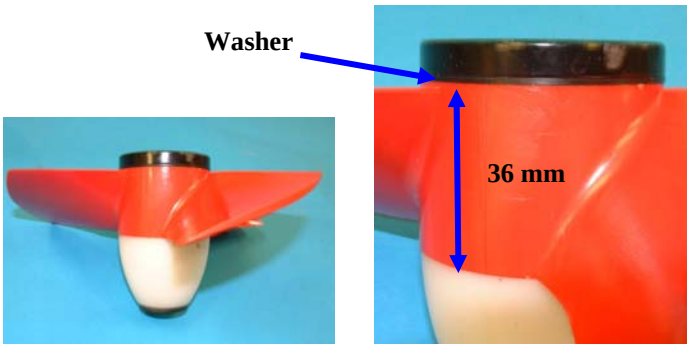


Fig. 5. Thruster 36 mm Version

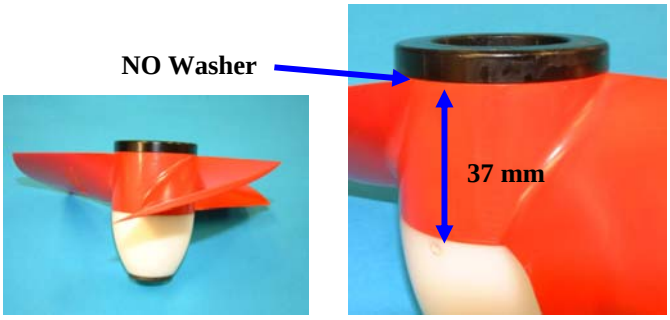


Fig. 6. Thruster 37 mm Version

NOTE

DO NOT fit the spacer to the 37 mm Propeller Blade.

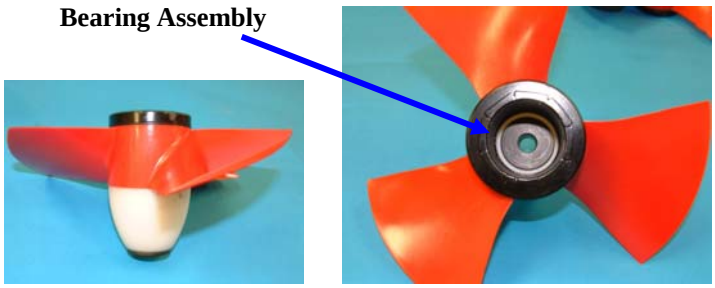


Fig. 7. Enclosed Water Lubricated Bearing Assembly

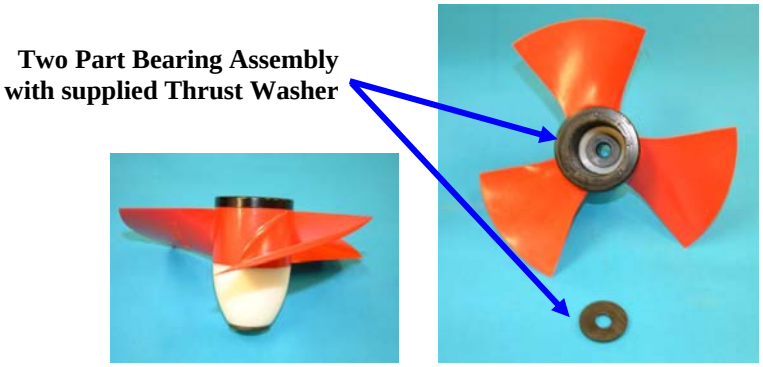


Fig. 8. Two Part Water Lubricated Bearing Assembly

Propeller Replacement Procedure

NOTE

The procedure photographs show the thruster removed from the ROV. This is for clarity only. The propeller blades can be replaced with the thruster in-situ on the ROV.

Proceed as follows:

1. Visually examine the propeller to see if replacement is completely necessary.

Fig. 9. Propeller Assembly

2. Remove the socket head screw, spring washer and propeller retainer.

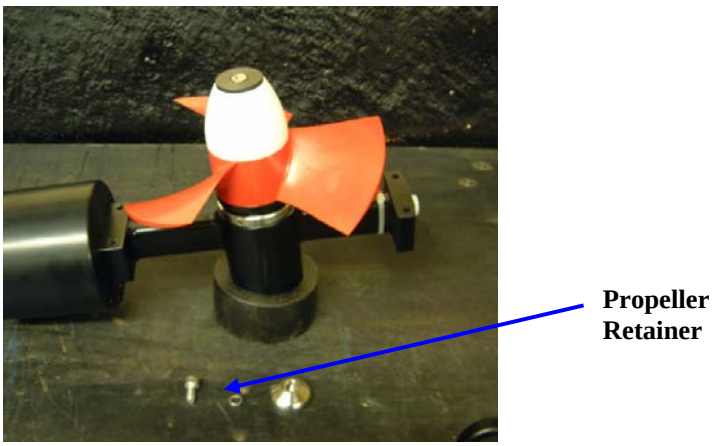


Fig. 10. Retainer Parts

3. The propeller assembly can now be removed; it may be difficult to remove as it is magnetically coupled.

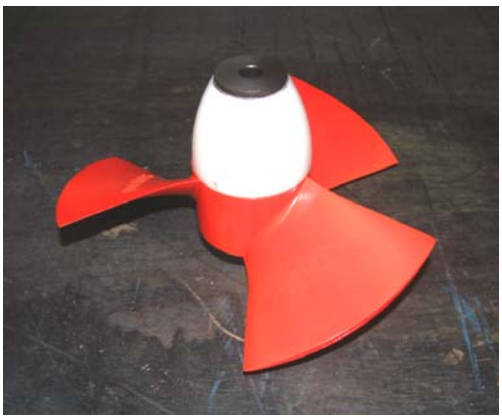


Fig. 11. Propeller Assembly Removed

4. The propeller assembly can now be dismantled, they are holes either side of the nose cone and one in the magnetic coupling, these can be used for the 'C' spanners to disassemble.

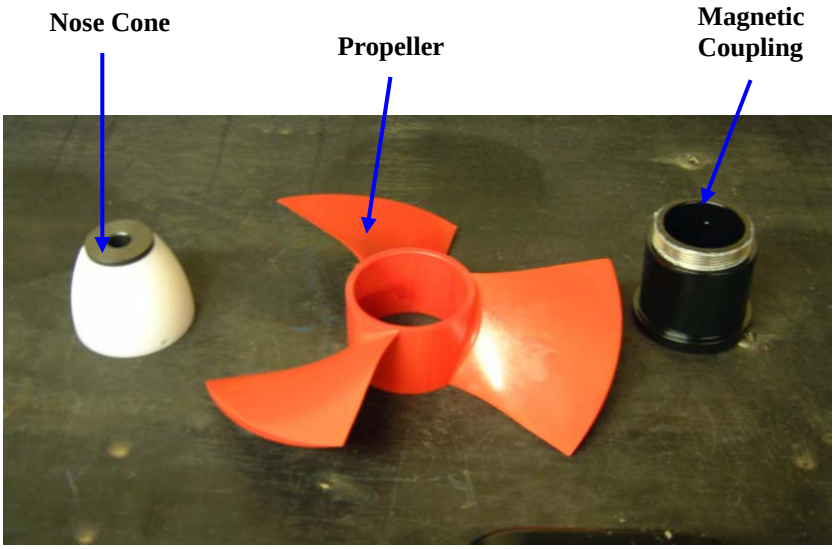


Fig. 12. Propeller Coupling Assembly

5. The propeller can now be changed.

6. When fitting the magnetic coupling to the nose cone, use Loctite 222 on the inside of the nose cone.

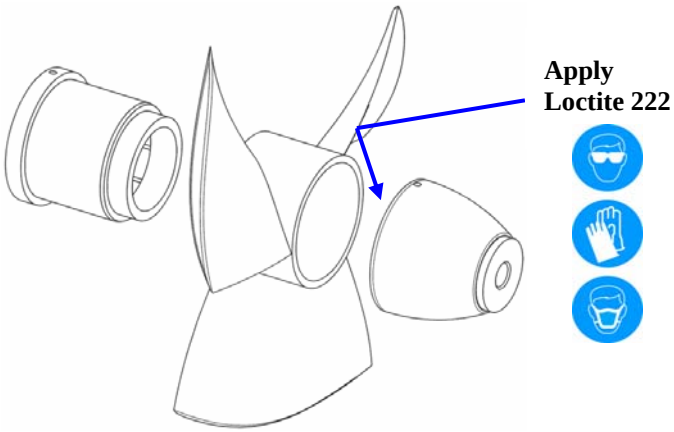


Fig. 13. Propeller Fitment

7. Use the 'C' spanners to tighten the assembly together.
8. Refit the propeller to the thruster. Ensure that the propeller rotates without any restriction, remember that the propeller is magnetically coupled.

6.7.4 Maintenance Procedure - Thruster Replacement

Frequency of Task

When the thruster motor is defective.

Introduction

This procedure details how to change the SI-MCT01 Thrusters fitted to Falcon ROV.

Tools Required

The following tools may be required:

- Flat bladed screwdrivers (common sizes).
- Open ended or ring spanners (common sizes).
- P02733 – Falcon Penetrator Spanner.
- Hex keys (common sizes).
- Torque wrench (various settings).

Parts Required

The following parts may be required:

- Loctite 222, 641 and 480.
- Silicone grease (Molycote MS111 or similar).
- Underwater Lubricant (Aqua Shield or similar).

Procedure

WARNINGS

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DANGER OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL. WHEN THE SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ROV SYSTEM IS TO BE UNDERTAKEN ONLY BY PERSONS FULLY AWARE OF THE DANGERS INVOLVED AND HAVE TAKEN ADEQUATE PRECAUTIONS.

POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE ROV SYSTEM, ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENANCE ACTIVITY IS IN OPERATION.

POSSIBILITY OF TOXIC HAZARDS. DURING MAINTENANCE OR REPAIR IT IS POSSIBLE TO COME INTO CONTACT WITH SUBSTANCES HARMFUL TO HEALTH. PRIOR TO ALL MAINTENANCE OR REPAIR TASKS ENSURE THAT THE RELEVANT DATA HAZARD SHEETS AND LOCAL COSHH PROCEDURES HAVE BEEN READ AND UNDERSTOOD.

DANGER TO PERSONNEL AND EQUIPMENT. THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE VEHICLE IS CLEAR OF ANY OBSTRUCTION AND PERSONNEL PRIOR TO ENERGISING THE DC SUPPLY.

CAUTIONS

Danger of damage to PCBs. Do not remove or replace PCBs unless the supply is switched off. PCBs must be handled in accordance with electrostatic discharge handling procedures. Damage to PCBs could affect the safe operation of the equipment.

Danger of damage to equipment. When checking connections, care is to be taken not to slacken them, otherwise their watertight integrity may be breached.

Danger of damage to Thruster Motor. Do not operate the Thruster Motor in air for longer than one minute.

Danger of damage to lights. Do not operate the vehicle lights for longer than ten seconds in air.

The following procedures are a general guide to removing/replacing the thrusters from the respective ROV.

Disassembly:

1. Ensure the ROV system electrically isolated.
2. Ensure that no person is performing maintenance work on the system or system cabling.

CAUTION

Danger of damage to equipment. The Falcon ROV Junction Box may have an excessive pressure build up due to heat conditions.

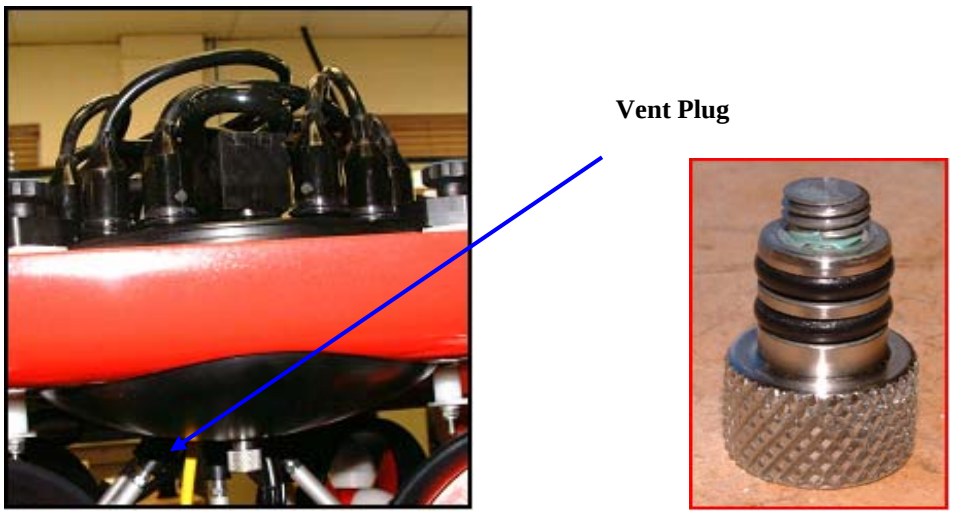


Fig. 14. ROV Junction Box Vent Plug

3. Remove the VJB vent plug and retain.
4. Remove the four ROV fairing securing fasteners and remove the fairing cover.

Fairing Retention Screws

Fig. 15. ROV Fairing

5. Remove the four VJB retention screws and spacers and carefully remove the ROV JB cover. Secure the cover so that you can access the penetrators.

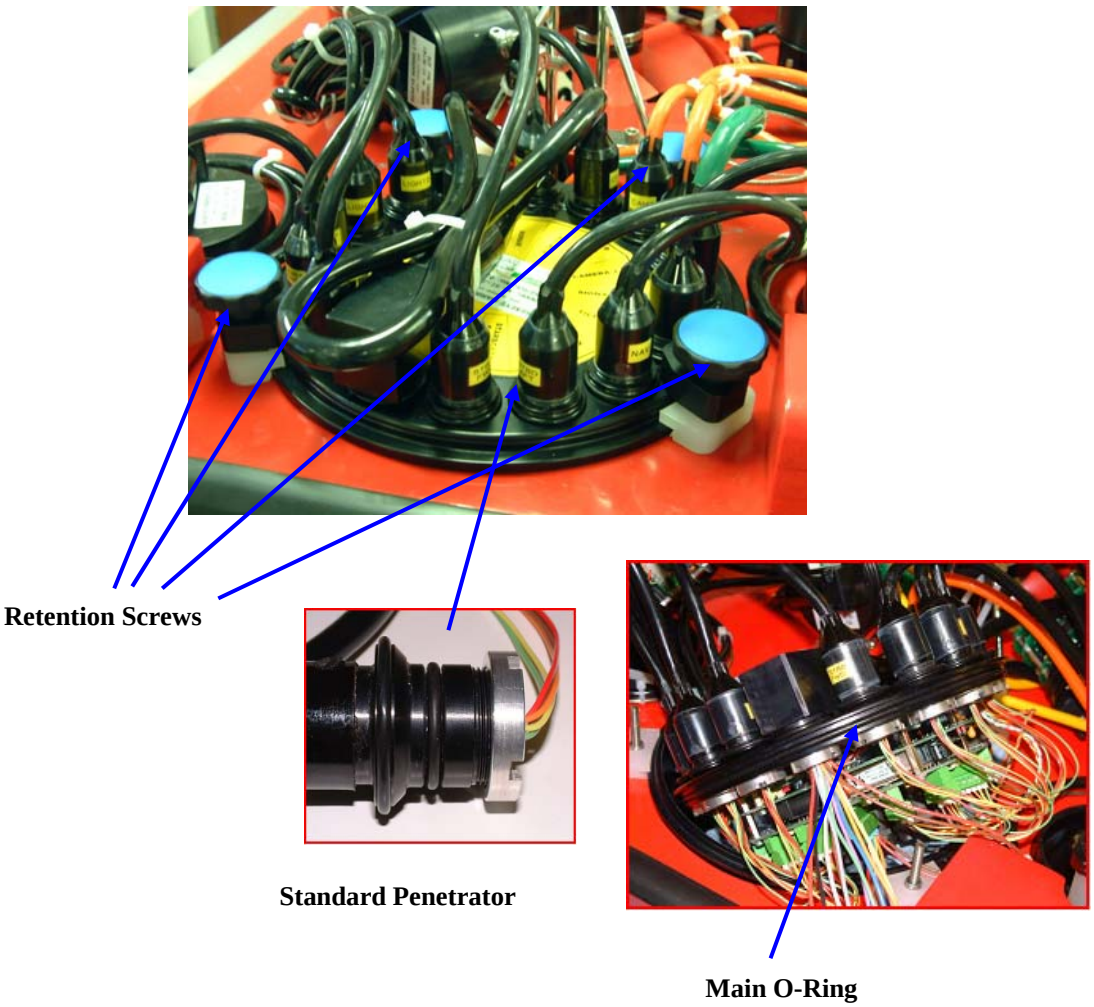


Fig. 16. ROV Junction Box

6. Disconnect the respective thruster terminal block connector from the ROV Junction Box.

Fig. 17. Thruster Connector

7. Unscrew the whip retaining ring from the ROV JB using the supplied C-spanner.

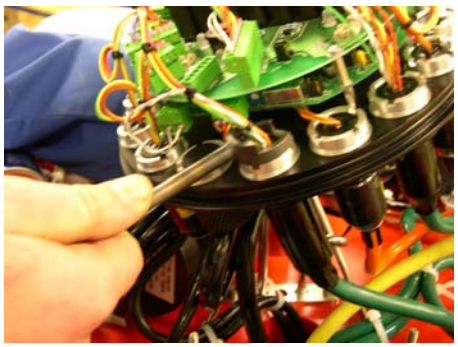


Fig. 18. Whip removal

8. Remove all the tie wraps that are holding the whip onto the vehicle chassis.

The following steps refer to the removal of one thruster. Where there is a difference between the thrushers, additional detail is added. Refer to Fig. 22 for details of the thruster components in steps 9 to 19.

NOTES

If a single function manipulator or CP probe is fitted to the ROV, this will have to be removed to allow access to the forward starboard thruster.

It may be possible to remove the thruster without removing the thruster nozzle and propeller. If this is the case, go to step 13. However, if you have difficulty removing the complete thruster assembly, carry out steps 9 to 12.

Horizontal Thruster

9. Remove the two M6 x 12 socket screws securing the thruster assembly to the mounting bracket to enable access to the top two socket screws (8).

10. Remove the four M5 x 30 socket screws (8), four M5 coil washers (11) and four M5 plain washers (7) securing the thruster nozzle (2).

11. Remove the thruster nozzle (2).

Fig. 19. Thruster Nozzle Removal

12. Remove the M6 x 12 socket screw (9), M6 coil washer (10) and the thrusters propeller retainer (3) securing the thrusters propeller assembly (6). Remove the thruster propeller assembly (6).

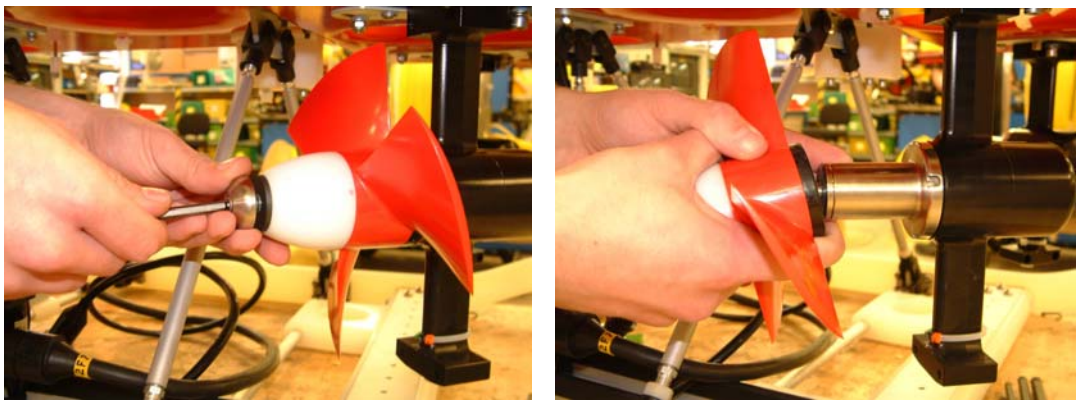


Fig. 20. Thruster Propeller Removal

13. Remove the three M6 Nylok nuts, three M6 plain washers securing the thruster mounting plate to the vehicle. On the two aft thrusters, a nylon spacer is also fitted between the mounting plate and ROV.

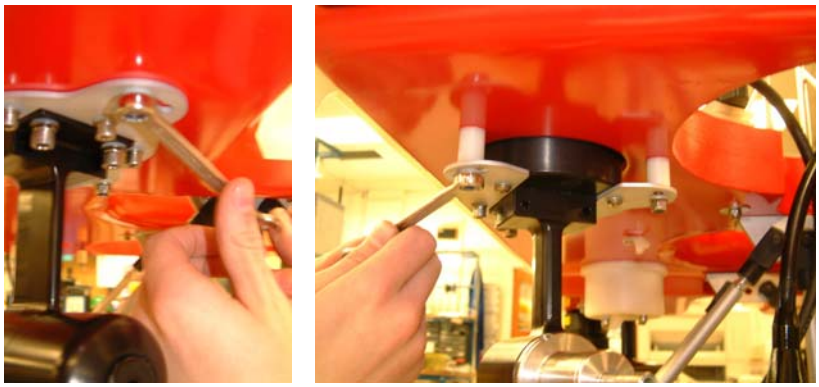


Fig. 21. Thruster Mounting Plate Removal

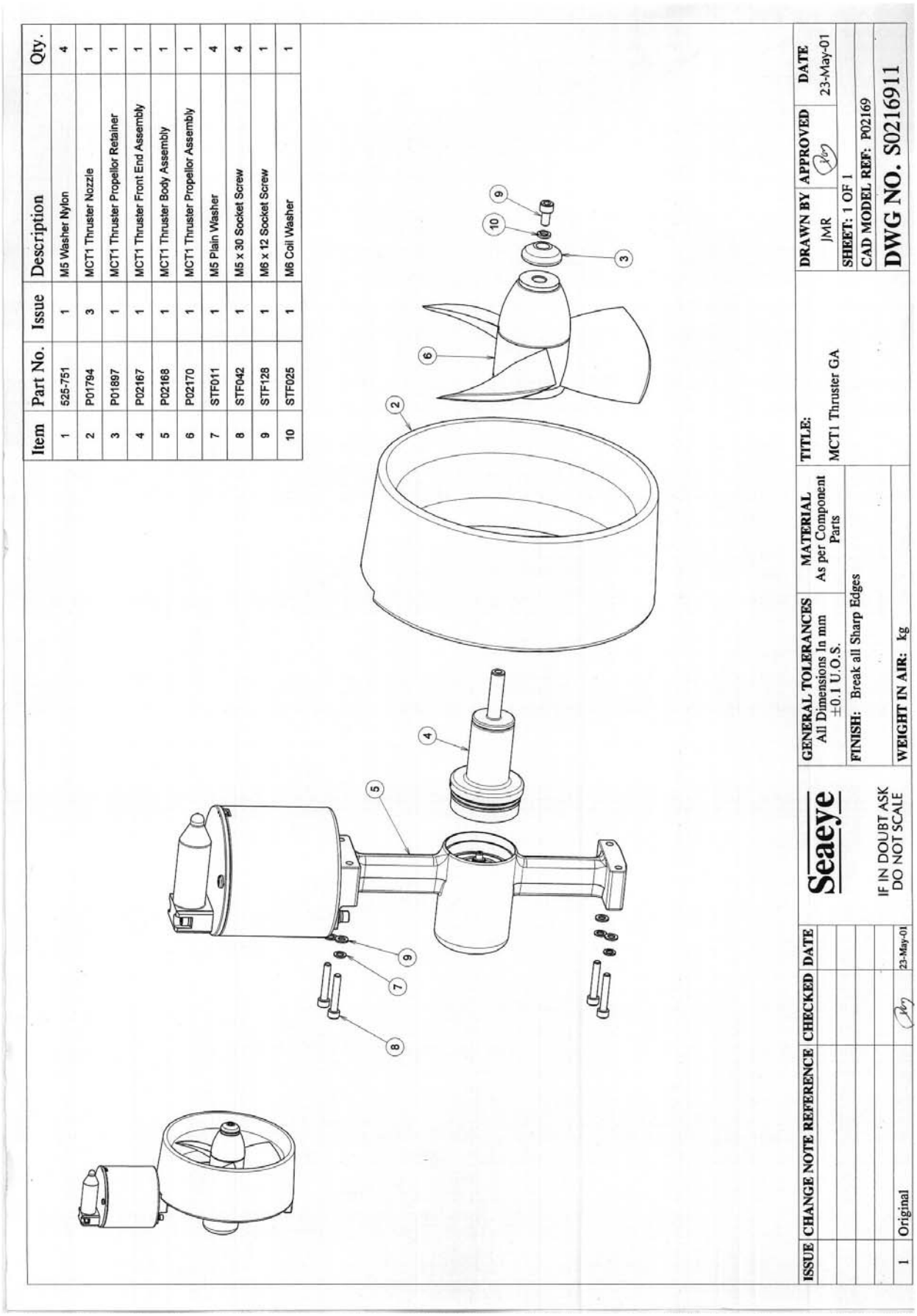


Fig. 22. Thruster Components

14. Note the position of the fitted thrusters to ensure that the replacement thruster is fitted into the same position. Remove the thruster.

Fig. 23. Thruster removal

Vertical Thruster

15. Remove the four M5 x 30 socket screws (8), four M5 coil washers (11) and four M5 plain washers (7) securing the thruster (5) to the ROV. Remove the spacers and retain for fitment. Remove the Thruster.

Fig. 24. Vertical Thruster

Assembly:

16. Remove the two M6 x 12 socket screws securing the thruster assembly to the mounting bracket to enable access to the top two socket screws (8).

17. **Forward thrusters only** - Locate the thruster onto the ROV, ensuring that it is fitted into the same position as the removed thruster. Fit the three M6 Nylok nuts and M6 plain washers and secure the thruster to the ROV.

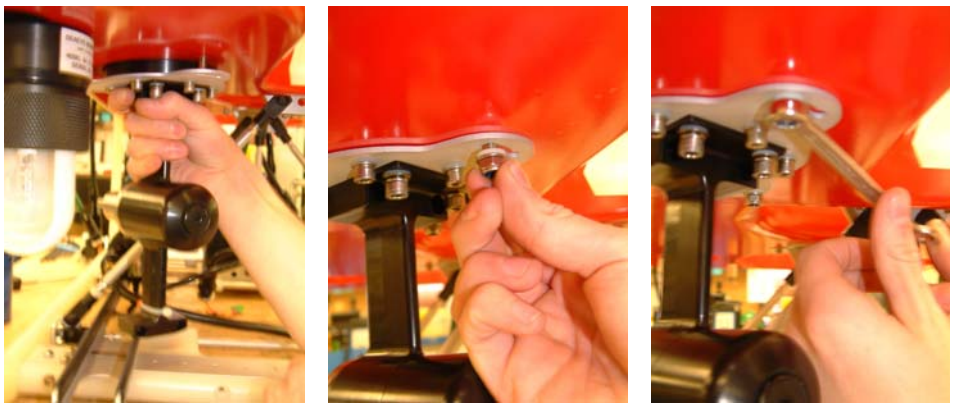


Fig. 25. Fitting the Forward Thruster

18. **Aft thrusters only** – To aid fitment of the nylon spacers, apply a small amount of grease to one end of the spacer and place into position over the thruster studs. Locate the thruster onto the ROV, ensuring that it is fitted into the same position as the removed thruster. Fit the three M6 Nylok nuts and M6 plain washers and secure the thruster to the ROV. To fit the starboard thruster, slide it into the manipulator chassis bracket to allow you to insert the thruster onto the location studs.

Fig. 26. Fitting the Aft Thruster

19. Refit the two M6 x 12 socket screws securing the thruster assembly to the mounting bracket.

Refer to Fig. 22 for details of the thruster components in steps 20 to 24.

20. Fit the propeller internal washer (12) into the propeller (6). Apply a small amount of lubricant to the internal propeller assembly.

Fig. 27. Propeller Assembly

21. Apply a small amount of underwater lubricant to the socket screw (9) threads. Locate the propeller assembly (6) onto the thruster assembly (4) and secure using the M6 x 12 socket screw (9), M6 coil washer (10) and the thruster propeller retainer (3). Check that there is slight movement of the propeller forward and aft to ensure that it is not 'locked'.

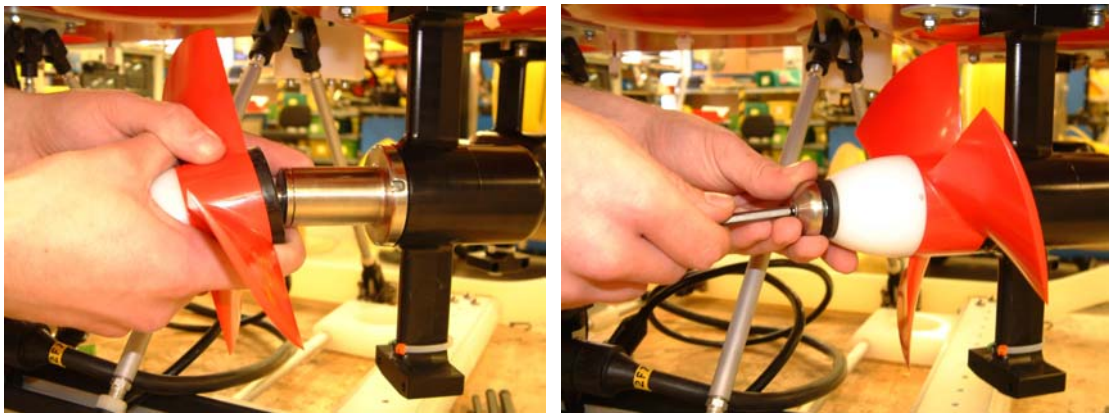


Fig. 28. Thruster Propeller Fitment

Horizontal Thruster

22. Fit the thruster nozzle (2).

23. Apply a small amount of underwater lubricant to the socket screw (8) threads. Secure the thruster nozzle (2) using the four M5 x 30 socket screws (8), four M5 coil washers (11) and four M5 plain washers (7).

Fig. 29. Thruster Nozzle Fitment

Vertical Thruster

24. Apply a small amount of underwater lubricant to the socket screw (8) threads. Secure the thruster assembly (5) to the ROV using the four spacers, four M5 x 30 socket screws (8), four M5 coil washers (11) and four M5 plain washers (7).

Fig. 30. Vertical Thruster

Assembly continued

25. Route the thruster cable whip.
26. Apply a small amount of silicone grease to the O-rings. Push the cable whip through the respective thruster penetrator on the junction box lid.

Fig. 31. O-ring and Castle Nut Fitment

27. Secure the whip to the ROV JB using the castle nut. Connect the thruster whip terminal connector.
28. Refit the ROV JB taking care not to trap or damage any cables or connectors. Secure using the ROV JB spacers and retention screws.
29. Tie wrap the thruster cable using the same routing previously used.
30. Fit the ROV fairing cover using the four retention screws, ensuring that no cables are trapped when fitting the cover.
31. Apply a small amount of silicone grease to the ROV JB vent plug O-rings and refit the ROV JB vent plug.

Thruster Configuration

Because a new thruster has been fitted, the thruster needs to be configured as detailed in the following paragraphs.

Initial Preparation

Before connecting to the external supply, set the switch and controls as follows:

Control	Setting
LIGHTS control	Fully anticlockwise
LIGHTS Switch	Set OFF position
VERTICAL control	Centre position
CAMERA switch	Set to CAM 1
TILT control	Centre position
Joystick	Operate in all axes and ensure joystick returns to the centre position on release
THRUSTER switch	Set to the OFF position

Table 2. Initial Settings for SI-HCU

Control	Setting
Input Breaker	Set to OFF
Vehicle On/Off	Set to OFF
Input Trip	Set to UP

Table 3. Initial Settings for SI-PSU

Powering Up

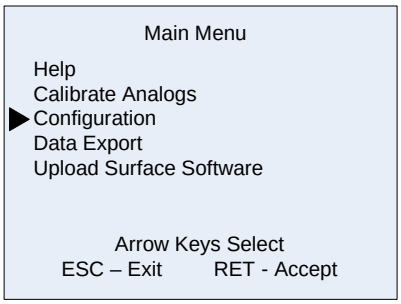
Connect and switch on the external power supply. Set the PSU control switches as follows:

Control	Setting
Power Input Breaker	Operate to ON
System Video Monitor	Confirm operational and showing Video Overlay
Vehicle Power Switch	Operate to ON

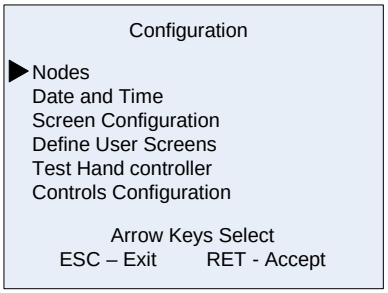
Table 4. Switching On

Configuration

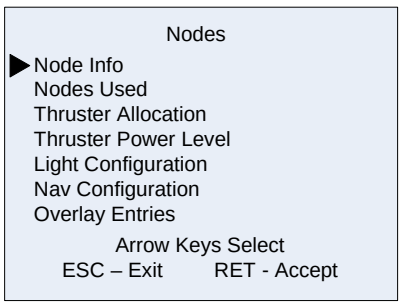
1. Confirm the system monitor displays video overlay and that the SI-HCU Power indicator on the SI-HCU is illuminated.
2. Press **F1** on the keyboard, the Main menu is display.

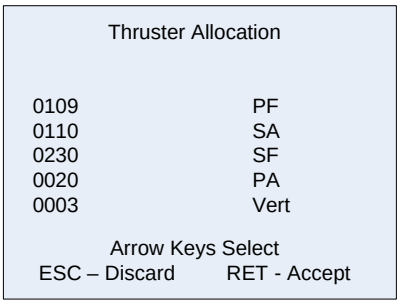


3. Select the Configuration option and the Configuration menu is displayed.



4. Select the Nodes option and the Nodes menu is displayed.





5. Select the Thruster Allocation option.
6. Allow the system to search for all five thrusters, this may take a few minutes.
7. A list of the Thrusters is displayed, with serial numbers on the left hand side of the screen and its respective position displayed on the right hand side.
8. Using the keyboard up/down keys, navigate to highlight the correct serial number of the thruster you fitted. Press the right key to highlight the respective position indication. Use the up/down keys to select the correct thruster position (PF – Port Forward; SF – Stbd. Forward; PA – Port Aft; SA – Stbd Aft, Vert - Vertical). Use the left key to return to select another thruster.
9. Repeat this process until all five thrusters are configured. Press the RET bar to accept the configuration.
10. Press the Esc key until you have returned to the overlay menu.
11. Remove the vehicle camera lens cap(s).

NOTE

Confirm the SI-HCU camera switch is switched to the required camera.

12. Confirm the system monitor displays images received from the camera with video overlay.

WARNING

DANGER TO PERSONNEL AND EQUIPMENT. THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE VEHICLE IS CLEAR OF ANY OBSTRUCTION AND PERSONNEL PRIOR TO ENERGISING THE DC SUPPLY.

CAUTIONS

Possible damage to Thruster motor: Thrusters must not be operated for longer than one minute in air, damage to the water lubricated bearing may occur.

Possible damage to lamps: Vehicle lamps must not be operated for longer than 10 seconds in air.

13. Set the following unit switch and control settings on the SI-HCU:

Control	Setting
TILT control	Operate over full range and confirm vehicle camera ball rotates through its full range and its movement is unobstructed.
THRUSTER switch	Set to ENABLE.
VERTICAL Control	Operate over full range and confirm that the vertical thruster responds.
LIGHT Control/Switch	Operate switch to ON position and confirm that the lights respond to the LIGHTS control.
JOYSTICK	Operate in all axes and confirm thrusters respond to joystick demand.

Table 5. Testing Normal Operation of the ROV

14. The following tests require the ROV to be suspended. Care must be taken when swinging the ROV to prevent damage from surrounding structures.
15. Slowly rotate the suspended ROV and confirm that the compass' digital display responds to ROV movement.
16. Confirm depth and CP (if fitted) indication is displayed as overlay on the system monitor.
17. Set the following unit switch and control settings on the SI-HCU:

Control	Setting
THRUSTER switch	Set to ENABLE.
AUTO HEADING switch	Operate and confirm key symbol is displayed next to the heading on the overlay on the system monitor.
Vehicle	Rotate the vehicle and ensure the thrusters oppose rotation.
AUTO HEADING switch	Operate the switch again and confirm the key symbol is no longer displayed.
AUTO DEPTH switch	Operate and confirm key symbol is displayed next to the depth on the overlay on the system monitor.
Vehicle	Observe that after a short period of time the vertical thruster will begin to operate.
AUTO DEPTH switch	Operate the switch again and confirm the key symbol is no longer displayed.
Vehicle	 WARNING: TAKE EXTREME CARE TO AVOID CONTACT WITH THE THRUSTER MOTORS With the vehicle suspended, sharply rotate the vehicle, by a few degrees only, to confirm that the gyro responds by momentarily 'driving' the thrusters to test heading compensation.
THRUSTER switch	Set to OFF.

Table 6. Testing Autos and Gyro Operation of the ROV

Powering Down

Set the following unit switch and control settings:

Hand Control Unit	
Vertical Control	Set to centre position
Tilt Control	Set to centre position
THRUSTER Switch	Set to OFF position
Power Supply Unit	
Vehicle ON/OFF Switch	Set to OFF
Power Input Breaker	Rotate anticlockwise to "0" position

Table 7. Switching Off the System

Switch off and isolate the external power supply, lower the ROV and replace the ROV lens cap(s).

6.7.5 Fibre Optic Terminations

Epoxy and Polish fibre optic cable terminations generally have 3 stages, they are :

- Cable Preparation.
- Assembly.
- Polishing.

WARNINGS

To avoid personal injury, always wear safety glasses when working with optical fibres.

Be very careful to dispose of fibre ends properly. The fibres create slivers that can easily puncture skin and cause irritation.

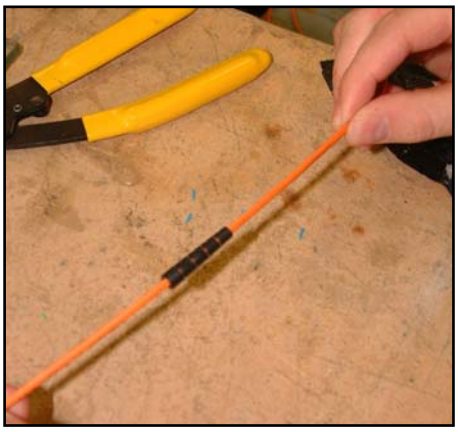
Tools

Seaeye supply a Fibre Optic Kit that contains all the necessary tools, connectors and accessories.

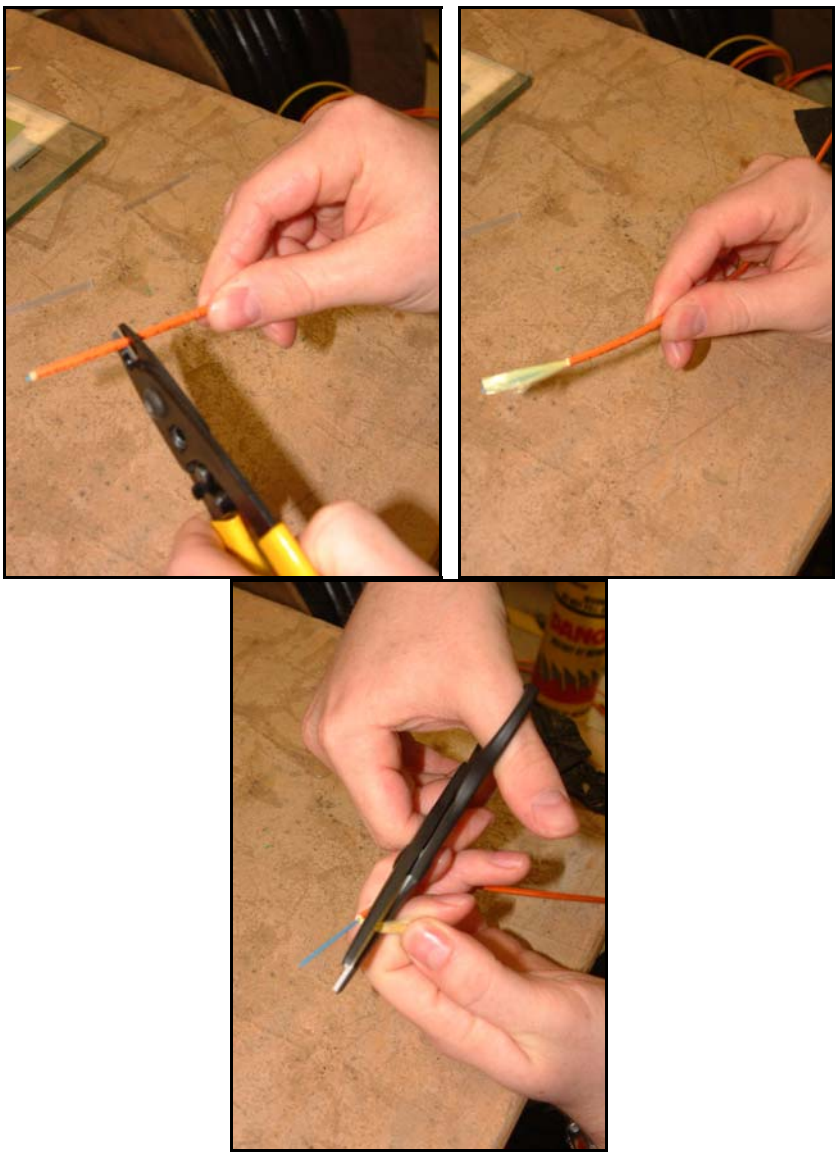
The figure shows the Fibre Optic Stripper, Cleave Tool and Scissors.

Cable Preparation

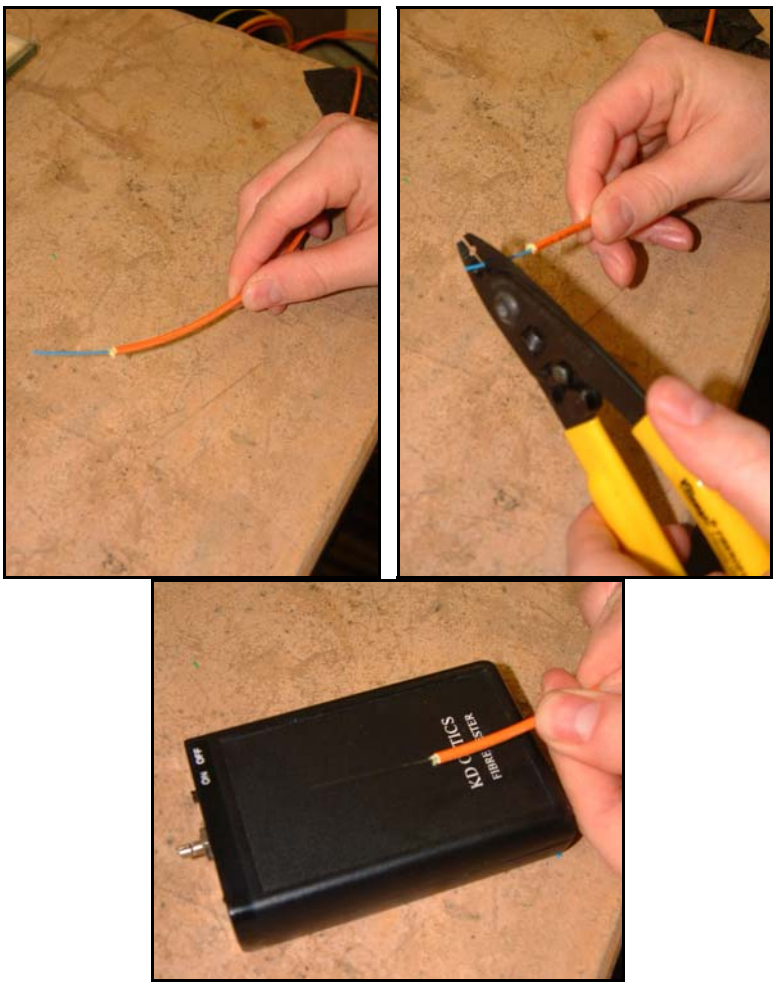
1. If using a bend relief boot or cable sleeve, slide the bend relief boot and crimp sleeve onto the cable. It is much easier to do this at the beginning rather than wait until you have stripped the fibre.



2. Strip the cable outer protection jacket. The amount of outer jacket that you strip depends on what fibre you are using and what manufacturer's connectors you are using. Read the manufacturer's instructions that came with your connectors for information on how much to strip back. Cut the inner strands to reveal the inner fibre optic cable.



3. Strip back the inner fibre optic jacket to reveal the bare fibre optic element. Once you have stripped your cable back and removed coatings, clean the fibre using IPA (Isopropyl Alcohol) and a wipe; pull the stripped fibre end through the wipe gently to clean.



Assembly

Terminating fibre optic cable using Hot Melt Terminations is a quick, easy and safe method for fibre optic terminations. It has the advantage of using connectors ready loaded with epoxy resin that becomes soft when heated.

The procedure for terminating the fibre optic cable using Hot Melt Terminations are:

1. Place the connector into a termination holder. This allows you to place the connector into the curing oven and safely remove it afterwards.
2. Place connector into curing oven; the curing oven must be able to heat the connector to the stated manufacturer's temperature, usually in excess of 200°C. Different manufacturers will require differing times in the oven for their connectors. Ensure you check the instructions carefully.

3. Insert fibre into connector; since the epoxy resin begins to harden as it cools you have a limited amount of time - normally a few seconds - to insert the fibre through the connector and push the cable into the back of the connector until it is firmly seated.

4. Remove the connector, complete with fibre from the curing oven and allow to cool.

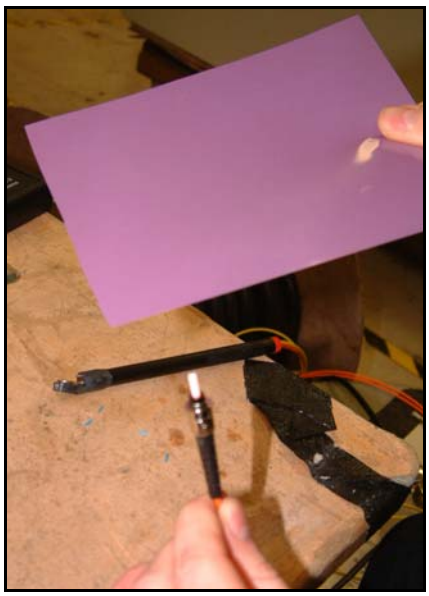
Polishing

The fibre end protruding from the ferrule needs to be cleaved cleanly and as close to the epoxy bead as possible. This is done using a ceramic cleaving tool to score the fibre and then pulling the fibre straight off (away from the ferrule). Scoring the fibre can be tricky and care needs to be taken not to break the fibre end off.

WARNINGS

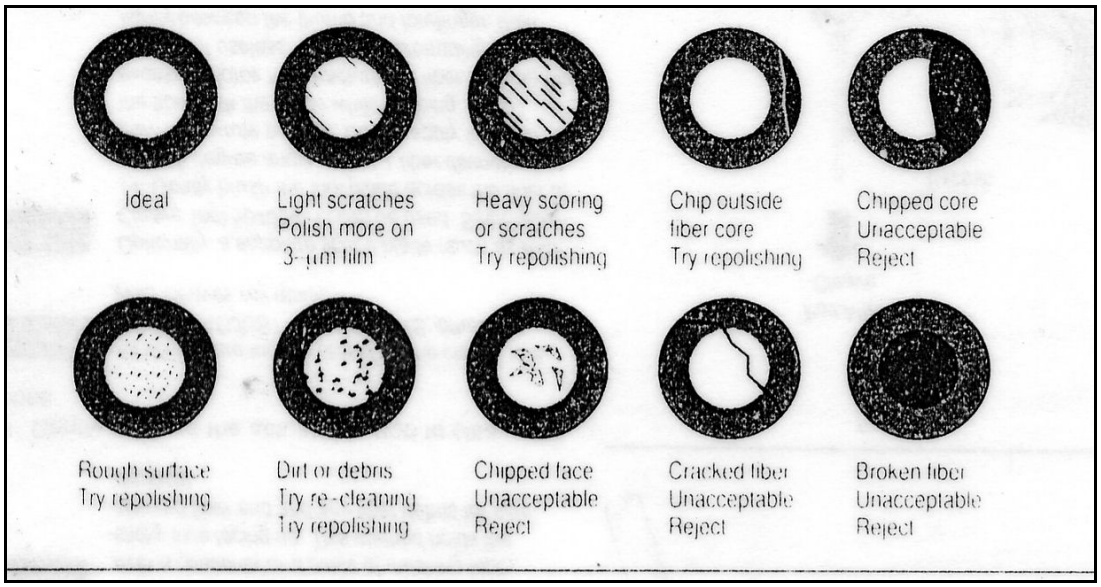
Ensure that when cutting the fibre, the excess is disposed into a container that is identified with a warning that it contains fibre optic strands.

1. Remove excess fibre, using the special piece of polishing paper supplied with the kit. This is the only paper that should be used for this purpose. Rest the paper on the connector tip and move gently in small circles or a figure of 8 until the protruding stub of the cleaved fibre is flush with the ferrule surface.



2. Clean the polishing plate with water or an appropriate window cleaning solution. Dry the plate thoroughly.
3. Place the polishing film onto the polishing pad and secure.
4. Gently insert the connector into the polishing tool.
5. Using a figure of 8 movement, and supporting the weight of the connector for the first three or four turns, gently polish the fibre.
6. During the process the end of the connector can be inspected through a microscope to ensure it is satisfactory.

7. Remove the connector from the polishing tool and clean the ferrule face with lint free tissue. Inspect the connector with the 100x microscope. If possible place the far end of the fibre near a bright light. Compare the fibre end to the examples below.



8. Verify that the fibre is flush with the ferrule surface by moving the microscope focus control. If the fibre and ferrule come into focus together, the fibre is flush. If the fibre comes into focus before the ferrule surface, then the fibre is protruding and additional polishing may be required.

6.7.6 Maintenance Procedure - Set Up of Video System

NOTE

For Non Fibre Optic systems only.

Frequency of Task

The video may need adjustment when:

- Tether has been replaced, or length has been changed.
- Either Video driver or receiver has been replaced.
- Camera has been replaced.

Introduction

The system comes supplied with the Video set up for use but if one of the above applies then it may need to be set up again.

Tools Required

The following tools may be required:

- Flat bladed screwdrivers (common sizes).
- Open ended or ring spanners (common sizes).

Parts Required

The following parts may be required:

- Loctite 222, 641 and 480.
- Silicone grease (Molycote MS111 or similar).
- Underwater Lubricant (Aqua Shield or similar).

WARNINGS

DANGER OF FATAL ELECTRIC SHOCK. BEFORE REMOVING OR OBTAINING INTERNAL ACCESS TO THE EQUIPMENT, ISOLATE ALL THE UNITS POWER SUPPLIES.

DANGER OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL. WHEN THE SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ROV SYSTEM IS TO BE UNDERTAKEN ONLY BY PERSONS FULLY AWARE OF THE DANGERS INVOLVED AND HAVE TAKEN ADEQUATE PRECAUTIONS.

POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE ROV SYSTEM, ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENANCE ACTIVITY IS IN OPERATION.

POSSIBILITY OF TOXIC HAZARDS. DURING MAINTENANCE OR REPAIR IT IS POSSIBLE TO COME INTO CONTACT WITH SUBSTANCES HARMFUL TO HEALTH. PRIOR TO ALL MAINTENANCE OR REPAIR TASKS ENSURE THAT THE RELEVANT DATA HAZARD SHEETS AND LOCAL COSHH PROCEDURES HAVE BEEN READ AND UNDERSTOOD.

DANGER TO PERSONNEL AND EQUIPMENT. THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE VEHICLE IS CLEAR OF ANY OBSTRUCTION AND PERSONNEL PRIOR TO ENERGISING THE DC SUPPLY.

CAUTIONS

Danger of damage to PCBs. Do not remove or replace PCBs unless the supply is switched off. PCBs must be handled in accordance with electrostatic discharge handling procedures. Damage to PCBs could affect the safe operation of the equipment.

Danger of damage to equipment. When checking connections, care is to be taken not to slacken them, otherwise their watertight integrity may be breached.

Danger of damage to Thruster Motor. Do not operate the Thruster Motor in air for longer than one minute.

Danger of damage to lights. Do not operate the vehicle lights for longer than ten seconds in air.

Procedure

The follow procedure requires access to the Surface Control Unit internal PCBs and to the Vehicle Junction Box PCBs when power is switched on. Only personnel familiar with the dangers and are fully conversant with all the necessary precautions should carry out this procedure.

9. Ensure the ROV system electrically isolated.
10. Ensure that no person is performing maintenance work on the system or system cabling.

CAUTION

Danger of damage to equipment. The Falcon ROV Junction Box may have an excessive pressure build up due to heat conditions.

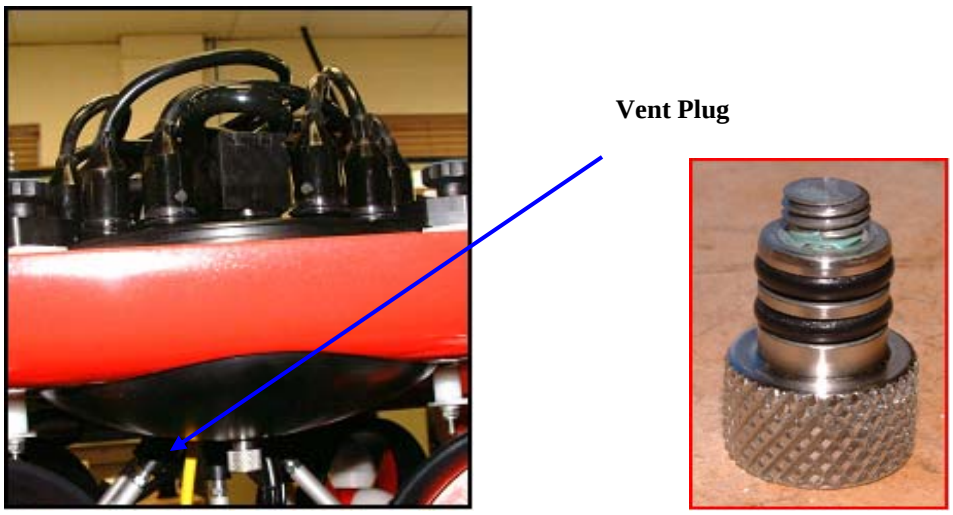


Fig. 32. ROV Junction Box Vent Plug

11. Remove the VJB vent plug and retain.
12. Remove the four ROV fairing securing fasteners and remove the fairing cover.

Fairing Retention Screws

Fig. 33. ROV Fairing

13. Remove the four VJB retention screws and spacers and carefully remove the ROV JB cover. Secure the cover so that you can access the PCBs.

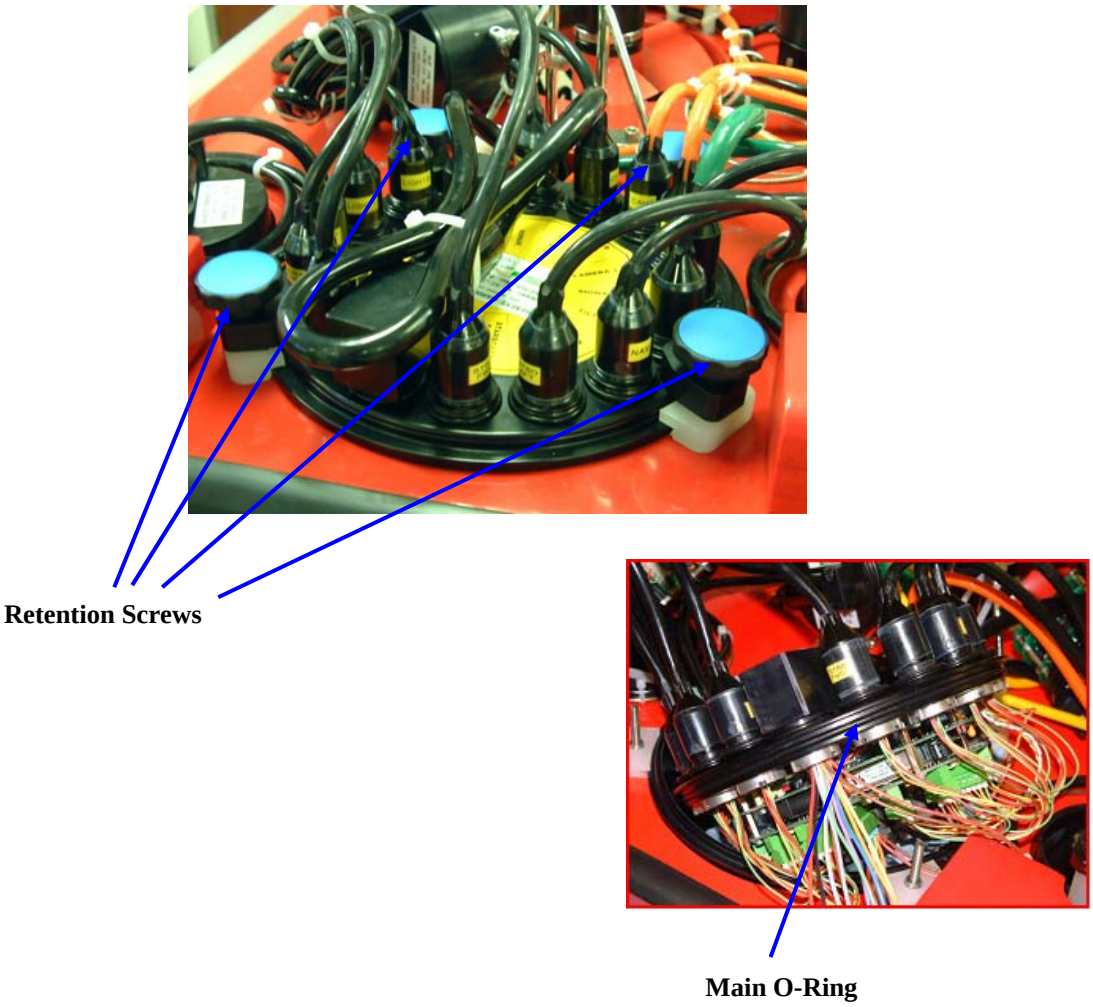


Fig. 34. ROV Junction Box

14. Remove the four retention screws securing the Surface Control Unit in the transit case.

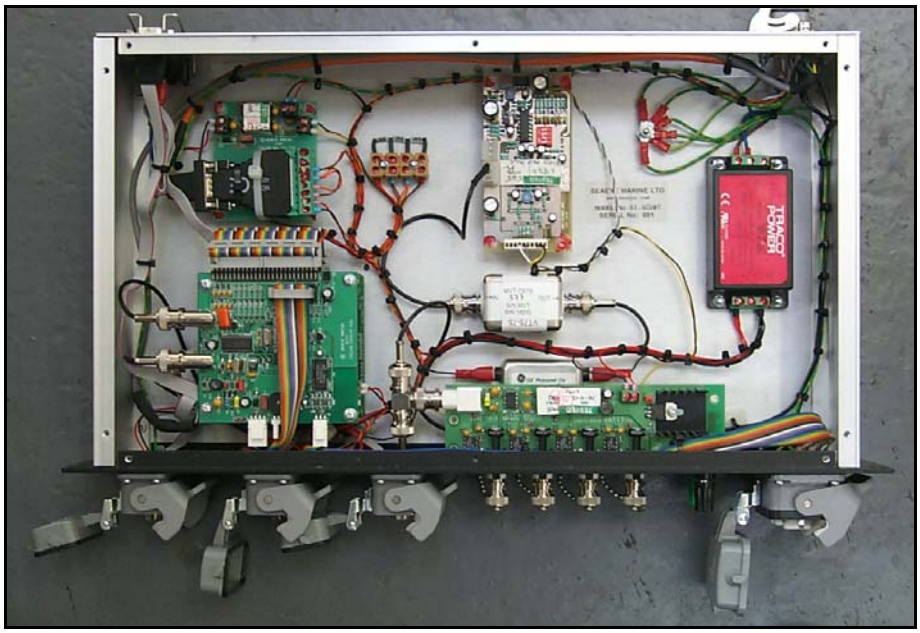


Fig. 35. Surface Control Unit

15. Withdraw the Surface Control Unit from the transit case and remove the eight screws secure the top cover. Carefully position the Surface Control Unit so that you can access the internal Video PCB whilst the unit is still connected to the system.

WARNING

DANGER OF FATAL ELECTRIC SHOCK. THE FOLLOWING STEPS NEED ACCESS TO THE SURFACE CONTROL UNIT AND VEHICLE JUNCTION BOX INTERNAL PCBS WHILST POWER IS ON. ENSURE THAT ALL NECESSARY SAFETY PRECAUTIONS ARE TAKEN.

Initial Preparation

16. Before connecting to the external supply, set the switch and controls as follows:

Control	Setting
LIGHTS control	Fully anticlockwise
LIGHTS Switch	Set OFF position
VERTICAL control	Centre position
CAMERA switch	Set to CAM 1
TILT control	Centre position
Joystick	Operate in all axes and ensure joystick returns to the centre position on release
THRUSTER switch	Set to the OFF position

Table 8. Initial Settings for SI-HCU

Control	Setting
Input Breaker	Set to OFF
Vehicle On/Off	Set to OFF
Input Trip	Set to UP

Table 9. Initial Settings for SI-PSU

Powering Up

17. Connect and switch on the external power supply. Set the PSU control switches as follows:

Control	Setting
Power Input Breaker	Operate to ON
System Video Monitor	Confirm operational and showing Video Overlay
Vehicle Power Switch	Operate to ON

Table 10. Switching On

The standard “starting” video setup is:

Vehicle Junction Box Video PCB	
DIP SW1	OFF
DIP SW2	ON
DIP SW3	OFF
DIP SW4	OFF
Balance Pot	Fully clockwise
Gain Pot	Fully clockwise
Surface Control Unit Video PCB	
DIP SW1	OFF
DIP SW2	ON
DIP SW3	OFF
DIP SW4	OFF
Balance Pot	Central position
Gain Pot	Central position

This configuration should give you the best video image displayed on the monitor. Where the tether is not the standard supplied length, these setting may have been changed to provide the best possible image.

The factory setup includes fine adjustments of the potentiometers using an oscilloscope to measure the video signal. However, when in the field, the following procedure should enable the operator to compensate for video line differences.

Locate the Video Line Driver PCB in the Vehicle Junction Box.

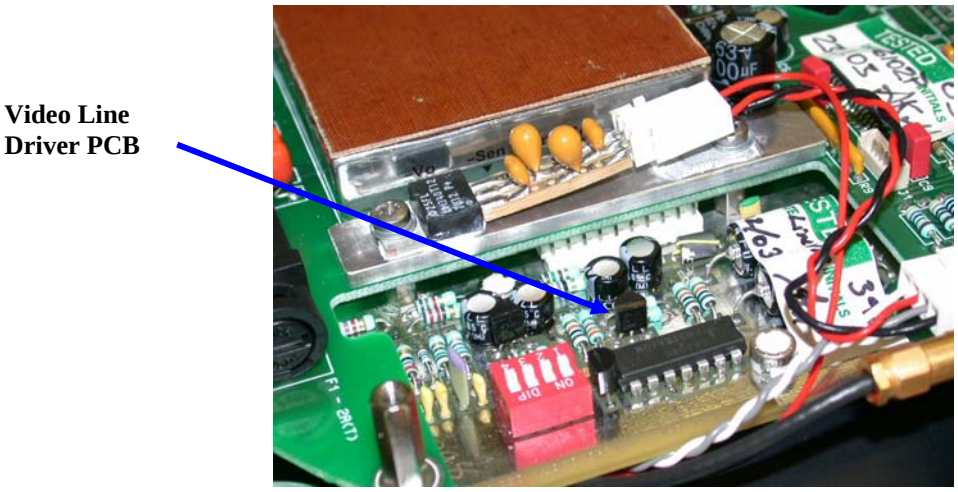


Fig. 36. Vehicle Junction Box Video Line Driver

18. Select the DIP Switch 1 ‘ON’, ensure DIP Switches 2, 3 and 4 are ‘OFF’. Adjust the Balance pot and Gain pot ‘FULLY CLOCKWISE’.

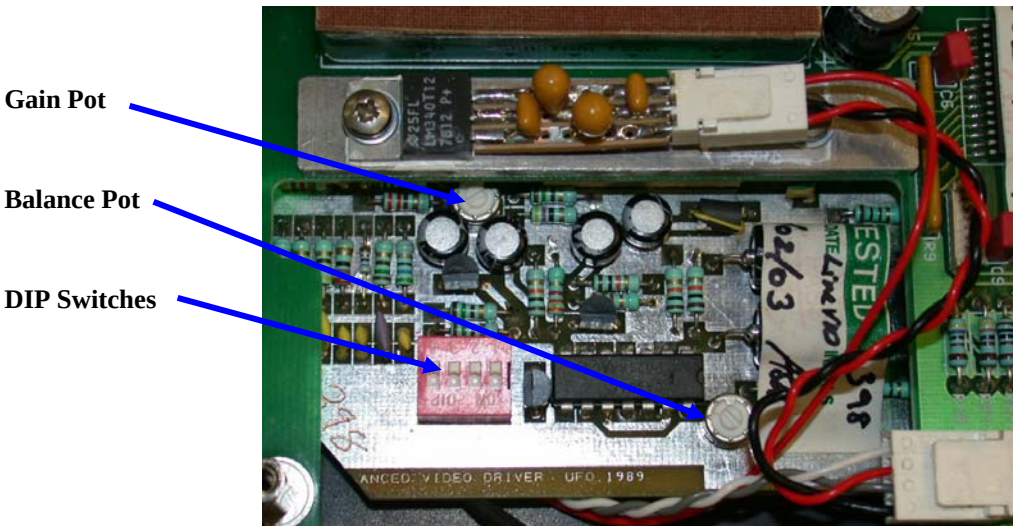


Fig. 37. Video Line Driver PCB Dip Switches and Adjustment Pots

19. Locate the Video Amp PCB in the Surface Control Unit.

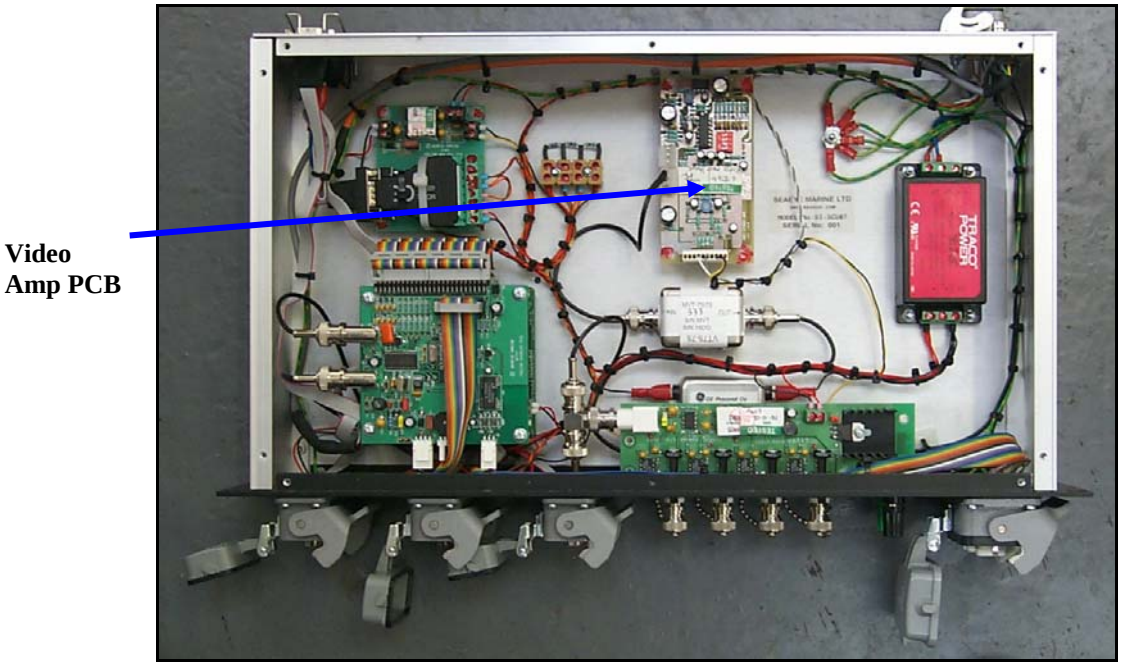


Fig. 38. Surface Control Unit Video Amp PCB

20. Select DIP Switch 1 ‘ON’, ensure DIP Switches 2, 3 and 4 are ‘OFF’. Adjust the Balance pot and Gain pot to the ‘CENTRAL’ position.

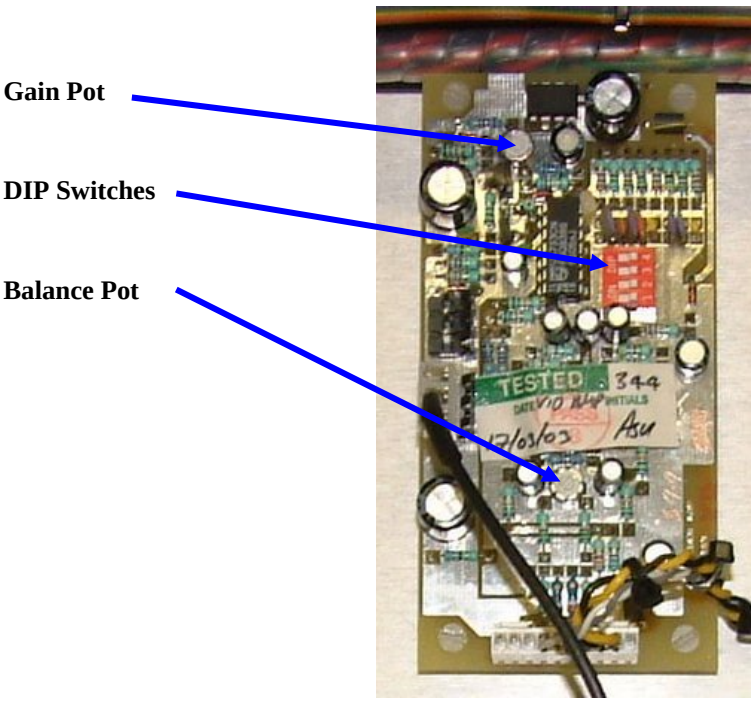


Fig. 39. Video Amp PCB Switches and Potentiometers

21. View the camera image on the monitor. Check for interference or image distortion. To improve the image quality, select the Vehicle Junction Box DIP Switch 1 OFF and DIP Switch 2 ON. Check the image. If the image quality still needs to be improved, select the Surface Control Unit DIP Switch 1 OFF and DIP Switch 2 ON. Again check the image.

22. By using a combination of the Vehicle Junction Box and Surface Control Unit DIP switches, the video compensation should provide a high quality video image.

23. If after all DIP switch combinations, the video image still cannot be setup, contact Seaeye Marine Ltd.

Powering Down

24. Set the following unit switch and control settings:

Hand Control Unit	
Vertical Control	Set to centre position
Tilt Control	Set to centre position
THRUSTER Switch	Set to OFF position
Power Supply Unit	
Vehicle ON/OFF Switch	Set to OFF
Power Input Breaker	Rotate anticlockwise to “0” position

Table 11. Switching Off the System

25. Switch power off and isolate the external power supply.
26. Refit the Vehicle Junction Box taking care not to trap or damage any cables or connectors. Secure using the spacers and retention screws.
27. Fit the ROV fairing cover using the four retention screws, ensuring that no cables are trapped when fitting the cover.
28. Apply a small amount of silicone grease to the Vehicle Junction Box vent plug O-rings and refit the vent plug.
29. Replace the lid on the Surface Control Unit and secure. Refit the Surface Control Unit into the transit case.
30. Carry out a full system test.

6.7.7 Maintenance Procedure - Vent Plug Removal

Frequency of Task

The Vent plug is to be removed in the following circumstances:

- Prior to air transportation.
- Exposure to direct sunlight.
- Prolonged storage in high temperatures.

Introduction

This task is to prevent excessive pressure build up within the Junction Box, Navigation Pod, Vehicle Power Supply, etc in the vehicle.

Tools Required

The following tools may be required:

- Open ring spanners (common sizes).
- Flat bladed screwdriver.

Parts Required

No parts required.

Procedure

Proceed as follows:

1. Remove and retain the vent plug.
2. Place the vent-plug in a protective plastic bag and attach in prominent position for later fitting.
3. Cover the vent opening with tape to prevent dirt ingress, allow the tape to “breathe”, by pinpricking through the tape.

6.8 Connectors

In order to simplify the maintenance of the vehicle system, all the wiring to the connectors of the vehicle is colour coded. The colour code adopted is based on the International Standard Resistor Colour Code. This colour code assigns a unique colour to represent a number from 0 to 9. It would be impractical to number wiring in such a manor as connectors are generally numbered starting at 1. Therefore the colour coding applied to the vehicle system wiring starts at 1 (Brown). There is another deficiency in the colour coding in that wire numbers greater than 9 cannot be represented. Where it is necessary to represent such numbers, the colour code is repeated starting at brown (to represent the first digit) with a sleeve coloured black (to represent the second digit). To distinguish these repeated colours, each repeated colour will carry a sleeve marker or **all** the wires will carry wire number markers in addition.

Wire Number Coding		
Colour		**Number**
BLACK		0
BROWN		1
RED		2
ORANGE		3
YELLOW		4
GREEN		5
BLUE		6
VIOLET		7
GRAY		8
WHITE		9
BROWN	With BLACK Sleeve marker	10
BROWN	With BROWN Sleeve marker	11
BROWN	With RED Sleeve marker	12

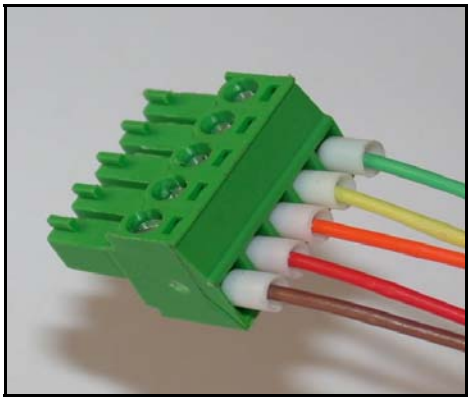


Fig. 40. Typical Node Connector & Wiring

These green connectors are connected to the ROV Junction Box PCBs.

Care should be taken not to damage or misalign when connecting to the PCB boards.

The following details the pin-out for the green connectors for the following nodes:

- Thrusters.
- Lights.
- Tilt.
- Navigation.
- Auxiliary Nodes.

Pin 1 (Brown)	+48Volts
Pin 2 (Red)	Telemetry A
Pin 3 (Orange)	Telemetry B
Pin 4 (Yellow)	0 Volts
Pin 5 (Green)	Earth

The following details the pin-out for the green connectors for the following nodes:

- Sonar.

Pin 1 (Brown)	+48Volts
Pin 2 (Red)	Telemetry A
Pin 3 (Orange)	Telemetry B
Pin 4 (Yellow)	0 Volts
Pin 5 (Green)	N/C

The following details the pin-out for the green connectors for the following nodes:

- Cameras.

Pin 1 (Brown)	0 Volts
Pin 2 (Red)	Video
Pin 3 (Orange)	+24 Volts
Pin 4 (Yellow)	Video 0 Volt

Always check with the ROV system drawings, as somebody may have completed a modification to the system and may have altered certain characteristics to the system. All modifications should be noted within the manual or on the system drawings and should have the persons name and date of modification.

6.9 O Rings

Where electrical connectors have been disconnected, before reconnecting the plugs and bulkhead connectors are to be examined for damage to the threadforms, O-rings, lead and pins and any dirt removed. Cleaning should only be with a solvent and the plug and socket assembly thoroughly dried and threads and O-rings lightly coated with silicone grease before reconnecting. It is advised where maintenance has disturbed units fitted with O-rings that the O-ring be discarded and replaced with a new one. Where this is not possible, the seal and O-ring groove should be cleaned and inspected for damage. O-rings are to be lightly coated with silicone grease prior to unit assembly.

O rings are the only thing that stops the water from penetrating any node, connector or camera on the ROV. A quick visual check will determine whether the O ring requires more grease or replacing.

Should you remove an O ring the following steps should be taken:

- Check for any damage, at the slightest sign of damage replace with the correct size O ring.
- Make sure the mating faces are clean, clean with a solvent and ear bud.
- If using the O ring which was removed, it should also be cleaned with Amberklene and then lightly greased with silicone grease.
- When using a new O ring, it should be inspected for any damage and lightly greased.

CAUTION

Do not put the O ring down on the side; fit the O ring to the part for which it is intended. By doing this there is less chance of picking up fluff or grime on the O ring, which would result in an imperfect seal and water penetration.

The following are a series of photographs designed to aid in the replacement of O-Rings.

STANDARD O-RINGS

All Junction Box Penetrators

Dirt Seal	200120
Main Seal	200617
Backing nut	P01880

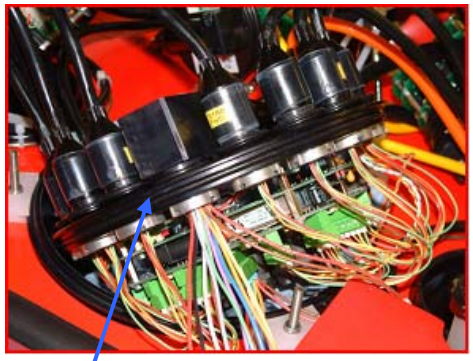
All Node Penetrators

Right Angle Bulkhead200012

Bleed Screw

O-Ring	200007
Bleed Screw	Y18-S11-A6

JUNCTION BOX O-RING DETAIL



Vent Plug P02626
O-Rings 200109

Main O-Ring 200267

Standard Penetrator

Right Angle Adapter for Power Penetrator P02617

Bung for unused bulkhead P02615

LAMP O-RING DETAIL

End Cap Seal 200143

Junction Box Penetrator

Dirt Seal	200120
Main Seal	200617
Backing nut	P01880

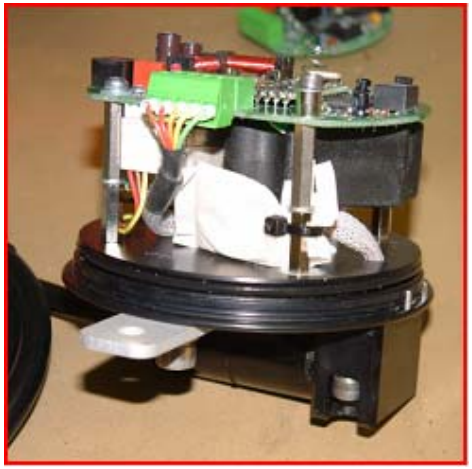
Node Penetrator

Right Angle Bulkhead	200012

Glass Interface

Internal Seal	200320
Face Seal	206345

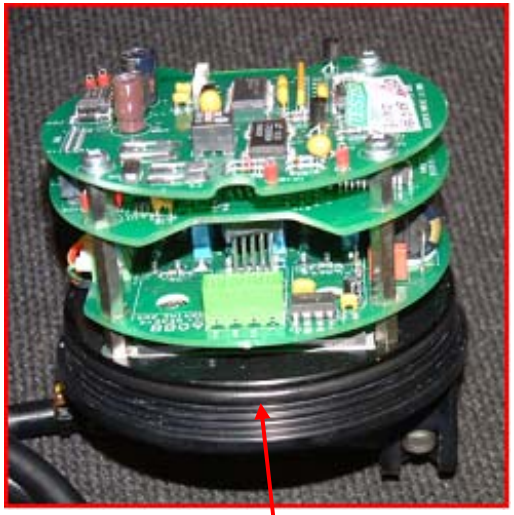
NAVIGATION NODE O-RING DETAIL



Junction Box Penetrator	
Dirt Seal	200120
Main Seal	200617
Backing nut	P01880
Node Penetrator	
Right Angle Bulkhead	200012
Bleed Screw	
O-Ring	200007
Bleed Screw	Y18-S11-A6

Lid Seal	200643

THRUSTER MCT01 O-RING DETAIL



Junction Box Penetrator	
Dirt Seal	200120
Main Seal	200617
Backing nut	P01880
Node Penetrator	
Right Angle Bulkhead	200012
Bleed Screw	
O-Ring	200007
Bleed Screw	Y18-S11-A6

Main Seal 200237

Body Plug at rear of Stator Shaft
200116

CAMERA O-RING DETAIL

Bleed Screw

O-Ring	200007
Bleed Screw	Y18-S11-A6

SI-AUXIP01 & SI-AUXOP01 O-RING DETAIL

Junction Box Penetrator	
Dirt Seal	200120
Main Seal	200617
Backing nut	P01880
Node Penetrator	
Right Angle Bulkhead	200012
Bleed Screw	
O-Ring	200007
Bleed Screw	Y18-S11-A6

Penetrator Seal	200014

Main Seal	200141

SI-TILT01 O-RING DETAIL

Drive End

Main Seal	200144

Junction Box Penetrator

Dirt Seal	200120
Main Seal	200617
Backing nut	P01880

Node Penetrator

Right Angle Bulkhead	200012

Bleed Screw

O-Ring	200007
Bleed Screw	Y18-S11-A6

Penetrator End

Main Seal	200150

SI-VPSU01 O-RING DETAIL

Power & Signals Penetrator

Dirt Seal	200120
Main Seal	200617
Backing nut	P01880
Bleed Screw	
O-Ring	200007
Bleed Screw	Y18-S11-A6

Power Penetrator

Signals Penetrator

Main Seal 200163

6.10 Example of ROV Dive Log

Falcon ROV Dive Log			
Client:	**Job No.:**		**Date:**
	Location:		**Vessel:**
	Conditions:		
Supervisor:	**Pilot:**	**Observer:**	**Deck Hand:**
Dive No.:	**Consumables:**		
Dive Task:			

Time	Heading	Depth	Description
			Total Time and Maximum Depth.

Client's Signature:	Supervisor's Signature

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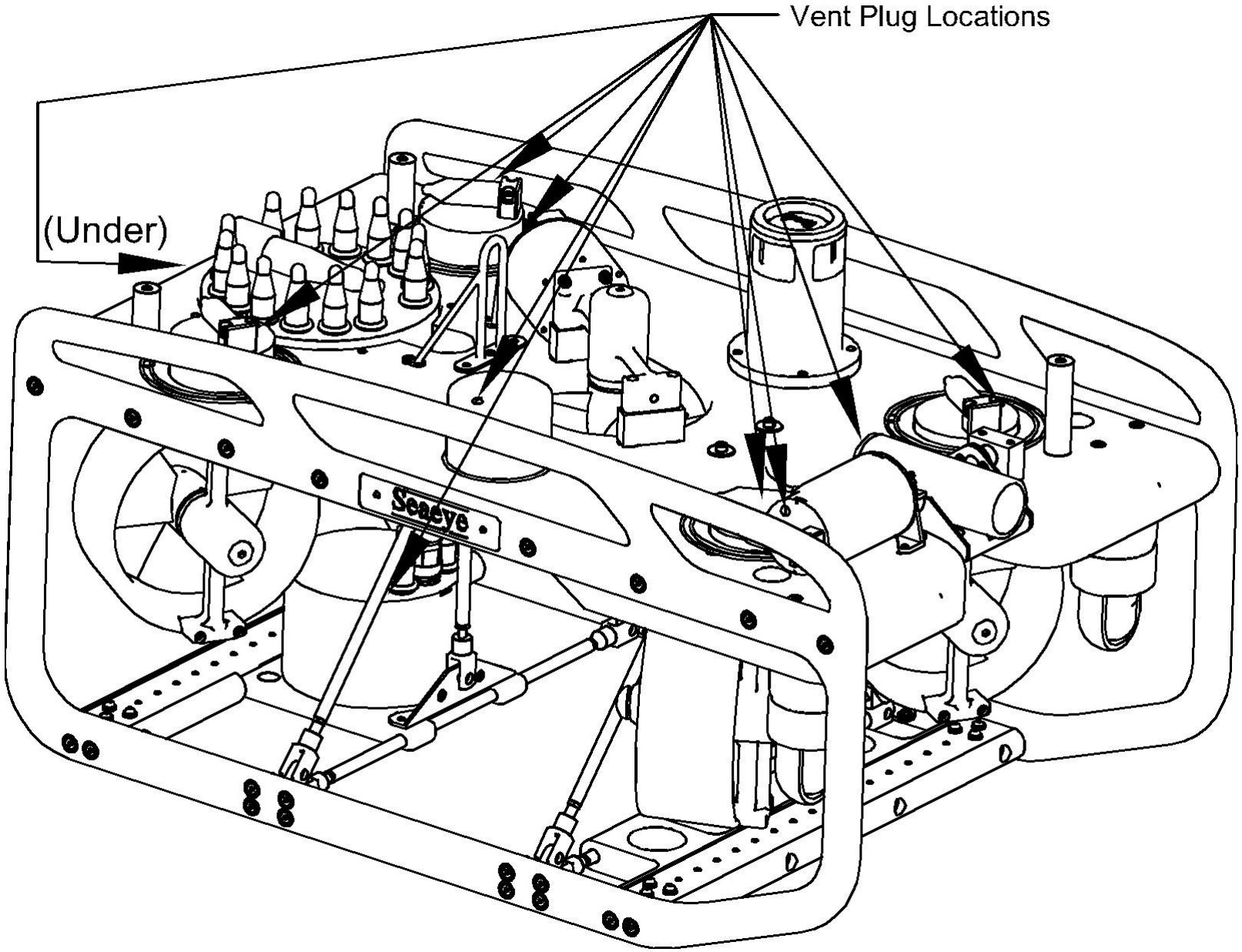
TASK 1

Location		Date		ROV Type		Serial No.	

PRE-OPERATIONAL CHECKS			
 **SWITCH OFF ALL SUPPLIES TO THE PSU (IE MAIN ISOLATOR PADLOCKED IN THE OFF POSITION) AND CHECK ALL INDICATORS ARE EXTINGUISHED**			
Physical Checks			√
Check **ALL** thrusters, lamps, specialist fitted equipment, fairing and buoyancy modules are correctly fitted and secure			
Check Thruster Propeller Retaining Bolts are secure			
Check Thrusters and Tilt Platform are free from fouling			
Remove camera lens cap(s) and clean lens with soapy water			
Confirm the following vent plugs are securely fitted:			
NOTE: If carrying out several dives in a day and the vehicle remains wet, a visual check of the vent plugs can be carried out after the first dive's security check. This ensures that there is no water ingress into the vent plug screw hole.		Camera(s) Junction Box Navigation Pod Thrusters Tilt Motor Vehicle Power Supply Auxiliary Pod(s)	
Confirm **ALL** unused penetrators in the Junction Box have penetrator blanks correctly fitted			
Confirm **ALL** lamp glasses and covers are undamaged and correctly fitted			
Check **ALL** connectors are properly mated, sleeved and all cables secure and clear of propellers			
Check **ALL** Camera/adaptors are correctly fitted and secure			
Operational Checks			√
Note. If any major components have been added or removed the ballast of the vehicle should be checked and adjusted as necessary			
Carry out the following switch settings			√
HCU	Lights Controls	Set **fully anti-clockwise**	
	Lights Switch	Set to **OFF**	
	Vertical and Tilt Controls	Set to **central position**	
	Thruster Switch	To **OFF**	
Power up the system and carry out the following Functional Tests			√
Confirm monitor displays video image with overlay data (for all cameras fitted)			
Confirm the correct operation of the Tilt Platform by operating the **TILT** control fully up and down			
 **WARNING. POSSIBLE DAMAGE TO LAMPS. VEHICLE LAMPS MUST NOT BE OPERATED FOR LONGER THAN 10 SECONDS IN AIR**			
Operate lights and confirm lights illuminate by switching the **LIGHTS** switch ON and **LIGHTS control** from LOW to HIGH			
 **WARNING. POSSIBLE DAMAGE TO MOTOR WATER LUBRICATED BEARINGS. DO NOT OPERATE THRUSTERS FOR LONGER THAN ONE MINUTE IN AIR**			
Operate the Thruster motors as follows			
HCU	Thruster Enable switch	Set to ENABLE	
	VERTICAL Control	Operate and Confirm Vertical Thruster Responds Correctly	
	JOYSTICK control	Operate in all directions and confirm thrusters respond correctly in all axes	
	THRUSTER ENABLE switch	Set to OFF	
Operate sonar and test (if fitted)			
Operate and test manipulator (if fitted)			

Pilot/Operator (sign and print)---------- Date----------

Supervisor (sign and print)---------- Date----------


Vent Plug Locations
(Under)
Seaeye

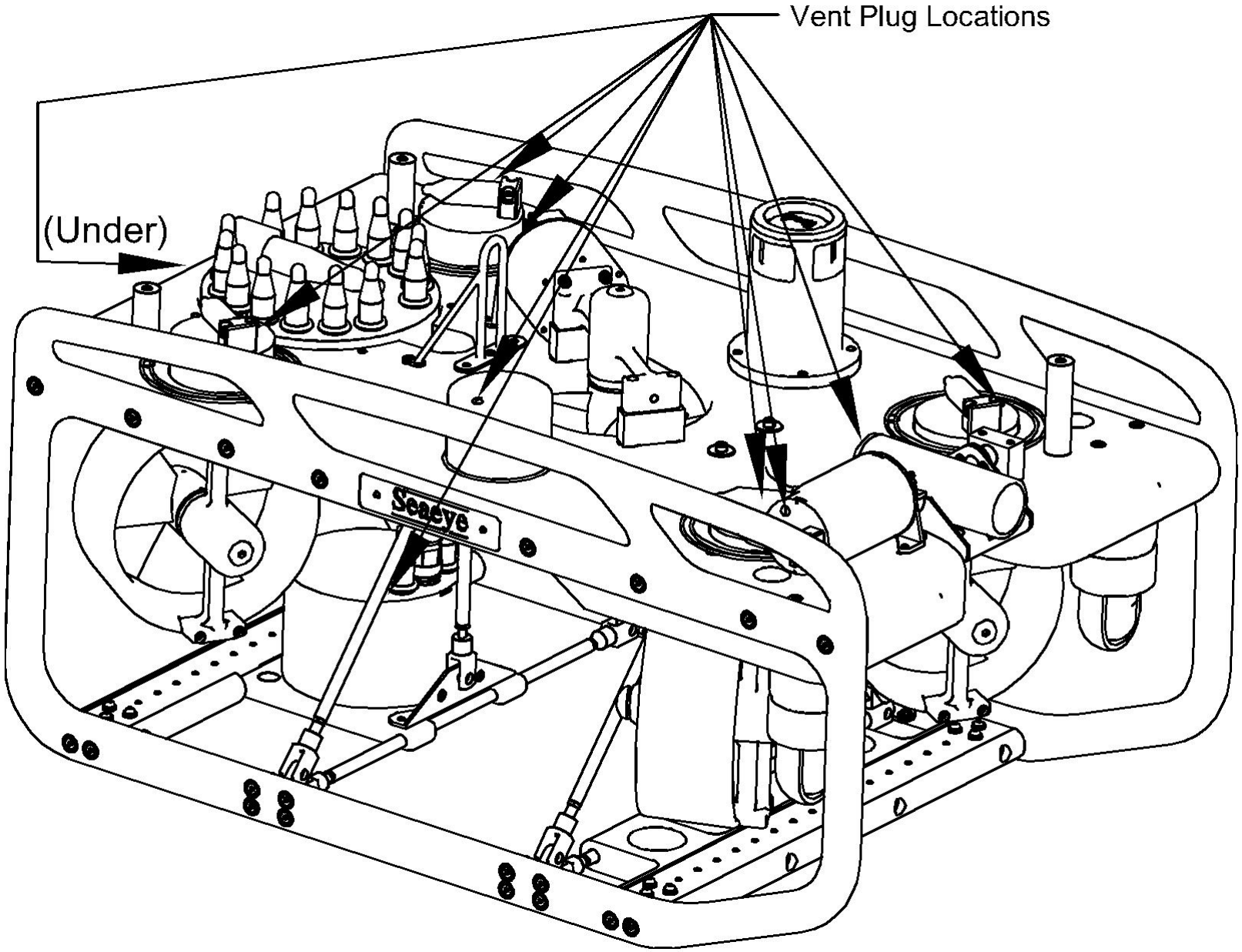
TASK 2

POST-OPERATIONAL CHECKS		
		√
SWITCH OFF ALL SUPPLIES TO THE PSU (IE MAIN ISOLATOR PADLOCKED IN THE OFF POSITION) AND CHECK ALL INDICATORS ARE EXTINGUISHED		
Vehicle checks		√
Wipe camera lens clean and replace lens cap(s)		
Check Thruster Retaining Bolts are secure		
Check Thrusters and Tilt Platform are free from fouling		
Confirm the following vent plugs are securely fitted:		
NOTE: If carrying out several dives in a day and the vehicle remains wet, a visual check of the vent plugs can be carried out after the first dive's security check. This ensures that there is no water ingress into the vent plug screw hole.	Camera	
	Junction Box	
	Navigation Pod	
	Thrusters	
	Tilt Motor	
	Vehicle Power Supply	
	Auxiliary Pods	
Remove any debris from structures		
Confirm **ALL** lamp glasses and covers are undamaged		
Check **ALL** connectors are properly mated, sleeved and all cables secure and clear of propellers		
Check **ALL** Thrusters, fitted equipment, crash bars, buoyancy foam and fairing are secure and undamaged		
Check **ALL** Thrusters are free to move in both directions		
Check **ALL** Camera/adaptors are secure and undamaged		
Clean vehicle with fresh water using a pressure hose		
Storage Checks		√
Ensure stored away from direct sunlight and water ingress		
If exposed to high temperatures or for air transportation remove vent plugs and store in plastic bags taped in a prominent position for later use		
Fit dust caps where applicable		

Pilot/Operator (sign and print)---------- Date----------

Authorised to Stow? YES/NO

Supervisor (sign and print)---------- Date----------


Vent Plug Locations
(Under)
Seaeye

6.11 Example of Equipment Failure Report

Date:	**ROV EQUIPMENT FAILURE REPORT**	
SUPERVISOR	**SUB ENGINEER**	

EQUIPMENT/COMPONENT AT FAULT:
EQUIPMENT IDENT. NUMBER:

SYSTEM	**PART OF SYSTEM**
REPORT No.	
SYSTEM	

PROBLEM

Electrical		Fibre Optic		Hydraulic		Mechanical	

CAUSE OF FAULT

Cable/Umbilical/Tether Defective/Damaged		Mechanical Failure	
Component Failure		Mechanical Wear	
Defective Connection		Mechanical Damage	
Contamination (Oil, Water, Carbon, etc)		Seal Defect	
Fitting Faulty / Loose		Software Problem	
Hose Faulty		Water Ingress	
Open Circuit		Wrong Component Fitted	
Short Circuit			

REMEDIES

Adjusted		Repaired		Re-terminated	
Flushed		Replaced		Returned for repair onshore	

DESCRIPTION OF EVENT:

EQUIPMENT FAULT FOUND DURING OPERATION OR MAINTENANCE	OPERATION		MAINTENANCE	

CONSEQUENCES

REPAIRS CARRIED OUT:

PREVENTATIVE RECOMMENDATIONS:

If the failure caused down time please state length of time	0 hours

ORIGINATOR	**SUPERVISOR**

6.12 Example of Mobilisation Check List

Falcon:_____ Date:_____ Job Ref:_____

Description	Tick	Checked By
Power Supply Unit with surface electronics module		
Pilot Monitor with keyboard module		
Sonar Monitor with Surface Unit modules		
All connecting cabling for above modules and power lead		
Umbilical		
ROV		
Cutter skid for ROV complete with electronics interface pod to		
ROV		
ROV tool box		
Consumables box		
Hydraulic oil pressure can for cutter skid		
Spare lead ballast		
Any other auxiliary equipment required		
ROV Manual		
Sonar Manual		
Cutter skid Manual		
System paper work and maintenance log		
ROV System set up	Working	
Surface Units		
Video Suite		
Umbilical		
Falcon ROV Complete pre dive checks completed		
Five / single function Manipulator		

6.13 Example of a Weekly Maintenance Schedule Report

SYSTEM: _____ Date: _____

Complete checks where applicable.
Do not strip parts down if it is not necessary. **Job Ref: _____**

Description	Check By
Thrusters	
Function check – reconfigure if needed	
View for any signs of damage or corrosion	
Spray WD40 onto end cone / magnetic coupling	
Check security of end cone bolt to the drive shaft	
Check for any foreign bodies in the thruster	
Check for damage on the propellers	
Check for security of thrusters to the ROV	
Check angle of main thrusters are the same	
Check for any signs of damage to the thruster whips to the Junction Box (JB)	
Check connection point to the JB	
Clean with fresh water and lubricate	
Lights	
Function check	
Check coupling is secure	
Check security of lights to the ROV	
Check shroud orientation	
Check for any signs of damage to the light whips to the Junction Box (JB)	
Check connection point to the JB	
Check for any signs of damage or corrosion	
Clean with fresh water	
Tilt Platform	
Function test– reconfigure if needed for full 180 degree axis	
Check security of platform to the ROV and Tilt motor	
Check grease coupling	
Check security of tilt motor to the ROV	
Check for any damage or corrosion to moving parts and tilt motor	
Check for any signs of damage to the tilt motor whip to the Junction Box (JB)	
Check connection point to the JB	
Check for any signs of damage or corrosion	
Clean with fresh water	
Auxiliary Equipment	
Function test	
Check for any damage or corrosion	
Check whip connection points	
Check security to ROV	
Clean with fresh water	

Complete checks where applicable.
Do not strip parts down if it is not necessary.

Description	Checked By
Cameras	
Function test	
Check security of cameras to the tilt platform	
Check orientation of cameras	
Check whip connection point to the camera for any damage or chaffing	
Check for any signs of damage or corrosion on the cameras / jubilee clips	
Check for any signs of damage to the camera whips to the Junction Box (JB)	
Check connection point to the JB	
Check for any signs of water ingress through camera ports	
Check cameras clear ROV body when tilt platform is operated	
Clean with fresh water	
Other nodes, auxiliary nodes, junction box (JB) and power pod	
Function test	
Check for any signs of damage or corrosion	
Check for any signs of damage to the node whips to the (JB)	
Check all connection point to the JB	
Check for security	
Clean with fresh water	
ROV	
Check security of all fixings	
Check all strength bars for slackness – tighten where applicable	
Check for any signs of damage, corrosion or distortion	
Check ROV frame for damage and security	
Check all buoyancy is secure, undamaged and paint coating is in place	
Check all Whips and cables are secure to the ROV body	
Check lifting point is not damaged	
Check cowling for damage and fixing posts	
Clean with fresh water	
Umbilical	
Check Kellams grip is in place and is not damaged	
Check connection point to the power pod	
Check for any cuts in the umbilical	
Megger umbilical and give lowest reading. **READING:_____ Meg Ohms** (Disconnect from ROV and Surface Unit)	
Complete Full Function Checks (Pre dive Checks)	

6.14 ROV Storage Checks

The following list details the checks to be carried out when storing the vehicle are long periods and checks to be carried out when first using the system after long storage periods.

6.14.1 Storing the ROV System

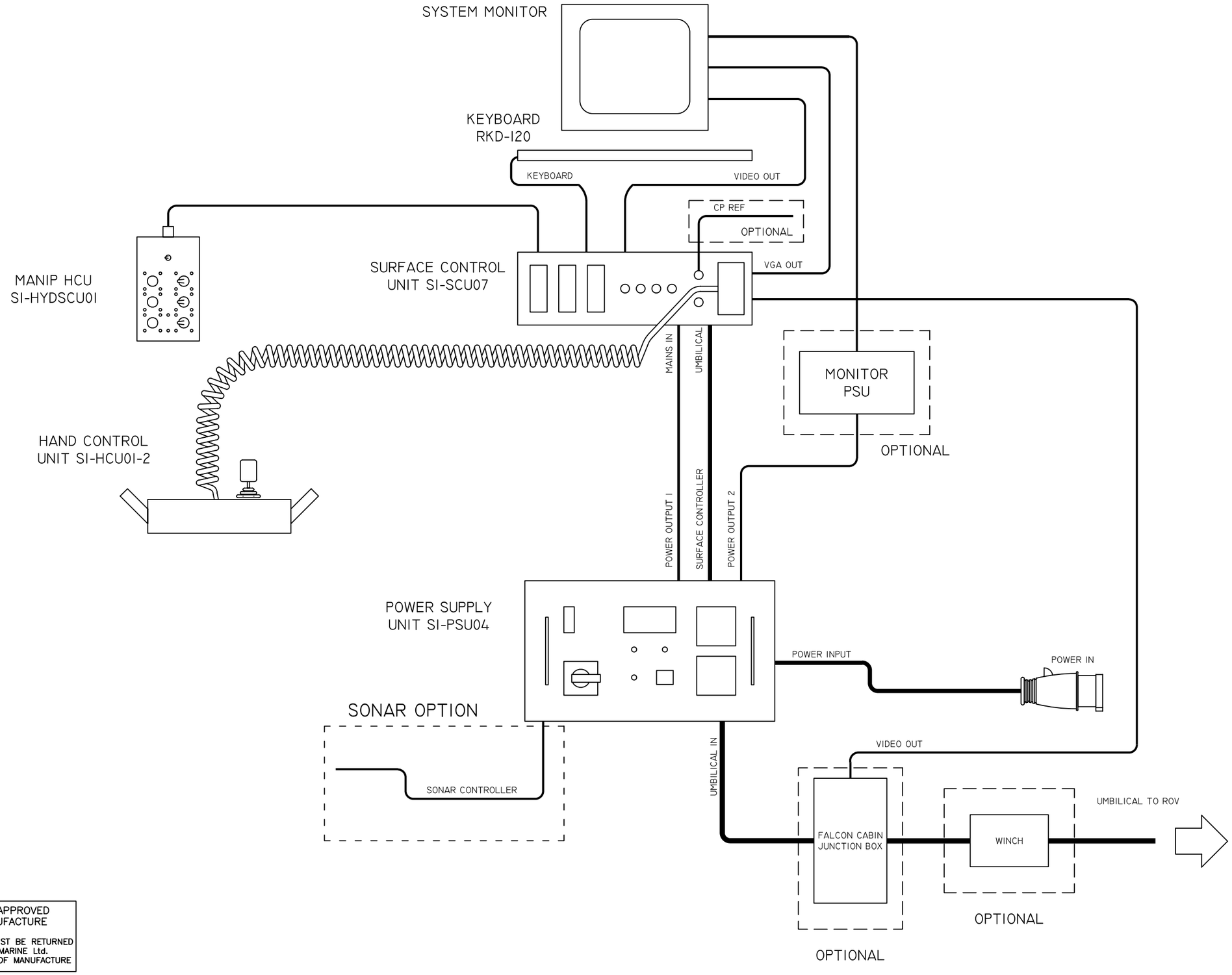
Description	Check By
System Check	
Carry out a full system check to ensure that all functions operate correctly	
Storing	
Ensure stored away from direct sunlight and water ingress.	
Remove vent plugs and store in plastic bags taped in a prominent position for later use. Tape over the vent plug holes to ensure no ingress of moisture or debris. Ensure that a large warning is displayed informing that the vent plugs have been removed.	
Fit dust caps where applicable.	
Thrusters	
View for any signs of damage or corrosion	
Spray WD40 onto end cone / magnetic coupling	
Remove the propellers. Clean the thruster shaft and inside the propeller assembly	
Check for any foreign bodies in the thruster	
Check for damage on the propellers	
Check for security of thrusters to the ROV	
Refit propellers and check security of end cone bolt to the drive shaft	
Check for any signs of damage to the thruster whips to the Junction Box (JB)	
Check connection point to the JB	
Clean with fresh water and lubricate	
Lights	
Check security of lights to the ROV	
Check shroud orientation	
Check for any signs of damage to the light whips to the Junction Box (JB)	
Check connection point to the JB	
Check for any signs of damage or corrosion	
Clean with fresh water	
Tilt Platform	
Check security of platform to the ROV and Tilt motor	
Check grease coupling	
Check security of tilt motor to the ROV	
Check for any damage or corrosion to moving parts and tilt motor	
Check for any signs of damage to the tilt motor whip to the Junction Box (JB)	
Check connection point to the JB	
Check for any signs of damage or corrosion	
Clean with fresh water	

Description	Checked By
Auxiliary Equipment	
Check for any damage or corrosion	
Check whip connection points	
Check security to ROV	
Clean with fresh water	
Cameras	
Check security of cameras to the tilt platform	
Check orientation of cameras	
Check whip connection point to the camera for any damage or chaffing	
Check for any signs of damage or corrosion on the cameras / jubilee clips	
Check for any signs of damage to the camera whips to the Junction Box (JB)	
Check connection point to the JB	
Check for any signs of water ingress through camera ports	
Check cameras clear ROV body when tilt platform is operated	
Clean with fresh water	
Other nodes, auxiliary nodes, junction box (JB) and power pod	
Check for any signs of damage or corrosion	
Check for any signs of damage to the node whips to the (JB)	
Check all connection point to the JB	
Check for security	
Clean with fresh water	
ROV	
Check security of all fixings	
Check all strength bars for slackness – tighten where applicable	
Check for any signs of damage, corrosion or distortion	
Check ROV frame for damage and security	
Check all buoyancy is secure, undamaged and paint coating is in place	
Check all Whips and cables are secure to the ROV body	
Check lifting point is not damaged	
Check cowling for damage and fixing posts	
Clean with fresh water	
Umbilical	
Check Kellams grip is in place and is not damaged	
Check connection point to the power pod	
Check for any cuts in the umbilical	
Megger umbilical and give lowest reading. **READING:_____ Meg Ohms** (Disconnect from ROV and Surface Unit)	

6.15 List of Falcon 1290 System Drawings

Drawing No	Description
Connection Drawings	
S0563411	Surface Equipment Electrical Connection Details
S0269141	Subsea Equipment Electrical Connection and Layout
Surface PSU Drawings	
CD60641(I).SCH	PSU01 500-600V DC Supply Wiring Diagram
S0305751	SI-PSU04 Additional Wiring
Surface Unit Drawings	
S0552121	SI-SCU07 Falcon Surface Control Unit Wiring Diagram Sheet 1
S0552122	SI-SCU07 Falcon Surface Control Unit Wiring Diagram Sheet 2
Hand Controller Drawings	
S0552211	SI-HCU01-2 Circuit Diagram Sheet 1 of 2
S0552212	SI-HCU01-2 Circuit Diagram Sheet 2 of 2
Vehicle Power Supply Unit Drawings	
S0308741	SI-VPSU02 Circuit Diagram
Vehicle Junction Box Drawings	
SO562311	SI-JB05A Circuit Diagram Twisted Pair Option Sheet 1 of 2
S0562312	SI-JB05A Circuit Diagram Fibre Optic Option Sheet 2 of 2
S0251921	6098P JB PCB Circuit Diagram
S0252011	6098P JB PCB Component Layout
S0300811	6102P Falcon Video Node Vehicle Junction Box Wiring Diagram
S0441111	6132P Falcon Fibre Optic Vehicle Junction Box Links and Pinout
Vehicle Auxiliary Junction Box Drawings	
S0550211	SI-AUXIP01 Circuit Diagram
S0413621	SI-AUXOP01 Pod Circuit Diagram
S0411721	SI-AUXOP01-B Circuit Diagram
S0318331	SI-AUXOP02-A Circuit Diagram

Umbilical, Tether, Connector and Whip Drawings	
S0333721	Umbilical 5823 and VOFT Connection
S0483621	Umbilical 5769 with Winch06
S0284531	Surface PSU Input Lead Wiring Diagram
S0284611	Surface Interconnect Lead Wiring Diagram
S0080971	Standard Single Ended Whips - Female
S0080871	Standard Single Ended Whips - Male



DRAWING APPROVED
FOR MANUFACTURE

ALL DRAWINGS MUST BE RETURNED
TO SEAEYE MARINE Ltd.
ON COMPLETION OF MANUFACTURE

ISS	DESCRIPTION	APPD	DATE	REF
1	First Issue		17/11/06	

Seaeye

Seaeye Marine Ltd.
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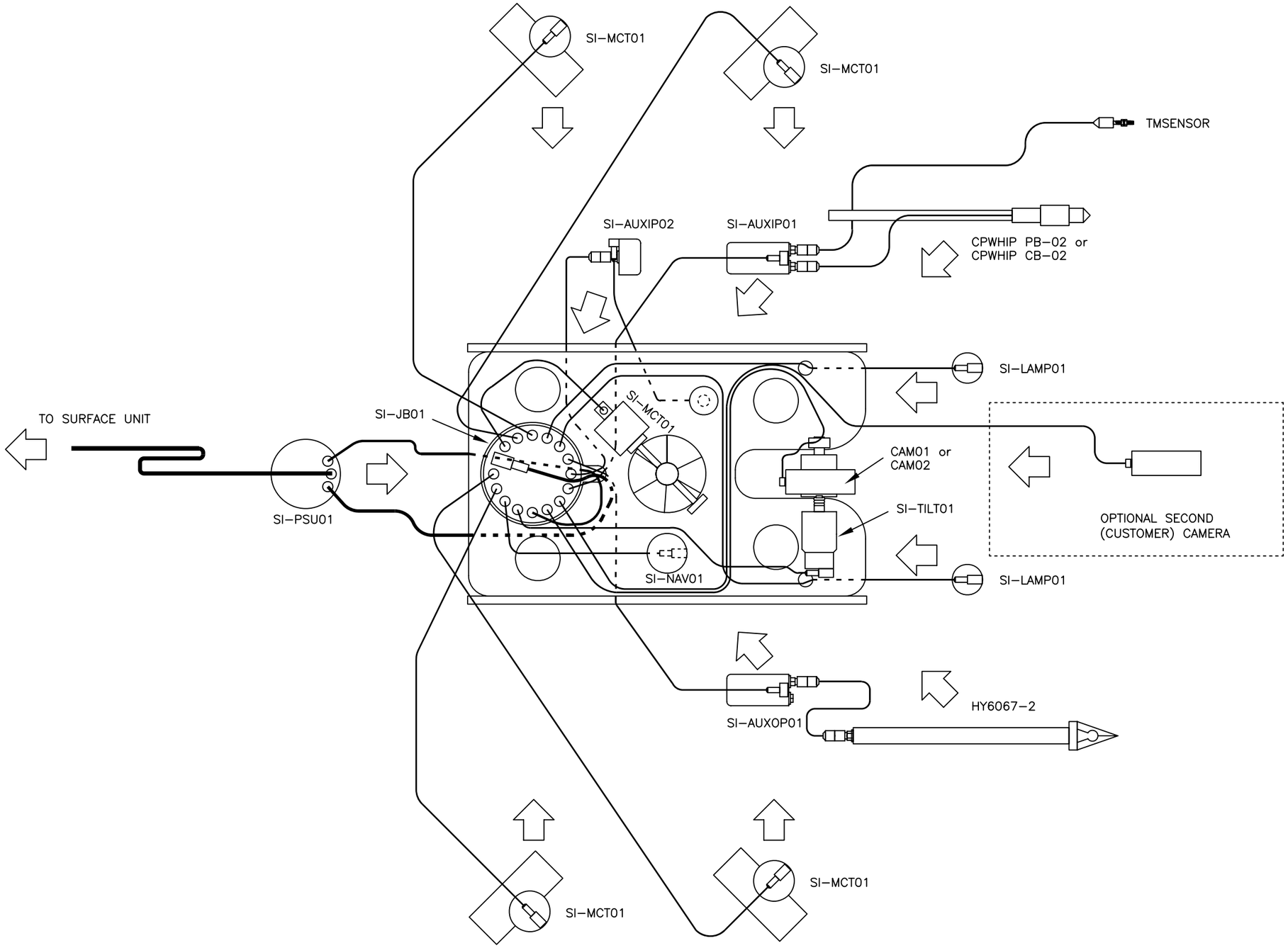
TITLE
FALCON SYSTEM SE2
SURFACE EQUIPMENT ELECTRICAL
CONNECTION DETAILS (1290 Only)

SHEET 1 OF 1

DRAWN	APPROVED	DATE
L.Morton	JMR	17/11/06

DWG.No. S05634 | Rev. 1 | Sht. 1



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ISS	DESCRIPTION	APPD	DATE	REF
4	Camera Stock Codes revised		17/2/04	ECR845–DW
3	SI–AUXOP02 added		3/11/03	DCR735–DW
2	Manipulator MV700–2 now HY6067–2		12/9/02	DCR609–DW
1	First Issue		24/4/02	N/A

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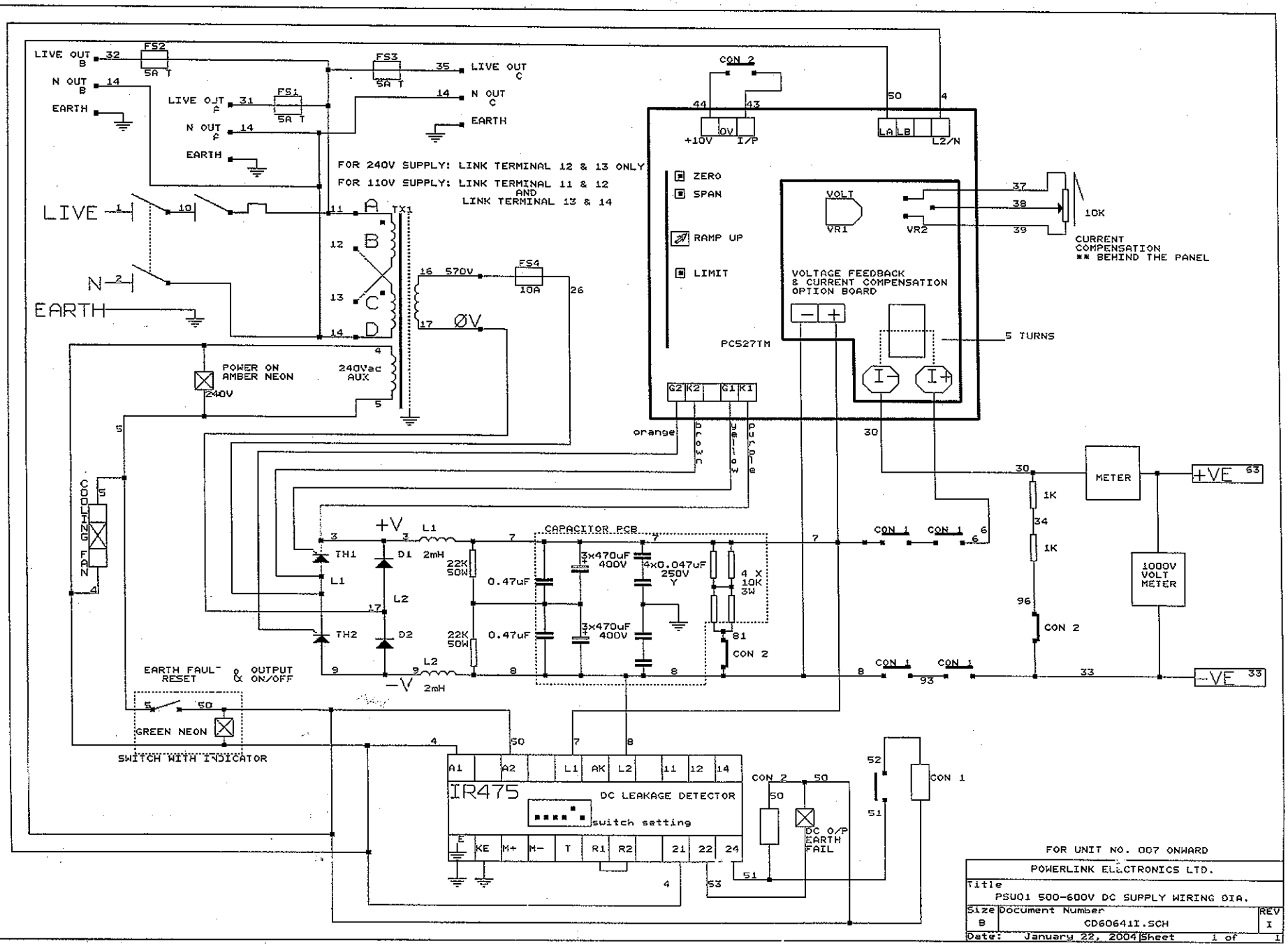
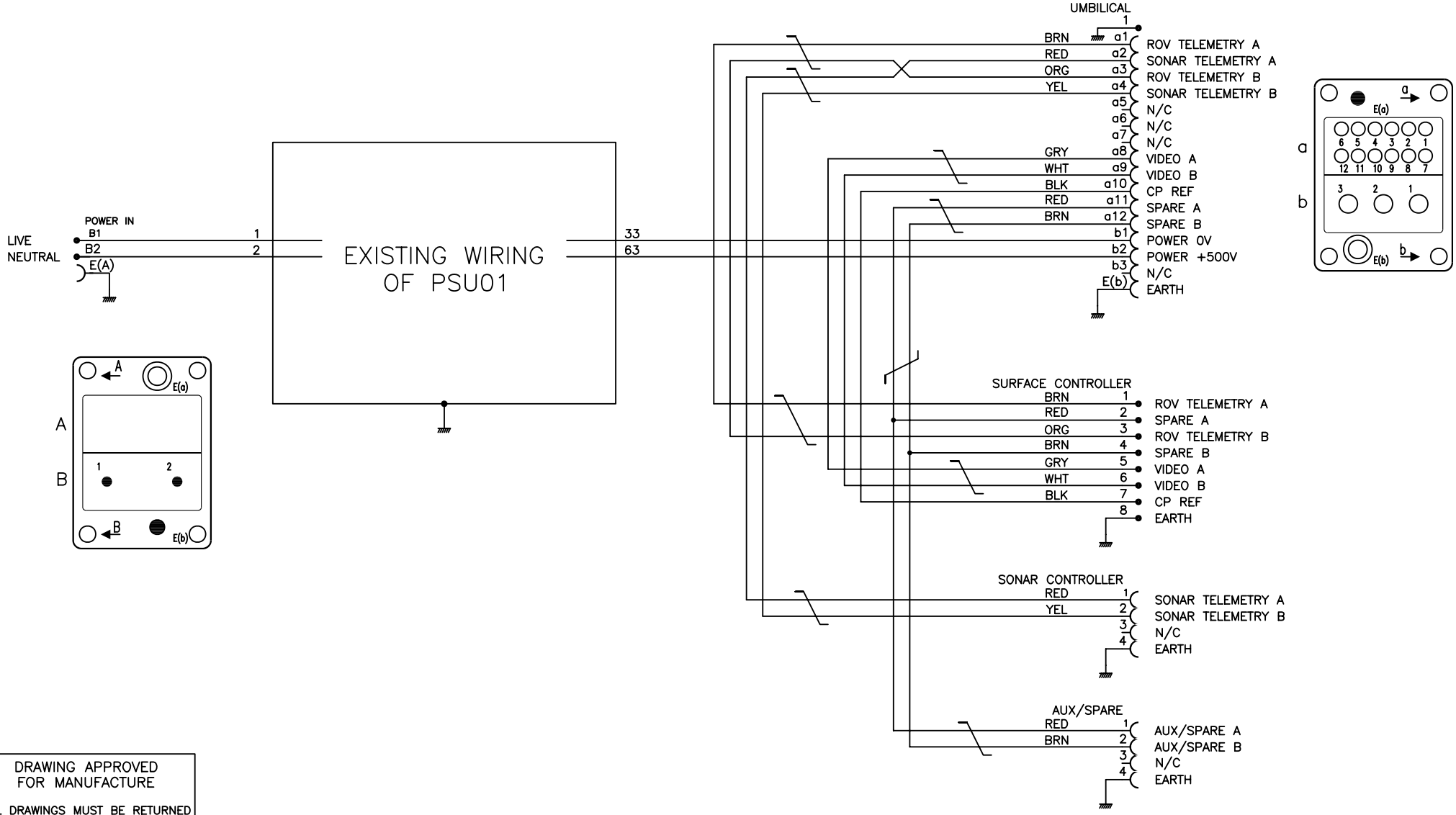
TITLE
FALCON SYSTEM
SUBSEA EUIPMENT ELECTRICAL CONNECTION
AND LAYOUT DETAILS

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite.	JMR	18/4/02

DWG.No. S02691 | Rev. 4 | Sht. 1


LIVE OUT B
32
FS2
5A T
N OUT B
14
EARTH
LIVE OUT C
31
FS1
5A T
N OUT C
14
EARTH
FS3
5A T
35
LIVE OUT C
14
N OUT C
EARTH
FOR 240V SUPPLY: LINK TERMINAL 12 & 13 ONLY
FOR 110V SUPPLY: LINK TERMINAL 11 & 12
AND
LINK TERMINAL 13 & 14
LIVE
1
10
N
2
EARTH
11
A
TX1
12
B
13
C
14
D
16
570V
FS4
10A
26
17
ØV
4
POWER ON
AMBER NEON
240V
240Vac
AUX
5
CON 2
44
43
50
4
+10V
0V
I/P
LA
LB
L2/N
ZERO
SPAN
RAMP UP
LIMIT
VOLT
VR1
VR2
37
38
39
10K
CURRENT
COMPENSATION
** BEHIND THE PANEL
VOLTAGE FEEDBACK
& CURRENT COMPENSATION
OPTION BOARD
PCS27TM
5 TURNS
I-
I+
G2
K2
G1
K1
orange
30
COOLING FAN
+V
L1
3
7
CAPACITOR PCB
TH1
D1
2mH
22K
50W
0.47uF
3x470uF
400V
4x0.047uF
250V
Y
4 X
10K
3W
L1
L2
17
TH2
D2
22K
50W
0.47uF
3x470uF
400V
81
CON 2
9
-V
2mH
8
CON 1
CON 1
6
93
30
1K
34
1K
96
CON 2
METER
+VE
63
1000V
VOLT
METER
-VE
33
EARTH FAULT
RESET
&
OUTPUT
ON/OFF
5
50
GREEN NEON
SWITCH WITH INDICATOR
A1
A2
L1
AK
L2
11
12
14
IR475
DC LEAKAGE DETECTOR
switch setting
E
KE
M+
M-
T
R1
R2
21
22
24
CON 2
50
DC O/P
EARTH
FAIL
52
51
CON 1
53
FOR UNIT NO. 007 ONWARD
POWERLINK ELECTRONICS LTD.
Title
PSU01 500-600V DC SUPPLY WIRING DIA.
Size
B
Document Number
CD60641I.SCH
REV
I
Date:
January 22, 2004
Sheet
1 of
1



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ISS	DESCRIPTION	CHECKED	DATE	REF
5	EATH CONNECTOR CHANGE		12/08/05	DCR873-RL
4	Change wire No. to Colours		7/5/05	DCR862-RL
3	SCU & SONCU connectors corrected		8/4/04	DCR772-DW
2	Correct title, 'Video2' to 'Spare' & wire numbers add Aux Spare		1/4/03	DCR682-DW

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TITLE
SI-PSU04 FALCON POWER SUPPLY UNIT
WITH SPARE TWISTED PAIR
WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite	JMR	7/3/03

DWG.No.S03057 Rev. 5 Sht. 1

KEYBOARD UNIT
SK4
4 VCC YEL
3 GND BLU
1 KBDATA RED
5 CLK GRN
GRN/YEL
VGA OUT
ICOP–J14
1 2 3 4 5
ICOP–J4
VGA OUT KEYBOARD

6111P
ICOP–6054VE
ZMM–C2
POSITION OF PCB's IN STACK

AUX
SK6
1 RED
2 BLK
3
4
5
6
7 GRN/YEL
8
9
10
11
12
13
14
15

ICOP–J16
N/C DCD 1
N/C RXD 2
TXD 3
N/C DTR 4
N/C GND 5
N/C DSR 6
N/C RTS 7
N/C CTS 8
N/C RI 9

COM4 (AUX)
COM3 (AUX COM A)

ICOP–J15
1 DCD 1
2 RXD 2
3 TXD 3
4 DTR 4
5 GND 5
6 DSR 6
7 RTS 7
8 CTS 8
9 RI 9

AUX COM A
PL5
1 2 3 4 5 6 7 8 9

AUX COM B
PL6
N/C 1
N/C 2
N/C 3
N/C 4
N/C 5
N/C 6
N/C 7
N/C 8
N/C 9

PCB1
ICOP–6054VE
CPU MODULE
PCB

PCB3–J1 & J2
PCB2–J1
STACK CONNECTOR

HANDCONTROL UNIT
SK1
7 BRN FWD/REV
8 RED LATERAL
9 ORG TURN
10 YELL VERT
11 GRN TILT
12 BL LIGHTS
13 VIO MANIP
14 GRY VERTICAL BUTTONS
15 WHT ENABLE THRUSTERS
16 BLK AUTO HEAD
2 BRN AUTO DEPTH
3 RED CAMERA SELECT
4
5 YELL THRUSTER POWER
6 GRN 0V
1 BL +5V
GRN/YEL

6111–J7
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

PCB3
6111P
FALCON OVERLAY
PCB

6111–J8
1 Ana7 1
2 Ana6 2
3 Ana5 3
4 Ana4 4
5 Ana3 5
6 Ana2 6
7 Ana1 7
8 Ana0 8

ZMM–J3
27 DA5 27
28 DA4 28
29 DA3 29
30 DA2 30
31 DA1 31
32 DA0 32
49 +5V Digital 49
50 0V Digital 50

PCB2
ZMM–C2
I/O PCB

09–16–024–3103
VIEWED FROM MATTING FACE
PINS 17–24 ARE UNPOPULATED

ICOP–J8 485F9–PL1
1 DCD 1
2 RXD 2
3 TXD 3
4 DTR 4
5 GND 5
6 DSR 6
7 RTS 7
8 CTS 8
9 RI 9
10

485F9i
ISOLATED
RS232/485
MODULE

485F9–SKT1
3
4
5
6
7 +5V
8 0V

R3 470R
R2 470R
R1 470R
TB4–3
TB4–2
TB4–4
TB4–1
RED
BLK

UMBILICAL
U1
TELE A BRN 1
TELE B ORG 3
4
VIDEO A GRY 5
VIDEO B WHT 6
CP REF BLK 7
8
GRN/YEL

COM1 (VEHICLE COMS)
COM2 (OVERLAY COMS RS485)

ICOP–J11
1 2

ICOP–J7
+5V 0V

6111–J2
1
2 TELE B ORG
3 TELE A BRN

TMS2510C PSU MODULE SHEET 2
RED
BLK

6111–J9
1 +5V
4 0V

VIDEO OUT
SKT1
6111–J5
VIDEO OUT
VIDEO IN
6111–J3
MVT175–75 VIDEO XMFR SHEET 2

RED
BLK
TMS2510C PSU MODULE SHEET 2
RED
BLK

PCB5 6101P TB2 SHEET 2
VIDEO AMP PCB6 SHEET 2
CP REF SKT2 SHEET 2
6119P SHEET 2

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ISS	DESCRIPTION	CHECKED	DATE	REF
2	Added Detail		06/10/06	ECR1194–RAL
1	First Issue		16/09/06	

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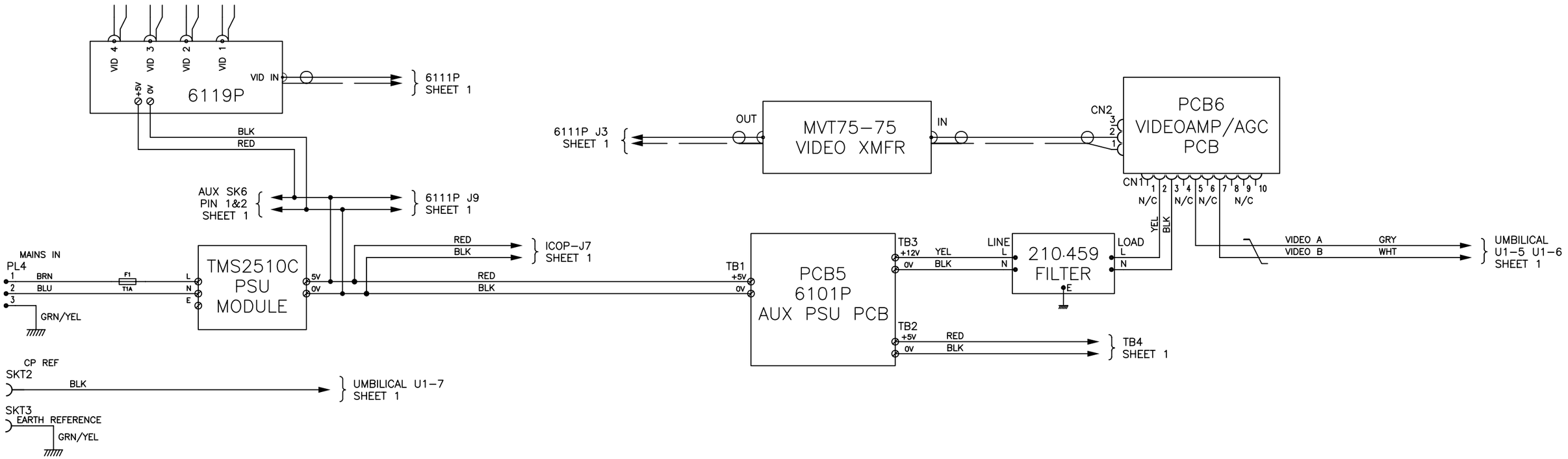
TITLE
SI–SCU07 FALCON SURFACE CONTROL UNIT CIRCUIT DIAGRAM
SHEET 1 OF 2

DRAWN	APPROVED	DATE
R.Lundbech		16/09/06

DWG.No. S05521 Rev. 2 Sht. 1

6119P	S1	INTERNAL LOAD	EXTERNAL MONITOR ON REAR PANEL SKT1
DEFUALT	1–2	NONE	YES
	2–3	75R	NO



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1	First Issue		16/09/06	

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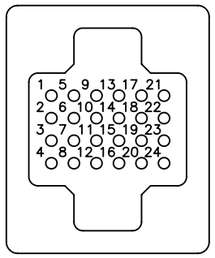
TITLE
SI–SCU07 FALCON SURFACE CONTROL UNIT
CIRCUIT DIAGRAM

SHEET 2 OF 2

DRAWN	APPROVED	DATE
R.Lundbech		16/09/06

DWG.No. S05521 | Rev. 2 | Sht. 2



09-16-024-3001

VIEWED FROM MATTING FACE

PINS 17-24 ARE UNPOPULATED

VCC
RED
YEL
BLU
GRN
BLK
JOYSTICK
0V

7 BRN TB1-1 FORWARD REVERSE 1
8 RED TB1-2 LATERAL 2
9 ORG TB1-3 TURNS 3
10 YEL TB1-4 VERTICAL
11 BLU TB1-5 TILT
12 VIO TB1-6 LIGHTS
13 GRY TB1-7 MANIP
14 GRN TB1-8 VERTICAL BUTTONS
15 WHT TB1-9 ENABLE THRUSTERS
16 BLK TB1-10 AUTO HEAD
2 WHT/BLK TB1-11 AUTO DEPTH
3 PNK TB1-12 CAMERA SELECT

4 DARK GRN TB2-1
5 PALE BLU TB2-2
6 RED/BLK TB2-3
TB2-4
TB2-5
TB2-6
1 BLU/BLK TB2-7
TB2-8
TB2-9
TB2-10
TB2-11
TB2-12

+5V
RV1 VERT 5K
0V

+5V
RV2 TILT 5K
0V

+5V
RV3 LIGHTS 4K7
0V

VCC
RED LED D1
R1 1K

MANIP
SW7 CLOSE
SW8 OPEN
R3 10K
0V
0V

LIGHT SWITCH
ON
SW10
OFF
0V

SW1 THRUST POWER
LOW
HIGH
0V

SW2 CAM SEL
B
A
0V

SW9 THRUST ENABLE
ENABLE
DISABLE
0V

VCC
R4 100
GREEN LED D2
0V

SW3 AUTO DEPTH
0V

SW4 AUTO HEAD
0V

VERT BUTTONS
SW5 DOWN
SW6 UP
R2 10K
0V
0V

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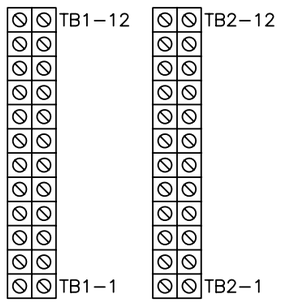
TITLE
SI-HCU01-2
FALCON HAND CONTROLLER
CIRCUIT DIAGRAM

SHEET 1 OF 2

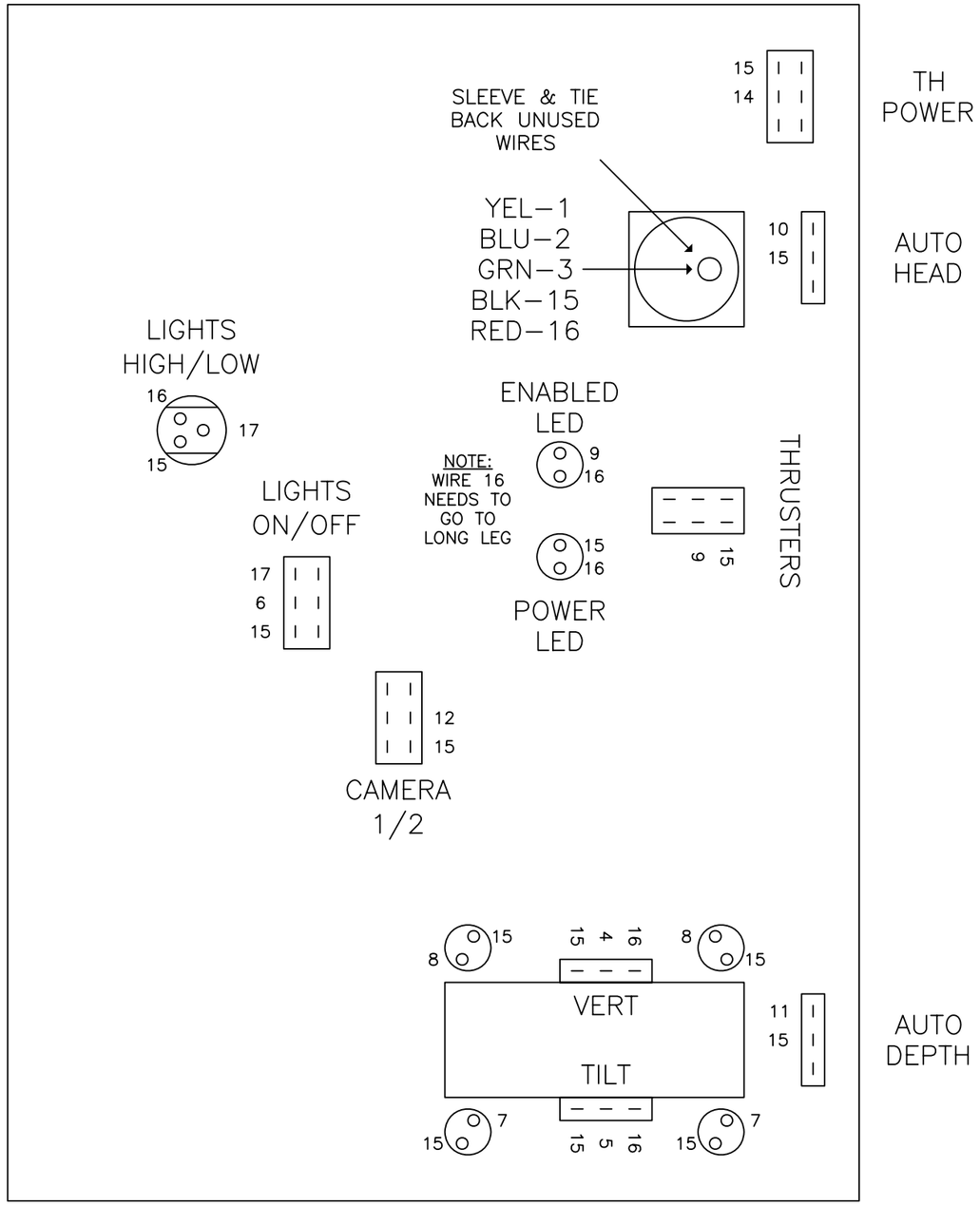
DRAWN	APPROVED	DATE
R.Lundbech	JMR	17/09/06

DWG.No. S05522 | Rev. 1 | Sht. 1

INTERNAL VIEW OF BASE



INTERNAL VIEW OF LID



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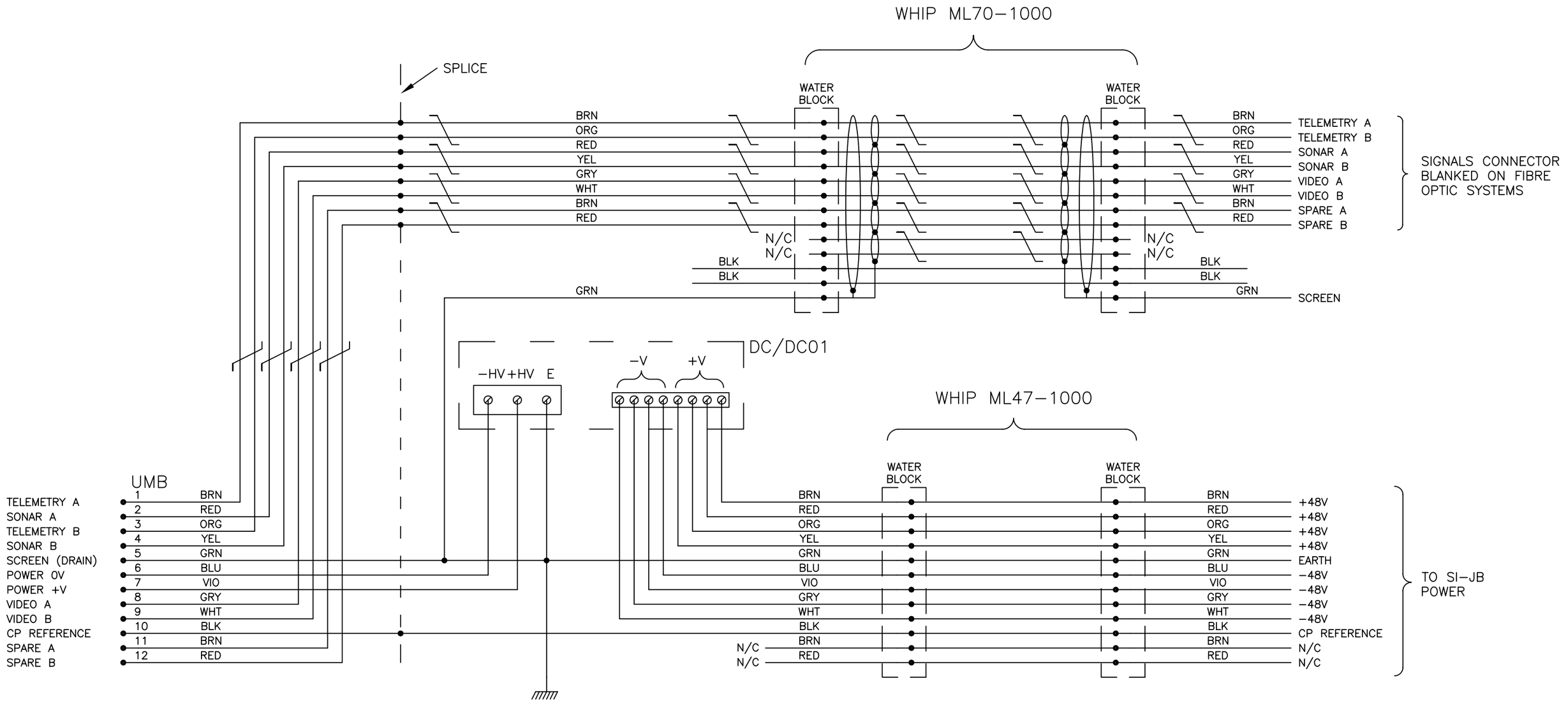
TITLE
SI–HCU01–2
FALCON HAND CONTROLLER
WIRING DIAGRAM

SHEET 2 OF 2

DRAWN	APPROVED	DATE
R.Lundbech	JMR	17/09/06

DWG.No. S05522 | Rev. 1 | Sht. 2

NOTE
1) UNUSED CORES TO BE SLEEVED AND TIED BACK.



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ISS	DESCRIPTION	CHECKED	DATE	REF
4	POWER CORES ADDED ON ML70		05/06/06	ECR1103–LM
3	LABELING CHANGE		07/03/06	DCR920–RAL
2	TITLE CHANGE		03/03/06	DCR919–RAL
1	First Issue		3/4/03	N/A

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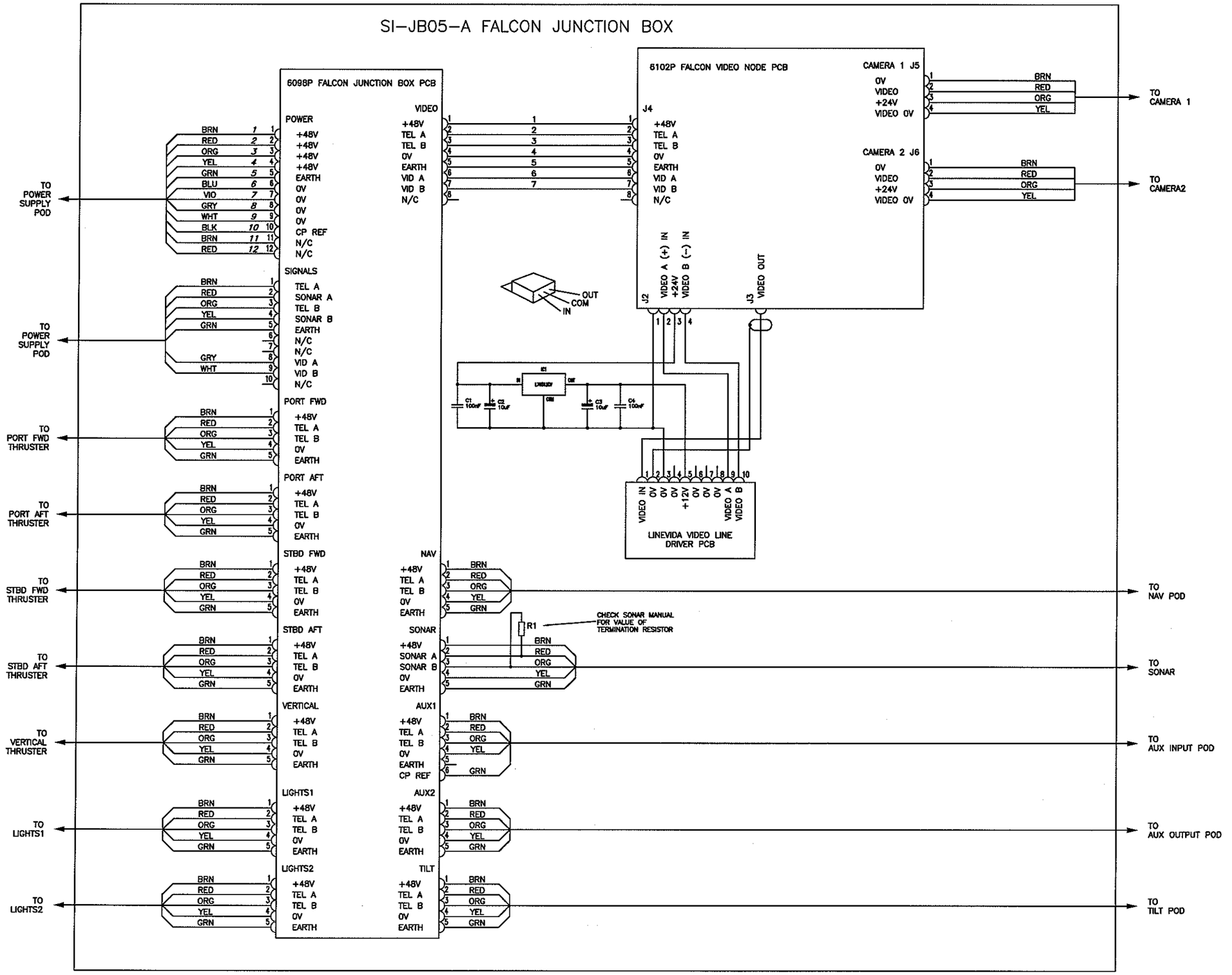
TITLE
SI–VPSU02 & SI–VPSU03
FALCON VEHICLE POWER SUPPLY UNIT
WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite	JMR	3/4/03

DWG.No. S03087 Rev. 4 Sht. 1

SI–JB05–A FALCON JUNCTION BOX



ISS	DESCRIPTION	CHECKED	DATE	REF
1	First Issue		13/11/06	

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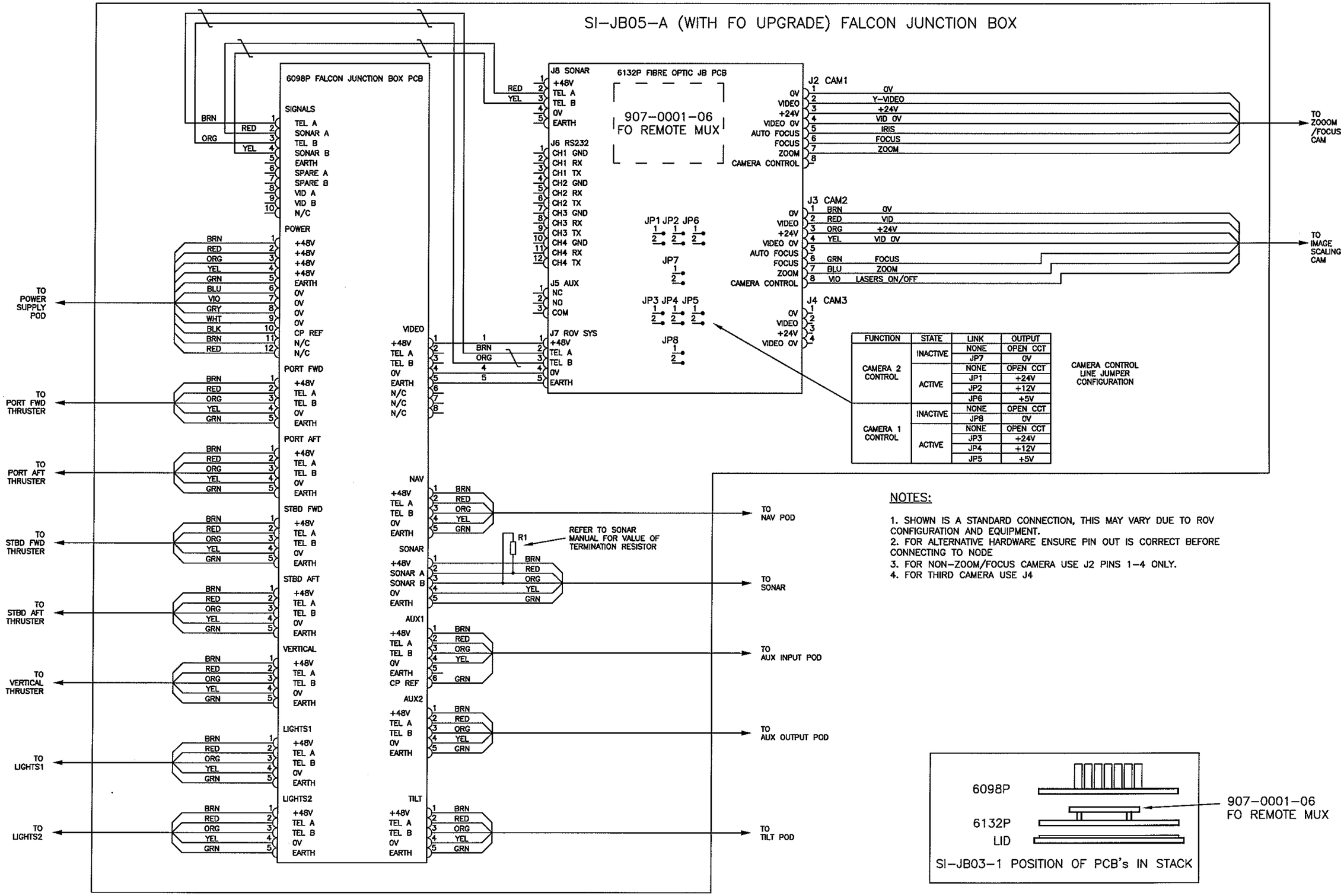
TITLE
SI–JB05–A FALCON JUNCTION BOX WITH 6098P & 6102P PCB WIRING DIAGRAM

SHEET 1 OF 2

DRAWN	APPROVED	DATE
R.Lundbech		13/11/06

DWG.No. S05623 | Rev. 1 | Sht. 1

SI-JB05-A (WITH FO UPGRADE) FALCON JUNCTION BOX



FUNCTION	STATE	LINK	OUTPUT
CAMERA 2 CONTROL	INACTIVE	NONE	OPEN CCT
		JP7	0V
	ACTIVE	NONE	OPEN CCT
		JP1	+24V
		JP2	+12V
		JP6	+5V
CAMERA 1 CONTROL	INACTIVE	NONE	OPEN CCT
		JP8	0V
	ACTIVE	NONE	OPEN CCT
		JP3	+24V
		JP4	+12V
		JP5	+5V

CAMERA CONTROL LINE JUMPER CONFIGURATION

NOTES:

1. SHOWN IS A STANDARD CONNECTION, THIS MAY VARY DUE TO ROV CONFIGURATION AND EQUIPMENT.
2. FOR ALTERNATIVE HARDWARE ENSURE PIN OUT IS CORRECT BEFORE CONNECTING TO NODE
3. FOR NON-ZOOM/FOCUS CAMERA USE J2 PINS 1-4 ONLY.
4. FOR THIRD CAMERA USE J4

SI-JB03-1 POSITION OF PCB's IN STACK

ISS	DESCRIPTION	CHECKED	DATE	REF
1	First Issue	JJ	13/11/06	

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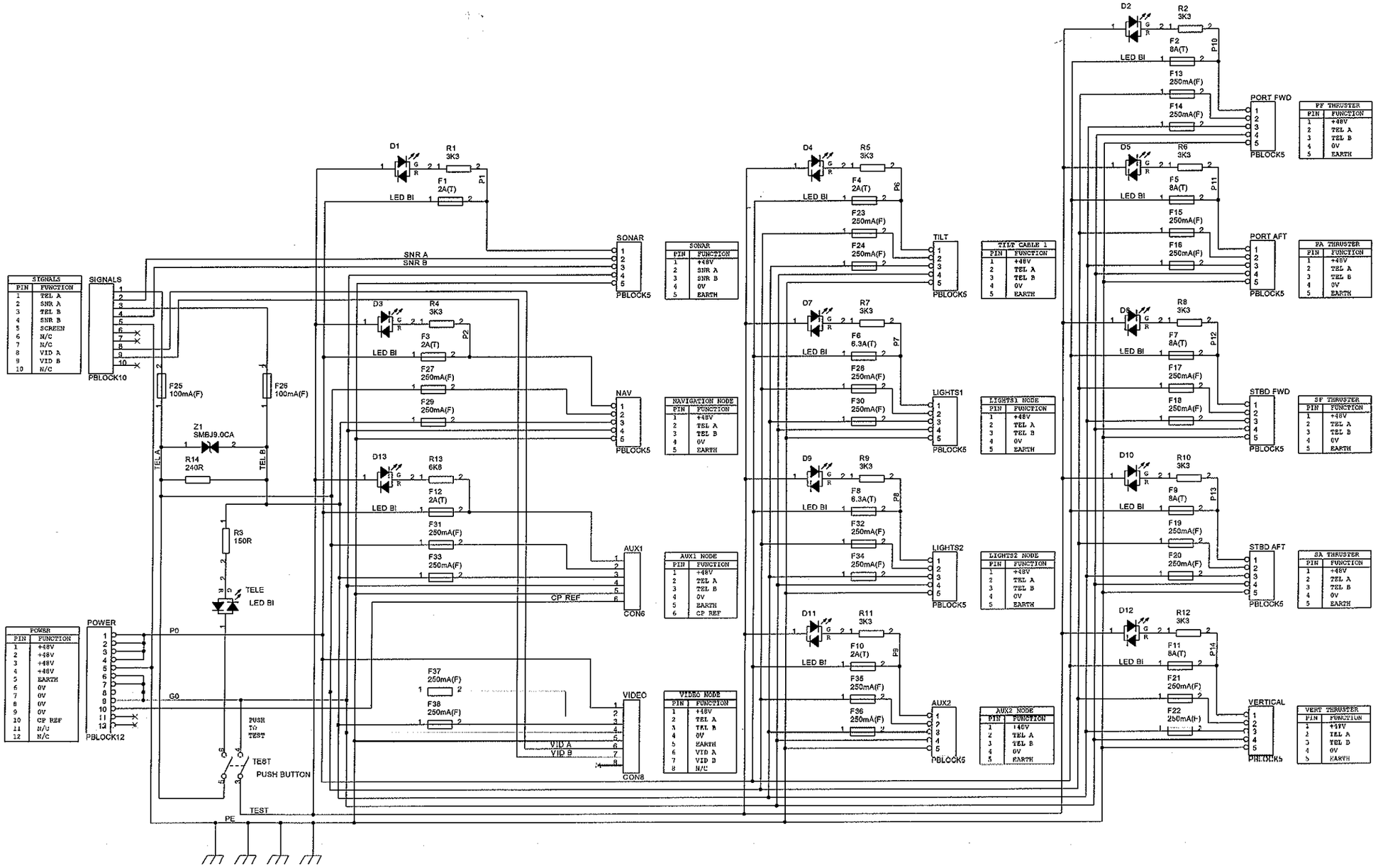
TITLE
SI-JB05-A FALCON JUNCTION BOX WITH 6098P & 6132P FO PCB WIRING DIAGRAM

SHEET 2 OF 2

DRAWN	APPROVED	DATE
R.Lundbech		13/11/06

DWG.No. S05623 Rev. 1 Sht. 2



Iss	Description	APPR	DATE	REF
2	R14 VALUE CHANGE		20/12/02	ECN1732
1	FIRST ISSUE		15/01/02	

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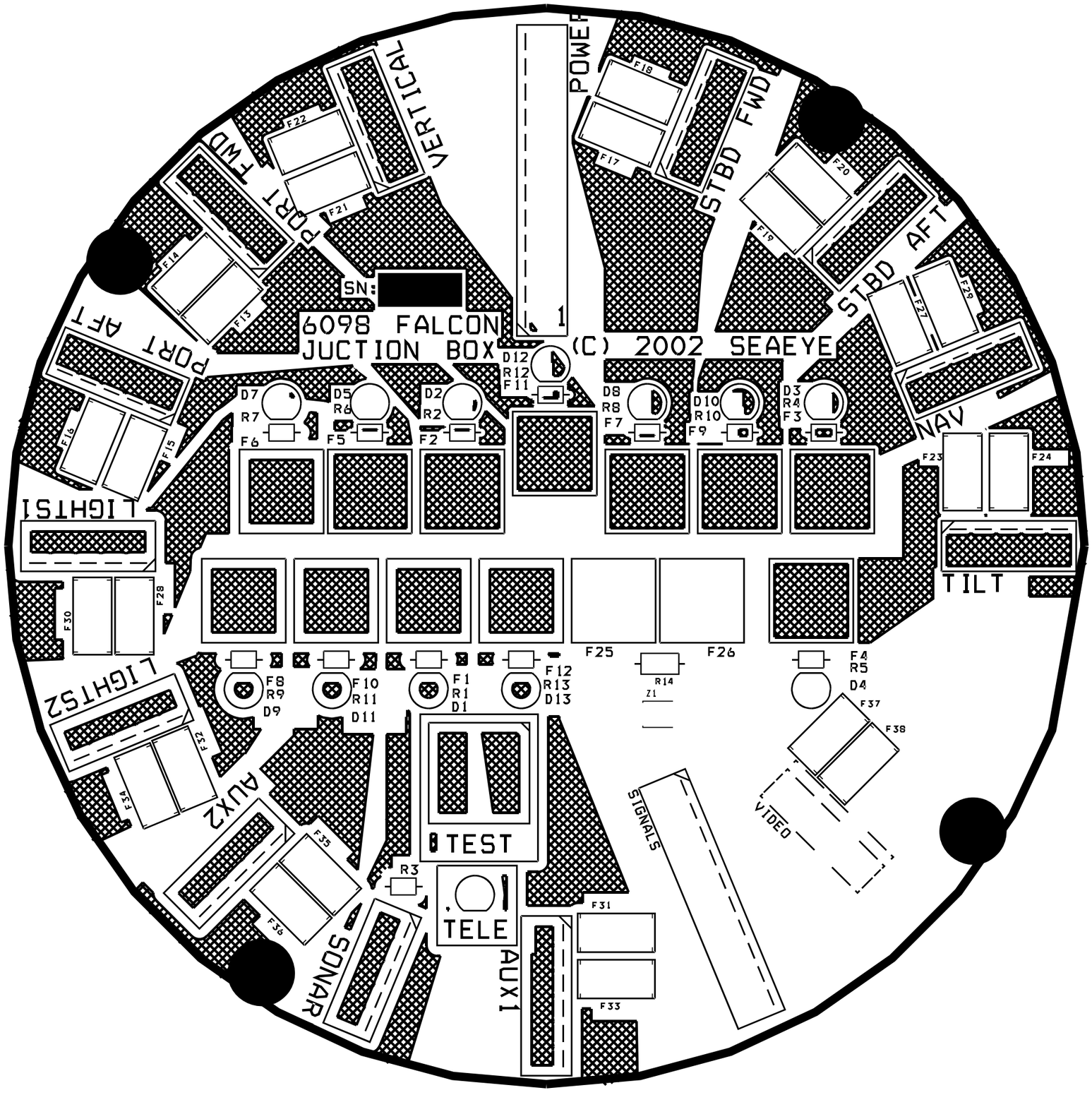
TITLE
FALCON SYSTEM
CIRCUIT DIAGRAM
JUNCTION BOX PCB

SHEET 1 of 1

DRAWN	APPROVED	DATE
C.G.PETTIT		15/01/02

DRG No.: S02519 2 1



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ISS	DESCRIPTION	APPD	DATE	REF
1	FIRST ISSUE		25/01/02	

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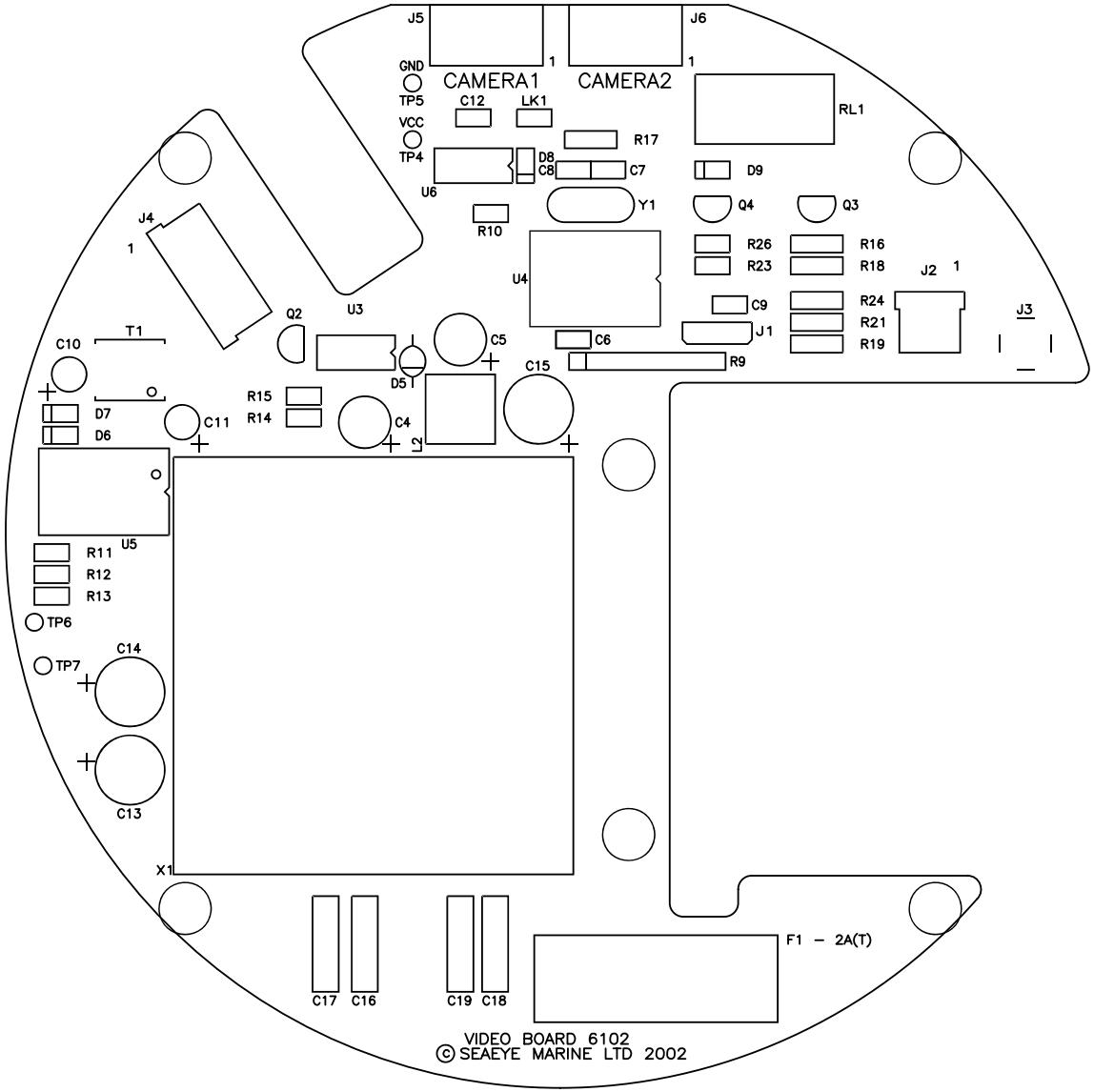
TITLE
FALCON SYSTEM
JUNCTION BOX PCB
COMPONENT LAYOUT

SHEET 1 OF 1

DRAWN	APPROVED	DATE
C.G.PETTIT	JMR	25/01/02

DWG.No. S02520 Rev. 1 Sht. 1



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ISS	DESCRIPTION	CHK'D	DATE	REF
1	FIRST ISSUE		14/01/03	

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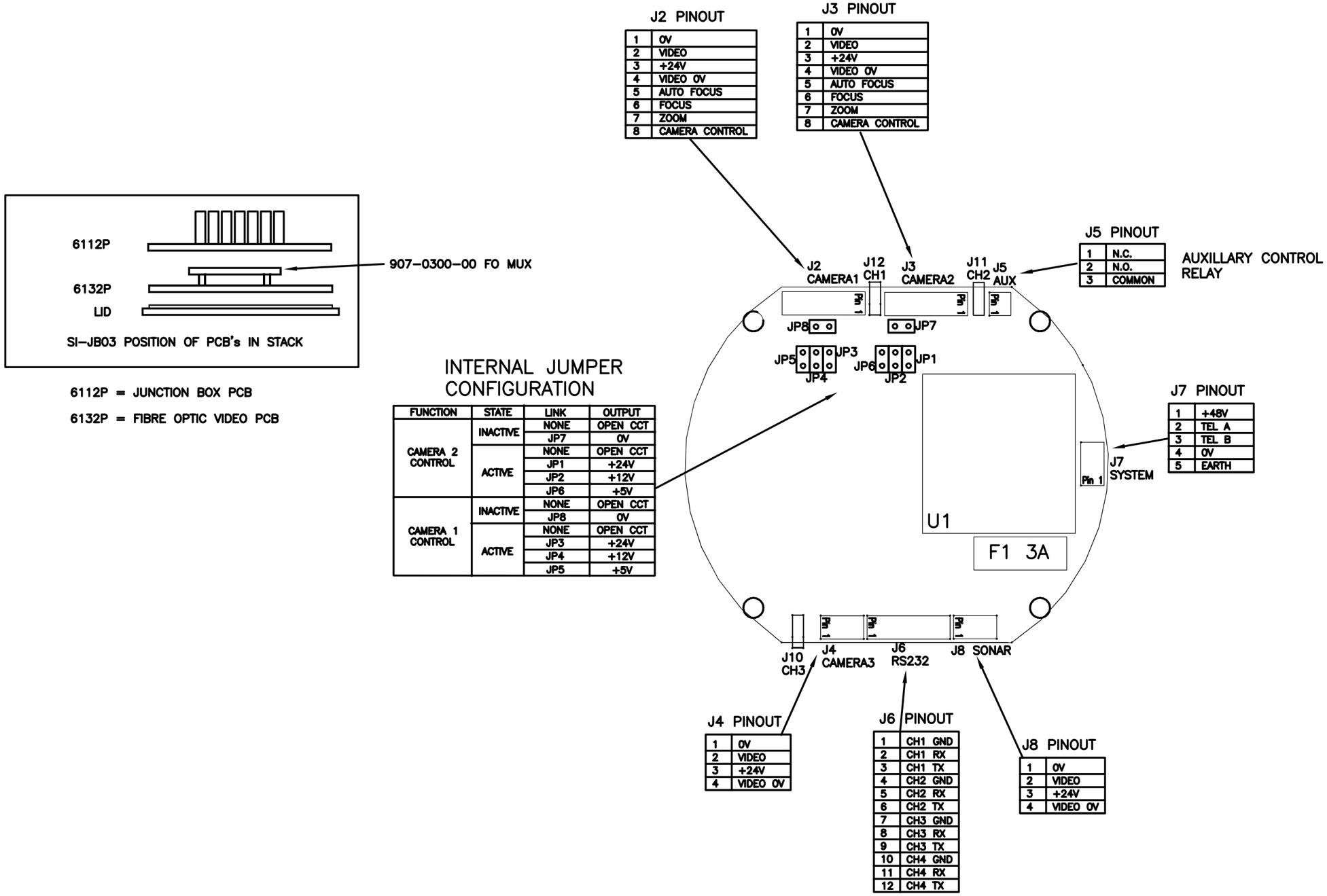
TITLE
6102P FFALCON VIDEO NODE PCB
COMPONENT LAYOUT DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
C.G.PETTIT	JMR	14/01/03

DWG.No. S03008 | Rev. 1 | Sht. 1



INTERNAL JUMPER CONFIGURATION

FUNCTION	STATE	LINK	OUTPUT
CAMERA 2 CONTROL	INACTIVE	NONE	OPEN CCT
		JP7	0V
	ACTIVE	NONE	OPEN CCT
		JP1	+24V
		JP2	+12V
		JP6	+5V
CAMERA 1 CONTROL	INACTIVE	NONE	OPEN CCT
		JP8	0V
	ACTIVE	NONE	OPEN CCT
		JP3	+24V
		JP4	+12V
		JP5	+5V

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ISS	DESCRIPTION	CHECKED	DATE	REF
1	First Issue		25/2/05	N/A

Seaeye

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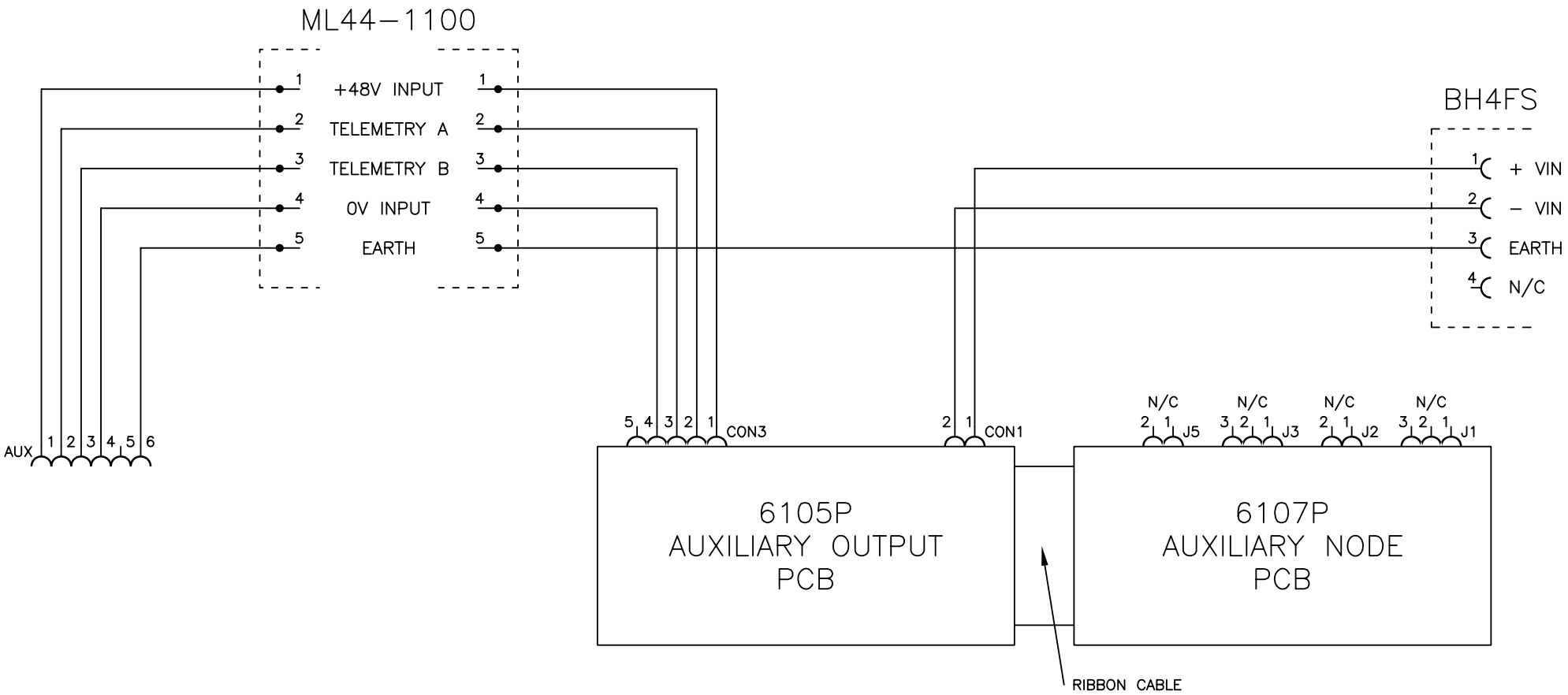
TITLE
6132P FIBRE OPTIC JB PCB.
PCB LINK OPTIONS AND
PINOUT DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. McInnes	JMR	25/2/05

DWG.No. S04411 Rev. 1 Sht. 1



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ISS	DESCRIPTION	APPD	DATE	REF
1	First Issue		07/09/06	

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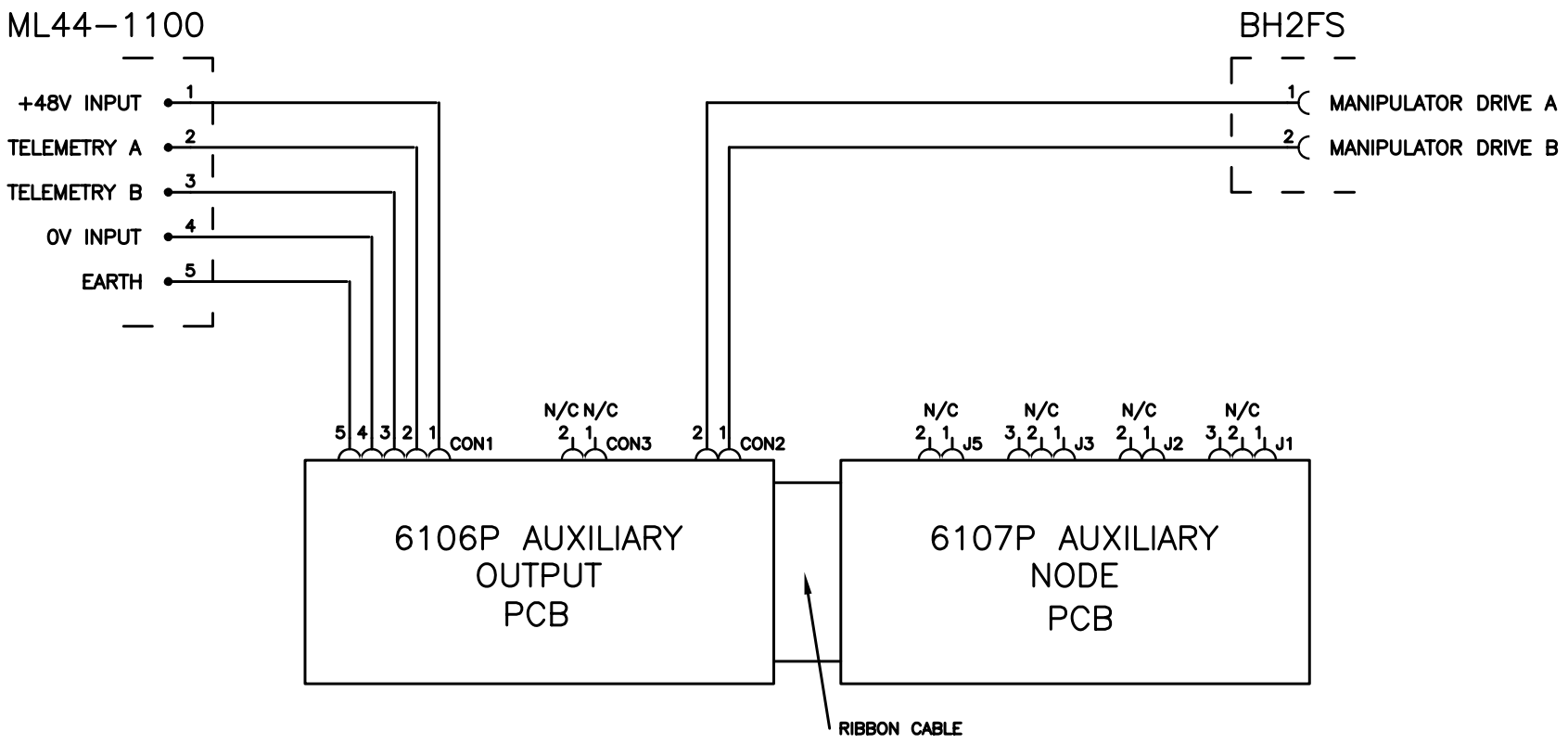
TITLE
SI–AUXIP01
AUX INPUT POD RS485
WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
R.Lundbech	JMR	07/09/06

DWG.No. S05502	Rev.	Sht.
	1	1



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ISS	DESCRIPTION	CHECKED	DATE	REF
2	Bulkhead connections swapped		1/3/06	ECR1053
1	First Issue		19/10/04	N/A

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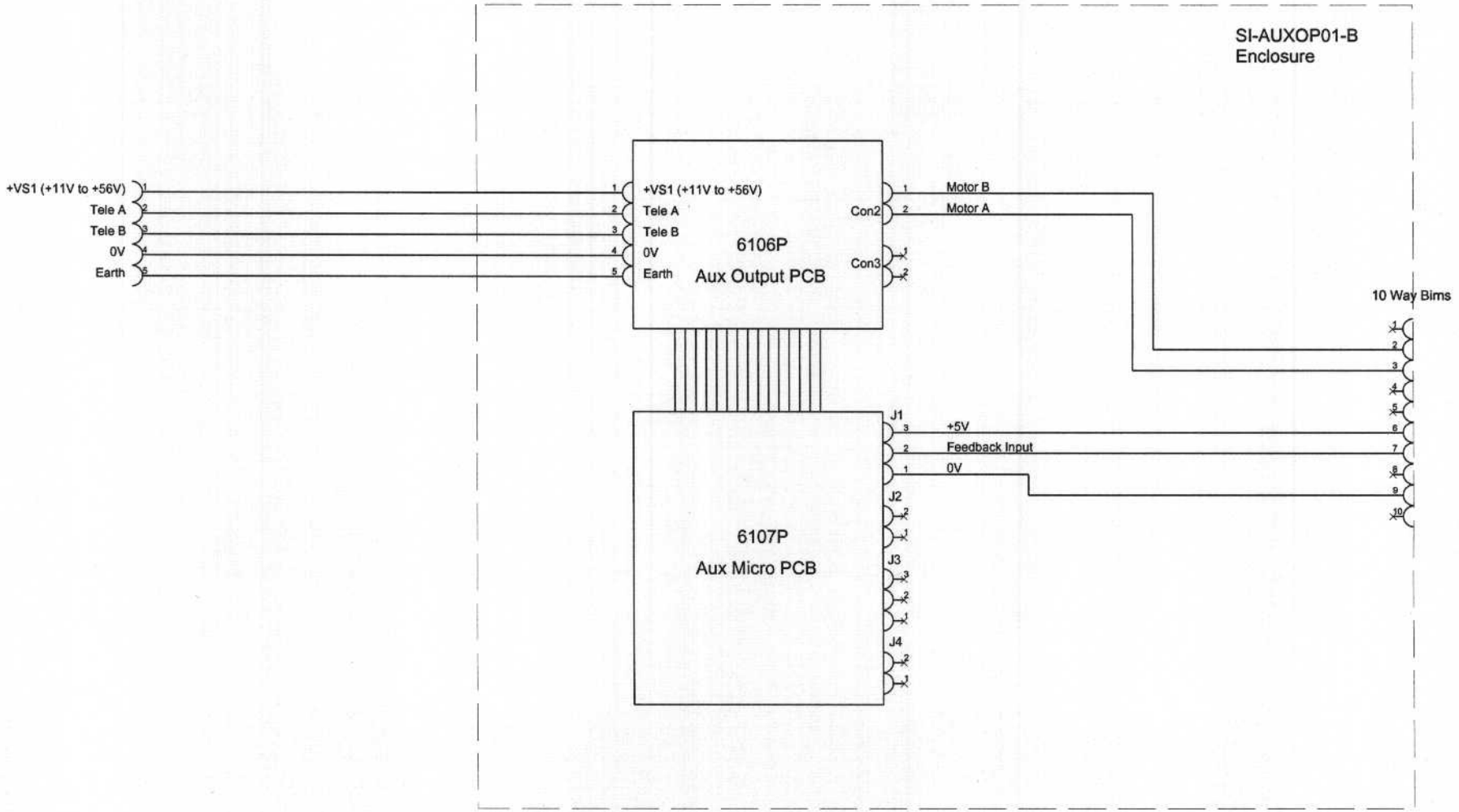
TITLE
SI-AUXOP01 RS485 AUXILIARY 2 WAY OUTPUT POD WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite	JMR	19/10/04

DWG.No. S04136 Rev. 2 Sht. 1



Iss	Description	APPR	DATE	REF
1	First Issue		22/9/04	

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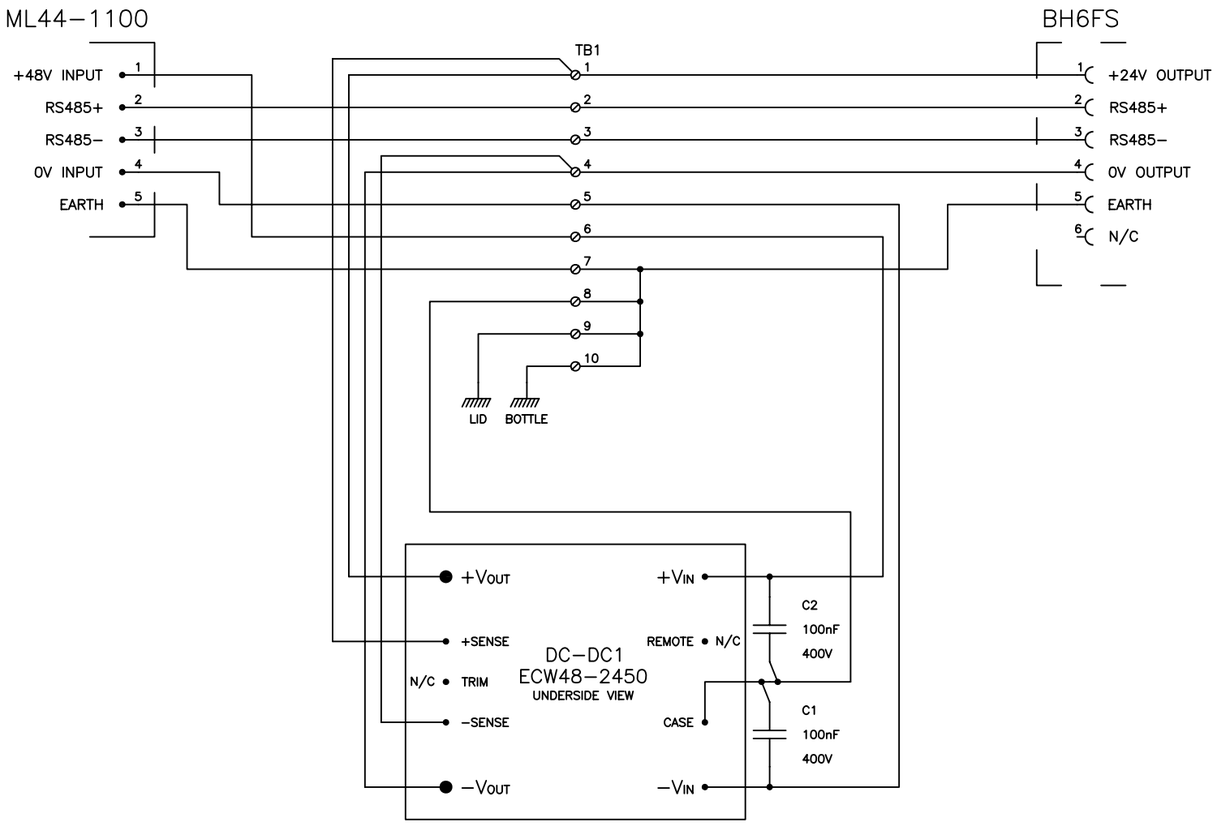
TITLE
SI-AUXOP01-B
Tilt Motor and Feedback Interface Unit

SHEET 1 of 1

DRAWN	APPROVED	DATE
M. Merckel		22/9/04

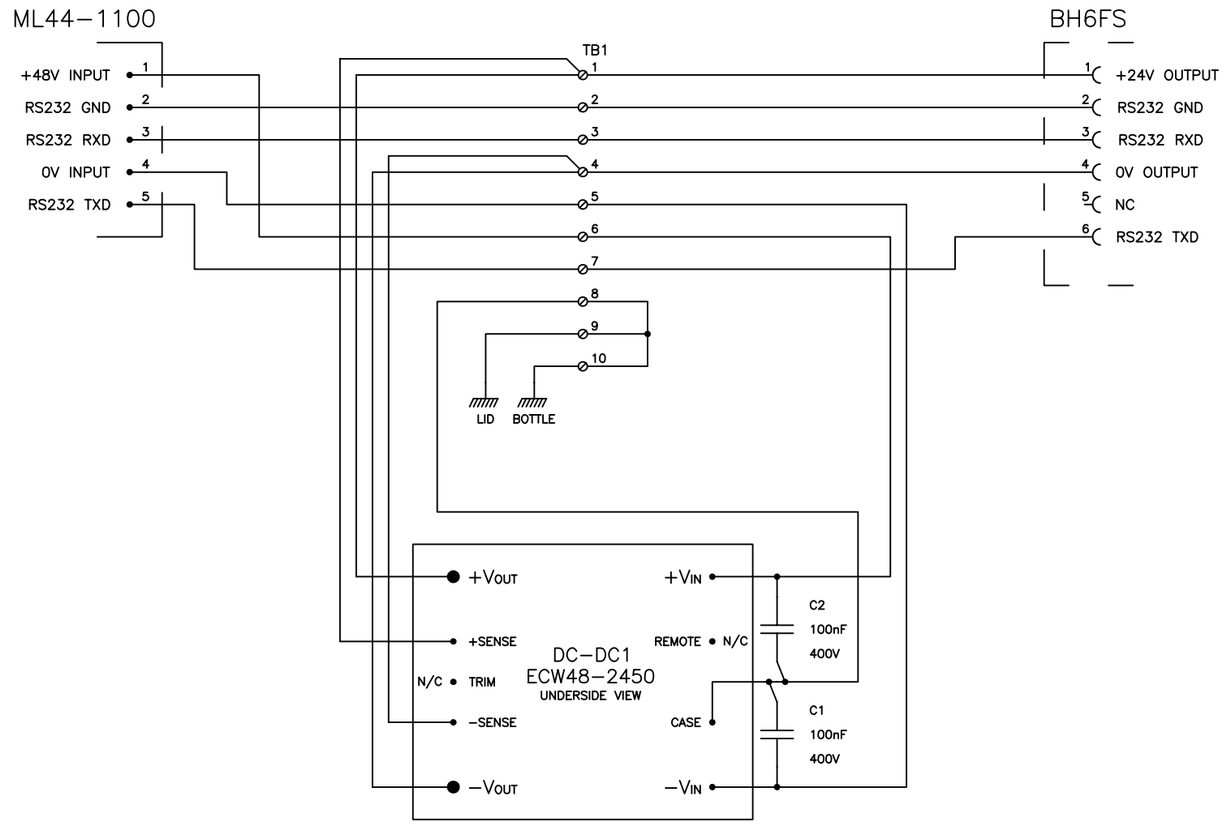
DRG No.: S0411711

RS485



DEFAULT

RS232



OPTIONAL CONFIGURATION

NOTES;

1. C1 & C2 FITTED DIRECTLY TO PINS ON DC–DC1.
2. POD IS TO BE EARTHED EXTERNALLY WHEN RECONFIGURED FOR RS232 (IN THE SAME MANNER AS SI–AUXIP01).
3. FOR RS485 TB1–7 IS CONNECTED TO PIN 5, BUT FOR RS232 TB1–7 IS CONNECTED TO PIN 6.
4. THERE IS A LINK BETWEEN TB1–7 & TB1–8 WITH RS485, BUT NOT WITH RS232.

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ISS	DESCRIPTION	CHECKED	DATE	REF
3	RS232 ReConfiguration info added		20/06/06	ECR1114–LM
2	0V link & note removed		18/1/05	ECR907–DW
1	First Issue		6/6/03	N/A

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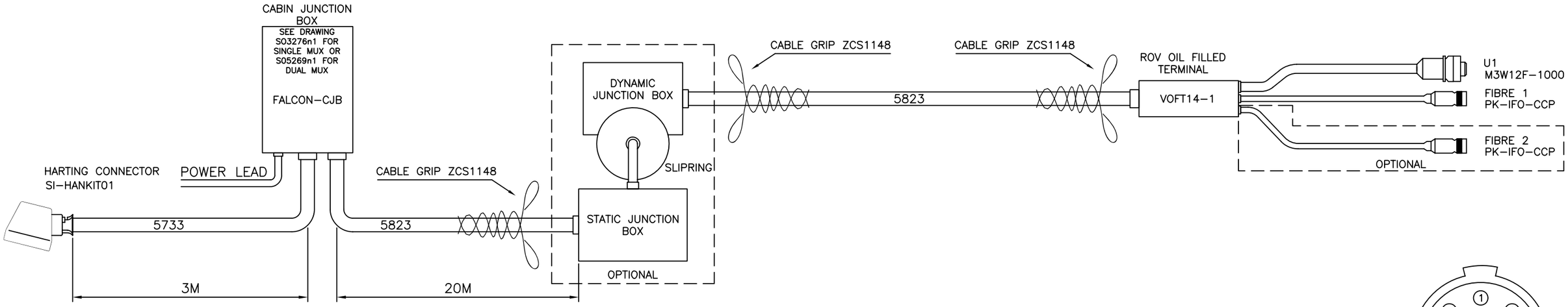
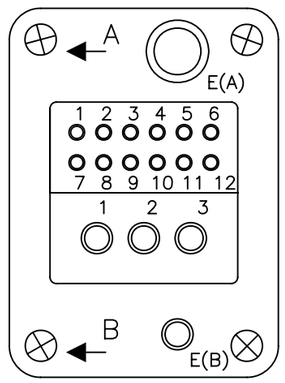
TITLE
SI–AUXOP02–A FALCON AUXILLARY
OUTPUT POD
WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite	JMR	6/6/03

DWG.No. S03183 Rev. 3 Sht. 1



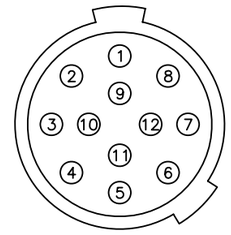


5733

PIN	FUNCTION
A1	BRN ROV TELEMETRY A
A2	RED SONAR TELEMETRY A
A3	ORG ROV TELEMETRY B
A4	YEL SONAR TELEMETRY B
A5	N/C
A6	N/C
A7	N/C
A8	GRY VIDEO A (RESERVED)
A9	WHT VIDEO B (RESERVED)
A10	BLK CP REFERENCE
A11	N/C
A12	N/C
B1	BLU POWER 0V
B2	VIO POWER +500V
B3	N/C
E(B)	DRAINS

5823

STATIC JUNCTION BOX		SLIPRING		DYNAMIC JUNCTION BOX		ROV OIL FILLED TERMINAL	
1	DECKLEAD RED	1	POWER +500V	1	UMBILICAL RED	UMBILICAL RED	WHIP VIO
2	DECKLEAD BRN				UMBILICAL BRN	UMBILICAL BRN	
3	DECKLEAD BLK	2	0V DC	2	UMBILICAL BLK	UMBILICAL BLK	WHIP BLU
4	DECKLEAD BLU				UMBILICAL BLU	UMBILICAL BLU	
5	DECKLEAD YEL	3	CP REFERENCE	3	UMBILICAL YEL	UMBILICAL YEL	WHIP BLK
6	DECKLEAD GRN	4	EARTH	4	UMBILICAL GRN	UMBILICAL GRN	WHIP GRN & DRAIN
FO	DECKLEAD FO BLU FIBRE	FO	MM FIBRE OPTIC	FO	UMBILICAL FO BLU FIBRE		
	DECKLEAD FO NAT FIBRE				UMBILICAL FO NAT FIBRE		

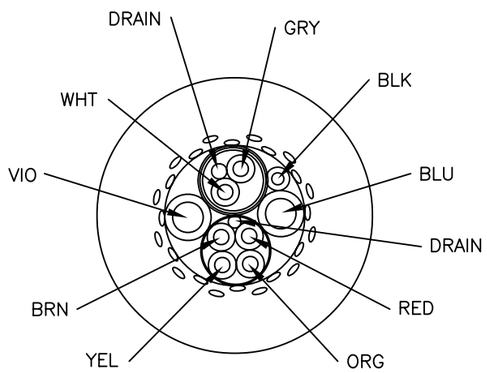


M3W12F

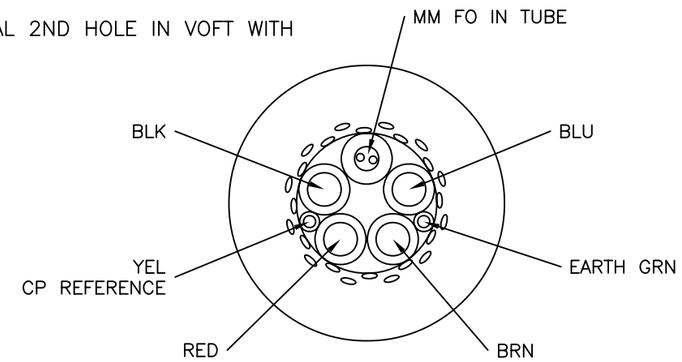
WHIP

PIN	FUNCTION
1	N/C
2	N/C
3	N/C
4	N/C
5	DRAINS EARTH
6	BLU POWER 0V
7	VIO POWER +500V
8	N/C
9	N/C
10	CP REFERENCE
11	N/C
12	N/C

NOTES;
1) A 2 WAY FIBRE MANIFOLD MUST BE USED WHEN BRINGING FIBRES OUT FROM TUBE.
2) ALL OPTICAL FIBRES TO BE TERMINATED WITH ST CONNECTORS EVEN IF UNUSED.
3) CONNECTORS ARE SHOWN FROM MATING FACE.
4) CUT AND SLEEVE ANY UNUSED CONDUCTORS.
5) WINCH ASSEMBLY FITTED AS AN OPTION.
6) IF OPTIONAL FIBRE 2 IS NOT FITTED THEN SEAL 2ND HOLE IN VOFT WITH BLANK.



5733
UMBILICAL



5823
UMBILICAL

ISS	DESCRIPTION	CHECKED	DATE	REF
2	Additional 2nd Fibre & Winch optional		17/05/06	ECR1096-LM
1	First Issue		10/10/03	N/A

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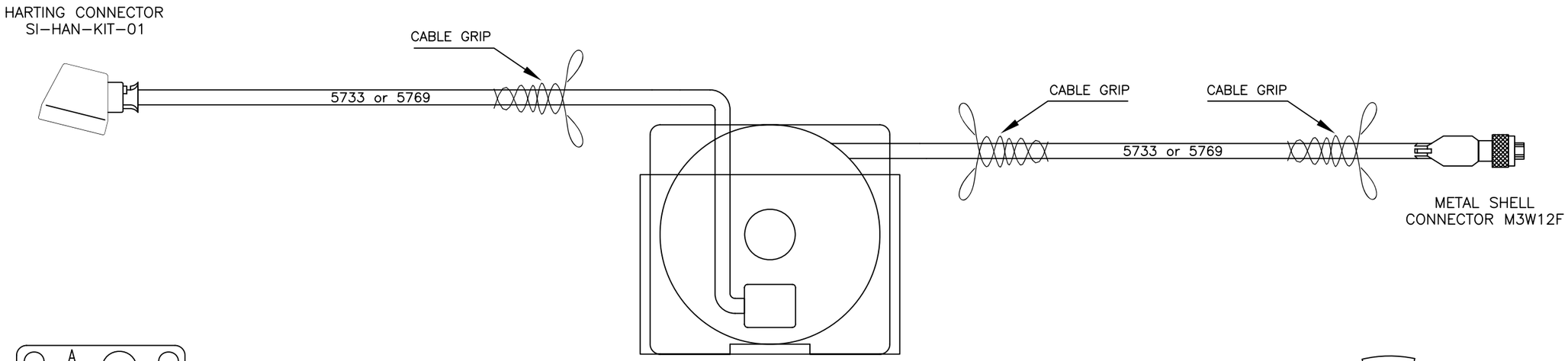
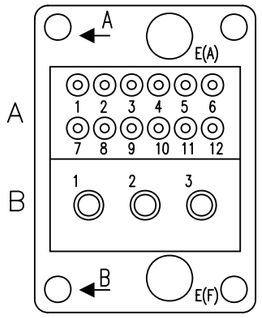
TITLE
FALCON DECK LEAD, WINCH & UMBILICAL WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite		10/10/03

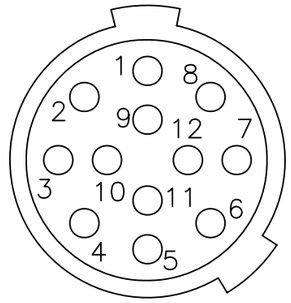
DWG.No.S03337 Rev. 2 Sht. 1





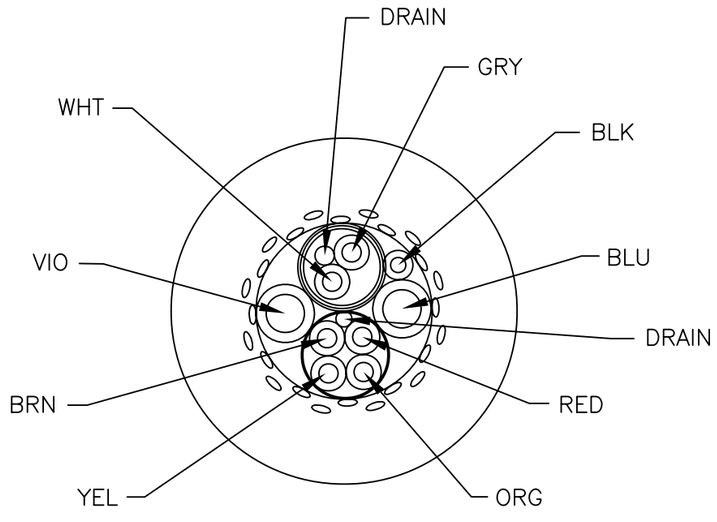
CONNECTOR VIEWED FROM MATING FACE

STATIC JUNCTION BOX			SLIPRING WAY	DYNAMIC JUNCTION BOX		
DECKLEAD BRN	1	ROV TELEMETRY A	4	ROV TELEMETRY A	1	UMBILICAL BRN
DECKLEAD RED	2	SONAR TELEMETRY A	5	SONAR TELEMETRY A	2	UMBILICAL RED
DECKLEAD ORG	3	ROV TELEMETRY B	6	ROV TELEMETRY B	3	UMBILICAL ORG
DECKLEAD YEL	4	SONAR TELEMETRY B	7	SONAR TELEMETRY B	4	UMBILICAL YEL
DECKLEAD DRAINS	5	SLIPRING EARTH	3	SLIPRING EARTH	5	UMBILICAL DRAINS
DECKLEAD BLU	6	POWER 0V	1	POWER 0V	6	UMBILICAL BLU
DECKLEAD VIO	7	POWER +500V	2	POWER +500V	7	UMBILICAL VIO
DECKLEAD GRY	8	VIDEO A	8	VIDEO A	8	UMBILICAL GRY
DECKLEAD WHT	9	VIDEO B	9	VIDEO B	9	UMBILICAL WHT
DECKLEAD BLK	10	CP REFERENCE	10	CP REFERENCE	10	UMBILICAL BLK
N/C	11	SLIPRING SPARE	11	SLIPRING SPARE	11	N/C
N/C	12	SLIPRING SPARE	12	SLIPRING SPARE	12	N/C



CONNECTOR VIEWED FROM MATING FACE

PIN	FUNCTION
A1	BRN ROV TELEMETRY A
A2	RED SONAR TELEMETRY A
A3	ORG ROV TELEMETRY B
A4	YEL SONAR TELEMETRY B
A5	N/C
A6	N/C
A7	N/C
A8	GRY VIDEO A
A9	WHT VIDEO B
A10	BLK CP REFERENCE
A11	N/C
A12	N/C
B1	BLU POWER 0V
B2	VIO POWER +500V
B3	N/C
E(B)	DRAINS



5733 or 5769
UMBILICAL

NOTE
ON SLIPRING TAILS THE FOLLOWING CABLES ARE TO BE TWISTED PAIRS:
4 & 6
5 & 7
8 & 9
11 & 12

PIN	FUNCTION
1	BRN ROV TELEMETRY A
2	RED SONAR TELEMETRY A
3	ORG ROV TELEMETRY B
4	YEL SONAR TELEMETRY B
5	DRAINS
6	BLU POWER 0V
7	VIO POWER +500V
8	GRY VIDEO A
9	WHT VIDEO B
10	BLK CP REFERENCE
11	N/C
12	N/C

DRAWING APPROVED FOR MANUFACTURE

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ISS	DESCRIPTION	CHECKED	DATE	REF
2	TBs revised & minor errors corrected		18/05/06	DCR863-LM
1	First Issue		1/11/05	N/A

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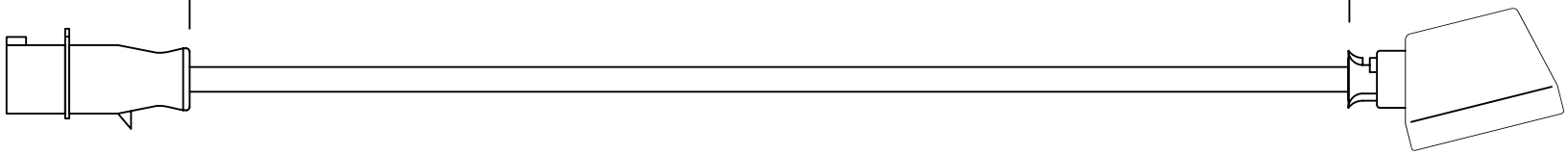
TITLE
FI–UMBKIT01 FALCON UMBILICAL WITH HARTING CONNECTOR, DECKLEAD AND WINCH 06 TO METAL SHELL M3W12F CONNECTOR USING 5733 or 5769 WIRING DIAGRAM, PARTS AND CABLE DETAILS
SHEET 1 OF 1

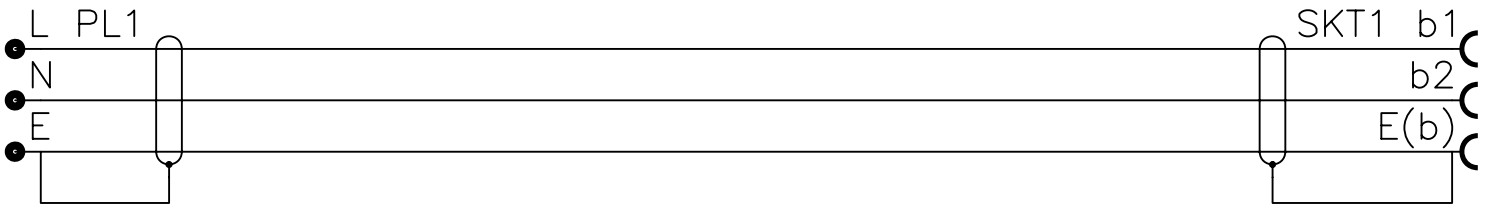
DRAWN	APPROVED	DATE
R.LUNDBECH	JMR	1/11/05

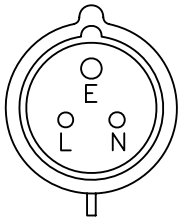
DWG.No. S04836 | Rev. 2 | Sht. 1

PART NO; SI-SL06-n

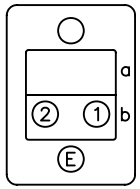
LEAD LENGTH
FINAL DIGIT OF PART NUMBER IS THE LENGTH OF LEAD IN METERS







NOTES
1) CONNECTORS VIEWED FROM MATING FACE.
2) PART No 847-297, YELLOW 110V CONNECTOR, TO BE PACKAGED WITH CABLE.



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ISS	DESCRIPTION	CHECKED	DATE	REF
3	Additional Note added		18/07/06	DCR930-LM
2	Title revised for SL06 redrawn		12/11/03	DCR737-DW
1	First Issue		12/11/03	N/A

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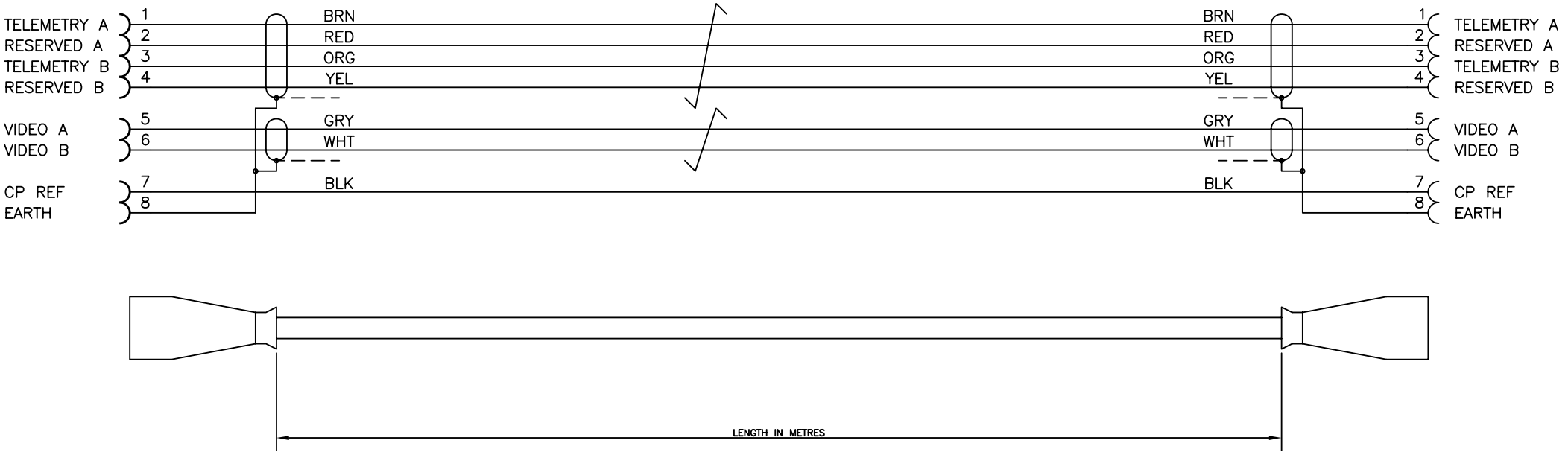
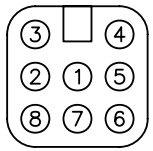
TITLE
SI-SL06-n FALCON SURFACE PSU
INPUT LEAD
WIRING DIAGRAM

SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite	JMR	12/11/03

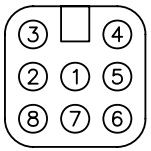
DWG.No.S02845 Rev. 3 Sht. 1





VIEWED FROM MATING FACE

PART NUMBER = SI-SL02-n.
WHERE n IS THE LENGTH IN METRES



VIEWED FROM MATING FACE

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ISS	DESCRIPTION	APPD	DATE	REF
1	FIRST ISSUE		13/08/02	

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TITLE
SI-SL02-n FALCON SURFACE INTERCONNECT LEAD

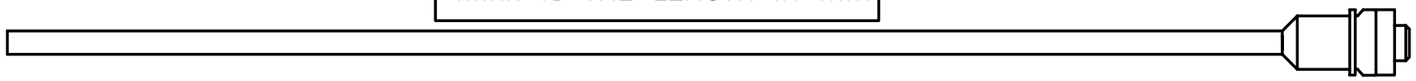
SHEET 1 OF 1

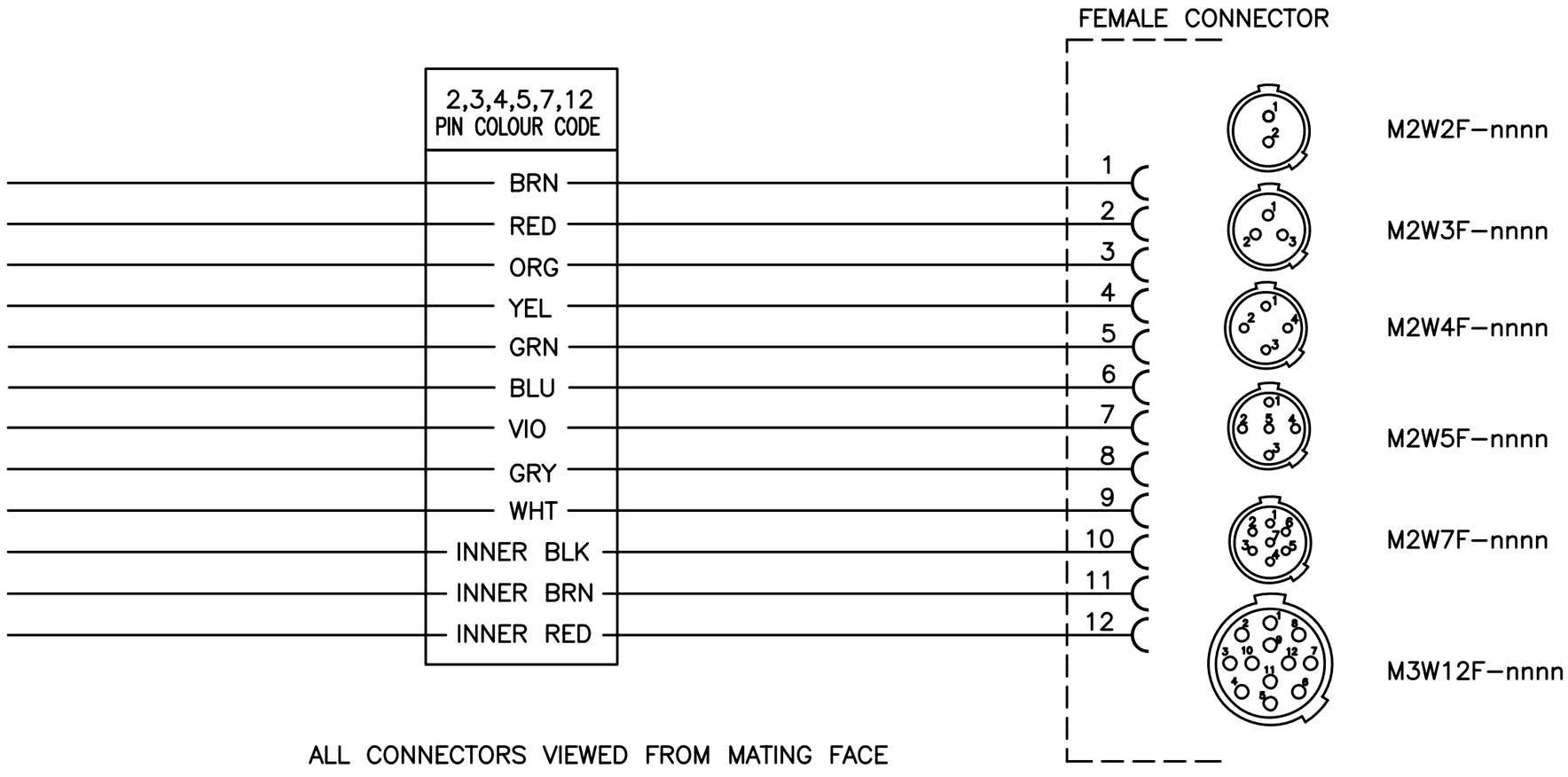
DRAWN	APPROVED	DATE
C.G.PETTIT	JMR	13/08/02

DWG.No. S02846 | Rev. 1 | Sht. 1

PART NO; MaWxxF –nnnn

PART No. MaWxxF–nnnn
a IS THE SHELL SIZE
xx IS THE No. OF PINS
nnnn IS THE LENGTH IN mm





ALL CONNECTORS VIEWED FROM MATING FACE

ISS	DESCRIPTION	APPD	DATE	REF
7	Standard Lengths note removed		23/7/03	DCR715–DW
6	MS Part numbers deleted, drg retitled		12/3/02	DW
5	First Issue		7.SEP.99	ECR394–JW

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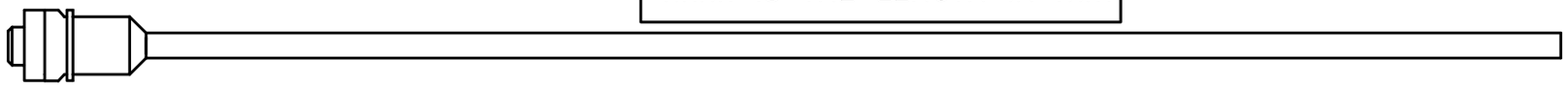
TITLE
PART NUMBER; MaWxxF–nnnn
STANDARD FEMALE WHIPS;
2F, 3F, 4F, 5F, 7F, 12F.
WIRING DIAGRAM
SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite.		8/3/02

DWG.No. S00809 | Rev. 7 | Sht. 1

PART NO; MaWxxM–nnnn

PART No. MaWxxM–nnnn
a IS THE SHELL SIZE
xx IS THE No. OF PINS
nnnn IS THE LENGTH IN mm



MALE CONNECTOR

M2W2M–nnnn

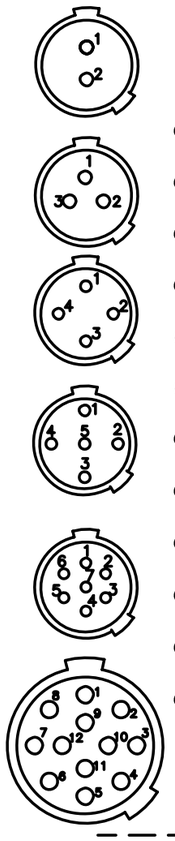
M2W3M–nnnn

M2W4M–nnnn

M2W5M–nnnn

M2W7M–nnnn

M3W12M–nnnn



	2,3,4,5,7,12 PIN COLOUR CODE
1	BRN
2	RED
3	ORG
4	YEL
5	GRN
6	BLU
7	VIO
8	GRY
9	WHT
10	INNER BLK
11	INNER BRN
12	INNER RED

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ALL CONNECTORS VIEWED FROM MATING FACE

ISS	DESCRIPTION	APPD	DATE	REF
7	Standard Lengths note removed		23/7/03	DCR715–DW
6	MS Part numbers deleted, drg retitled		12/3/02	DW
5	First Issue		7.SEP.99	ECR394–JW

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TITLE
PART NUMBER; MaWxxM–nnnn
STANDARD MALE WHIPS;
2M, 3M, 4M, 5M, 7M, 12M.
WIRING DIAGRAM
SHEET 1 OF 1

DRAWN	APPROVED	DATE
D. Waite.	JMR	8/3/02

DWG.No. S00808 Rev. 7 Sht. 1

CHAPTER 7

DIAGNOSTIC MAINTENANCE

Contents

Figures

Tables

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7. DIAGNOSTIC MAINTENANCE

This Chapter provides information and diagnostic flow charts to help the maintainer arrive at the possible defective area.

7.1 Introduction

The fault diagnosis flow charts in this chapter provides a series of decision boxes and prompts to help the maintainer arrive at the possible defective area. Where more than one possible solution is listed, the solution should be tried in the order given. However, these fault finding charts are by no means exhaustive.

Fault diagnosis is also presented in tabular form, the table dealing with a broad category of fault symptom. The table will assist in the localisation of faults, generally to a PCB or fuse which is available as a spare.

It is advised that the charts and fault diagnosis charts are used in conjunction with the technical manuals and the drawings contained therein.

It is worth noting a possible cause with all PCB based systems is a dirty contact on the connector, e.g. the edge-connector of a backplane socket. Therefore, before substitution a possible defective PCB can be simply rectified by reinserting it and/or cleaning the edge connections.

7.1.1 Safety Precautions

Lethal voltages are present in all of the units and can be present in cable connections between units and junction boxes. Diagnostic maintenance can involve contact with substances harmful to health. Before any diagnostic work is carried out, involving internal access to the units, junction boxes or cable connections, the following warnings and cautions are to be observed.

WARNINGS

1. **DANGER OF FATAL ELECTRIC SHOCK. BEFORE REMOVING OR OBTAINING INTERNAL ACCESS TO THE EQUIPMENT, ISOLATE ALL THE UNITS POWER SUPPLIES.**

2. **DANGER OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL. WHEN THE SUPPLY CANNOT BE DISCONNECTED, FUNCTIONAL TESTING, MAINTENANCE AND REPAIR OF THE ROV SYSTEM IS TO BE UNDERTAKEN ONLY BY PERSONS FULLY AWARE OF THE DANGERS INVOLVED AND HAVE TAKEN ADEQUATE PRECAUTIONS.**

3. **POSSIBILITY OF FATAL ELECTRIC SHOCK AND DANGER TO PERSONNEL AND EQUIPMENT. BEFORE SWITCHING ON THE ROV SYSTEM, ENSURE THAT THE SYSTEM IS FULLY ASSEMBLED AND OPERABLE AND NO MAINTENANCE ACTIVITY IS IN OPERATION.**

4. **POSSIBILITY OF TOXIC HAZARDS. DURING MAINTENANCE OR REPAIR IT IS POSSIBLE TO COME INTO CONTACT WITH SUBSTANCES HARMFUL TO HEALTH. PRIOR TO ALL MAINTENANCE OR REPAIR TASKS ENSURE THAT THE RELEVANT DATA HAZARD SHEETS AND LOCAL COSHH PROCEDURES HAVE BEEN READ AND UNDERSTOOD.**

CAUTIONS

1. **Danger of damage to PCBs. Do not remove or replace PCBs unless the supply is switched off. PCBs must be handled in accordance with electrostatic discharge handling procedures. Damage to PCBs could affect the safe operation of the equipment.**

2. **Danger of damage to equipment. When checking connections, care is to be taken not to slacken them, otherwise their watertight integrity may be breached.**

3. **Danger of damage to equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.**

4. **Danger of damage to Thruster Motor V-seal. Do not operate the Thruster Motor in air for longer than one minute.**

5. **Danger of damage to lights. Do not operate the ROV lights for longer than ten seconds in air.**

6. **Danger of damage to equipment. Ensure all vent plugs are securely fitted and shut prior to immersing the ROV.**

7. **Possibility of damage to equipment. Ensure that the PSU transformer tappings correspond to the external 3 phase input power supply.**

8. **Possibility of poor ROV handling. Addition of equipment or poor ROV ballast or trim will affect vehicle performance. Ensure the ROV trim and ballast is correct after adding or removing equipment.**

7.2 The Art of Fault Finding

Fault find is an art in its self, some people pick it up really easy and others go around the houses before finding the fault. There are many varied faults which may occur on an ROV. Experience operating one system or type of ROV is the key to success of good fault finding and corrective actions.

Remember Do Not Jump in Head First. Assess the problem and approach the fault in a logical manner, taking notes if necessary and always enter the fault and corrective action in the system maintenance / diary for future reference.

CAUTION

Do not connect or disconnect any power leads or connectors on the ROV unless the power has been isolated first. A surge of power may cause damage to the electronics.

When fault finding, use the **MASTER** program to check system communication. Establish that the system is 'talking' between the surface and sub-sea. If there is no communication, check for loose connectors and that the vehicle junction box fuses are serviceable. If these are good, look at the basic things first, bent pins, damaged umbilical or cuts in the cables leading to each node. Do not start replacing items unless you are sure it is the problem. Always try and work out why the fault happened, if you replace an item be sure that the fault was found. If the fault was not found then it may damage the replaced item.

There is always a reason for a fault.

Split the fault finding procedure down into sections; ie. Surface Modules – Umbilical – ROV. Test each step one at a time and then start joining them together.

Below is an example where the DC to the ROV keeps on tripping. Complete your fault finding method in stages unless you are sure you know where the fault is:

FAULT: **The ROV system is DC tripping.**

Step 1: Look at the alarms on the PSU LIM.

Step 2: Turn vehicle power off, disconnect the umbilical from the PSU. Turn vehicle power on, has the DC stopped tripping?

Step 3: If YES, the PSU is okay – Go to step 5.

Step 4: If NO, there is a problem within the PSU, isolate power and check to see if anything is obvious. (Contact Seaeye Marine for further technical support).

Step 5: Disconnect the umbilical from the ROV and reconnect the umbilical to the PSU turn on the vehicle. Wait approx 1 minute. Does the DC trip?

Step 6: If YES, to step 5 there is a fault within the umbilical.

Step 7: If NO, there is a fault on the ROV.

Step 8: Turn off the vehicle power and connect the umbilical to the ROV. Clean umbilical and power pod bulkhead connector before connecting.

Step 9: Turn on vehicle power, does the system DC trip?

Step 10: If NO, it must have been a dirty connector.

Step 11: If YES, turn off vehicle power, undo the ROV Junction Box and look for any clear reasons as to why the DC is tripping. If none found, start disconnecting the green node connectors one at a time. Follow the sequence below. (Remember there could be a faulty cable or loose connection).

Power Off – Disconnect green connector – Power On – DC trip, Power off – Disconnect green connector: - keep going in this sequence until the DC stops tripping. Remember that the LIM takes approximately 1 minute to sense a fault.

When the node or PCB has been found to be faulty change out the faulty item and power up the ROV as there may be more than 1 fault.

7.3 Initial Checks

Before carrying out the fault diagnosis procedures detailed in this section, you should always check the respective defect by using the on-screen **MASTER** program and/or the **handc** software program. Use these programs to confirm the defect and to aid rectification.

7.3.1 Using the Master Program

The **MASTER** program can be used to check that telemetry communication is functioning between the surface control equipment and the defective component (node) on the vehicle. You can refer to Chapters 4 for the MASTER program operation.

For example, you can check that the HCU is functioning correctly by using the MASTER program as follows:

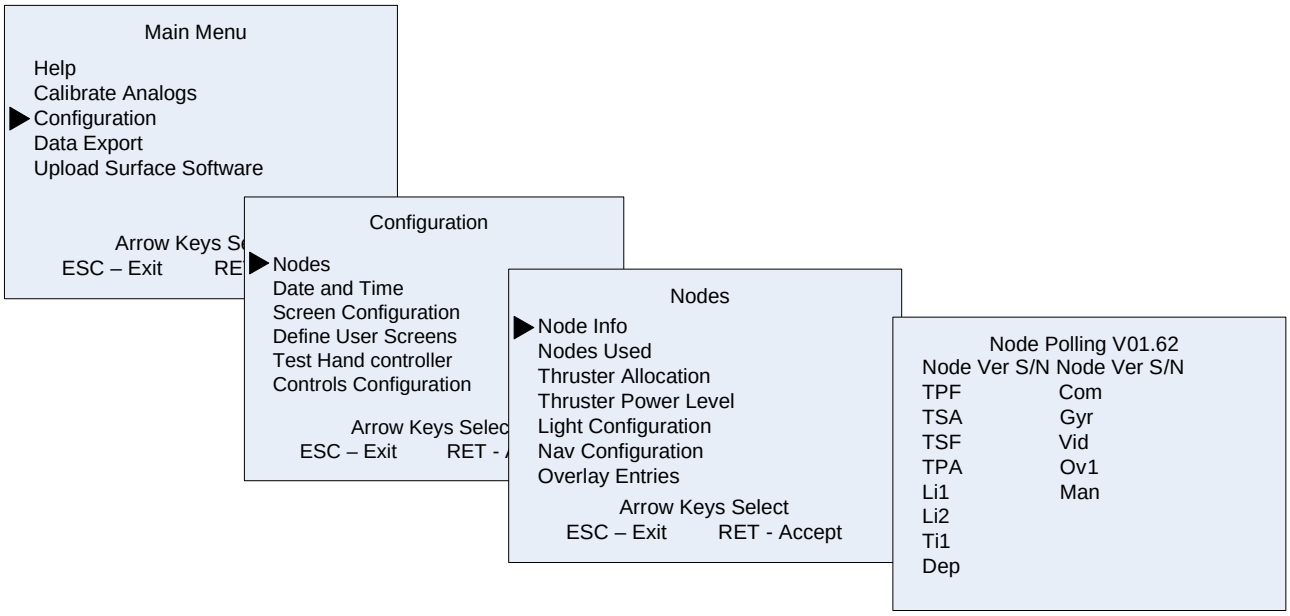
1. Disable the thrusters (on the HCU operate the Thruster switch to DISABLE).

2. Press **F1** on the keyboard.

3. The Main Menu is displayed. Use the arrow keys to select the Configuration option.

4. Use the arrow keys to select the Test Handcontroller option. You will now find this option useful for hand controller diagnostics as raw data values from the input devices on the hand controller can be examined. The program continuously reads data from the IO devices. To the left of the display are the Analogue input data and the right the Digital input data.

5. To escape from this screen press 'Esc' or 'Enter' and follow the screen instructions to return to normal operation.



By using the MASTER program you can check node functions, information, allocated options etc. The information displayed will help you during the fault diagnosis.

If for any reason a unit connected to the ROV needs to be replaced, it can simply be disconnected from the junction box and a new one connected in its place. **Making sure that the power to the ROV and surface unit has been turned off.**

Each unit has a unique address to identify it. In part this address is based on what type of unit it is, allowing the surface unit to communicate with one of each type of unit as soon as the ROV is powered up. Where there are multiple identical units such as lights or thrusters, the remainder of the address uniquely identifies each unit from the others of that type.

During production, all units have a default address of 1 assigned to them. Therefore, for the reasons stated above, an additional procedure needs to be performed when non-unique units are replaced on the vehicle in order to assign a unique address to such units. The need for this is obvious for units such as thrusters, as each thruster needs to respond to a separately addressed demand from the surface in order to maneuver the vehicle correctly. The lights however, are not so obvious, although each light responds identically to the demand made from the surface; each light must be communicated with individually as only one unit can communicate at a time.

The procedures for configuration of the system, including thrusters and lights, are detailed in Chapters 4 and 6.

7.4 Vehicle Junction Box Fuse Test

The vehicle Junction Box incorporates a Fuse Test Pushbutton. This allows the maintainer to check the integrity of the fuses fitted to the junction box PCB. To check the fuses, press the test switch. Note that power needs to be switched on, and that the junction box is open. Take all necessary safety precautions as detailed in Chapter 6. The fuse LEDs will illuminate GREEN if the respective fuse is serviceable or RED if unserviceable.

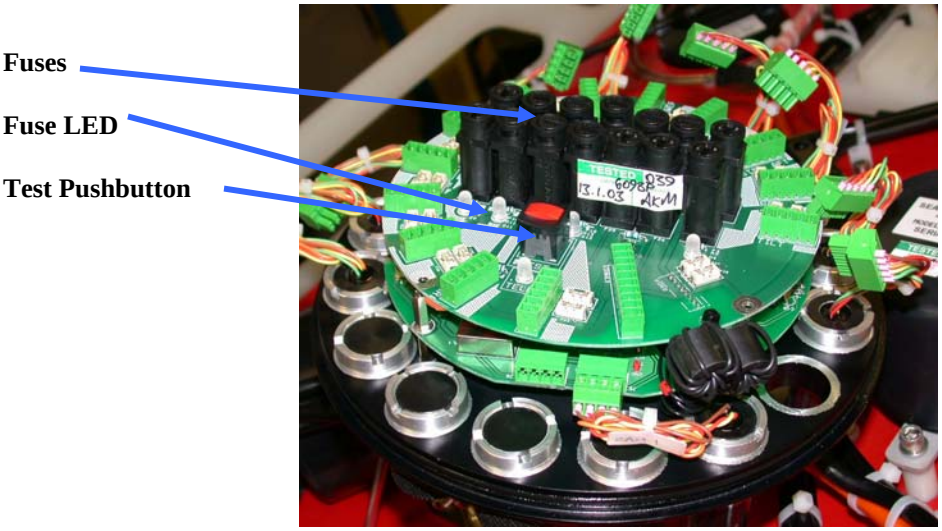


Fig. 1. Vehicle Junction Box Fuse Test Pushbutton

7.5 Using the Handc program

The **HANDC** program is designed for engineering development and may be useful for advance diagnosis by experienced engineers.

If you need to use this program, it is advised that you contact Seaeye Marine Ltd. who will guide you through the fault diagnosis and use of the program. However, this section provides a guide on how to use the Handc program.

The program polls all the nodes in a continuous loop, allowing nodes to be turned on or off, a delay between nodes and a delay between consecutive loops to be varied and different commands applicable to the various nodes to be performed.

To use the **HANDC** program a VGA monitor must be connected to the surface unit (AUX COMM A). To obtain the DOS command prompt:

- Hold down the '**F5**' key during the booting up sequence.
- When the C prompt is displayed, press the **RETURN** key to get the C:\ command prompt.
- Run the **HANDC** program by typing in: `handc`

If the version of handc is V2.17 (indicated on the status bar on the top of the screen) or later, the program should configure the serial port settings accordingly. The default is to set the com port for the ROV network.

The screen will display the Handc program and list the nodes.

Handc V2.23

Node	Type	Ad	Tx Data	Tx String	Rx String	Rx Data	Tx Count	D' Count
1	Thruster	1	+0	n16+0			251	0
2	Thruster	2	+0	n26+0			251	0
3	Thruster	3	+0	n36+0			251	0
4	Thruster	4	+0	n46+0			251	0
5	Thruster	5	+0	n56+0			251	0
6	Thruster	6	+0	n66+0			251	251
7	Light	1	0	1150			251	0
8	Light	2	0	1253			251	0
9	Light	3	0	1350			251	251
10	Depth	1	METRES	d16UN			251	0
11	Compass	1	HEADING	c16UN			251	0
12	Gyro	1	DIFF	g15F			251	0
13	Tilt	1	QUERY	t15?			251	0
14	Tilt	2	QUERY	t25?			251	251
15	Overlay	1	REPLY	o150			251	0
16	Overlay	2	REPLY	o250			251	251
17	CP	1	VOLTAGE	n15V			251	251
18	Vid Sw	1	POLL	n16?L			251	0
19	Manip	1	POLL	m14			251	0
20	Odometer	1	Count	q15?			251	251
21	Hand Clr	1	AMQ	h1??AQ			251	0

Fig. 2. Handc Menu Screen

WARNING

Handc allows nodes such as thrusters and lights to be operated without any enabling switches. Operators use this software at their own risk.

- **Navigating the menu**: To navigate the various nodes press the *TAB* key, this will move the cyan arrow down the list of nodes, to move up the list hold down *SHIFT* and press *TAB*.
- **Turn On/Off**: *SPACEBAR* toggles the selected node on and off.
- **Exit**: To exit the Handc program, reboot the system by pressing the CTRL/ALT/DEL keys on the keyboard.
- **Standard commands**: The keyboard functions are detailed in the following tables.

NOTE

The standard Falcon software is capable of searching for and configuring thrusters and lights (Thruster V01.52 and lights V01.47) automatically without using handc.

All Nodes

PC	Command	Value	Function	Reply	Notes
S	S		Request serial number	XXXX	4 Figure number
V	V		Request version number	Mmnn	Mm – major number Nn – minor number
Z	Z		Reset Node	-	

Falcon DR System 1290

Thruster Node

PC	Command	Value	Function	Reply	Notes
PGUP	+	-100% to 100%	Forward demand in 10% increments up to 100%	Ack	Additive
PGDN	-	-100% to 100%	Reverse demand in 10% increments down to -100%	Ack	Additive
↑	+	-100% to 100%	Forward demand in 1% increments up to 100%	Ack	Additive
↓	-	-100% to 100%	Reverse demand in 1% increments down to -100%	Ack	Additive
Home		100%	Max		
End		-100%	Min		
E	E		Emergency stop	Ack	
Ins			Toggles thrust value polarity		
Del			Emergency stop (as per E)		

Light Node

PC	Command	Value	Function	Reply	Notes
PGUP	+	100%	Set light intensity to maximum	Ack	
PGDN	-	-100%	Se light intensity to minimum	Ack	
↑	+	1%	Forward demand in 1% increments up to 100%	Ack	
↓	-	-1%	Reverse demand in 1% increments down to –100%	Ack	

Tilt Node

PC	Command	Value	Function	Reply	Notes
PGUP	+	0 to 90°	Increments absolute demand by 10° up to 90° or 180°		S = Sign N = Value
PGDN	-	0 to 90°	Decrements absolute demand by 10° down to -90° or -180°		S = Sign N = Value
↑	+	0 to 90°	Increments absolute demand by 1° up to 90° or 180°		S = Sign N = Value
↓	-	0 to 90°	Decrements absolute demand by 1° down to -90° or -180°		S = Sign N = Value
R		+90°	Max		
C		+0°	Centre position		
D	E	-90°	Min		

Depth Node

PC	Command	Value	Function	Reply	Notes
R	R		Zero depth		Value stored in Flash

Compass Node

PC	Command	Value	Function	Reply	Notes
R	R		Reset North heading		Ensure vehicle is pointing North. Value stored in Flash
C	C		Toggle Calibration Mode		SI-NAV02 only
O	O		Reset Roll		SI-NAV02 only
P	P		Reset Pitch		SI-NAV02 only

Video Switching Node

PC	Command	Value	Function	Reply	Notes
C	1		Select Camera 1		
D	2		Select Camera 2		

Manipulator Node

PC	Command	Value	Function	Reply	Notes
D	O		Open jaws		
C	C		Close jaws		

7.5.1 Diagnosing Communication Problems

Handc can be useful for identifying telemetry problems. Run the program as described and ensure only nodes fitted are turned on by selecting the appropriate node using the *TAB* key then pressing the spacebar to toggle the node on or off, note that all connected nodes are ON as default. When the node name is in light grey and text appears under the “TX Data” and “TX String” columns the node is turned on. When the node is turned on the value under “TX Count” will increment every time the node is polled, if the node does not reply with valid data in the allowed time the value under “D’ Count” (dropped count) will increment. A valid reply from the node is indicated with cyan coloured text under “RX String” column and white coloured text under “RX Data”. To reset both the “TX Count” and “D’ Count” press the return key. If left testing, dropped counts can be monitored, a 10% dropped count rate can be tolerated but anything worse should be investigated. Note that if a node is slow in replying the late reply can corrupt the following node communications. In this situation remove suspect nodes in the junction box (turn power of first) and turn off in handc one at a time to identify the faulty node.

WARNING

IF THE ROV IS LEFT POWERED ON IN AIR, EVEN WITHOUT OPERATING THRUSTERS OR LIGHTS, THE ROV POWER SUPPLY OVER HEATS.

7.6 Boot up Sequence

Like all PCs, the ICOP PC104 stack has software pre-installed at the factory. The PC104 comes with the Falcon ROV **MASTER** control software and the Tritech **SONV4** sonar software pre-installed. The PC104 **AUTO EXEC.BAT** file has been factory set to boot the **MASTER** program on system startup.

To change the factory set **AUTO EXEC.BAT** file, carry out the following:

- On power up, the **F5** key should be held down.
- When the **C** prompt is displayed, press the **RETURN** key to get the **C:** command prompt.
- Type in **edit auto exec.bat** and press the **RETURN** key.
- Edit the **AUTO EXEC.BAT** file to the required boot up program and save.
- Reboot the system and check that the boot up sequence is initiated as required.

7.7 BIOS Problems

Like all PCs, the PC104 stack has a BIOS (Built In Operating System or Basic Input/Output System). The BIOS settings in the PC are factory set but if maintenance is carried out, the settings may be lost.

To restore the required settings a VGA monitor must be connected to the SCU. On power up the **F2** key should be held down, this enables access to the BIOS settings. **There are a considerable number of entries in the BIOS settings, anyone of which, if incorrectly set, may cause incorrect operation of the system**. It is beyond the scope of this manual to describe each setting (contact SEAEYE MARINES Ltd. if you require information). However, the following should be set in order to allow the system to operate normally.

Under the section “Main” the “Diskette A” option should be set as below:

```
Diskette A        [Not Installed]
```

Under “Boot Options” page of “Main”, disable all settings for improved boot up time and set “Boot Sequence” as shown below:

```
Boot Sequence     [C: Only]
```

Finally go to the Exit page and select 'Save Changes and Exit'.

7.8 PC Communication Problems

Instances have occurred where the PC used for the Tracklink software has problems when using Windows 2000 or XP. The problem is shown by an erratic screen cursor movements caused by the NMEA 183 data on the serial port being detected as a serial mouse.

The problem is solved by making changes to the PC operating system files, but carries the danger of making your PC perform incorrectly. You are strongly advised to backup your PC before proceeding, if in doubt please contact a qualified computer technician or Seaeye Marine.

To disable the detection of devices on COM ports in Windows NT/2000/XP carry out the following procedure:

1. Make a backup copy of the Boot.ini file. (Usually found in the C:\driver route).

2. Remove the hidden, system and read-only attributes from the Boot.ini file. (Use Windows explorer and right click on file, then properties).

3. Using a text editor (such as Notepad), open the Boot.ini file (try double clicking on the file).

4. Add the /NoSerialMice option to the end of each entry in the [operating systems] section of the Boot.ini file. See the example below for more information.

5. Save the Boot.ini file and quit Notepad.

6. Restore the hidden, system and read-only attributes to the Boot.ini file.

7. Shutdown and restart Windows.

Example of sample Boot.ini file

```
[boot loader]
timeout=3
default=multi(0)disk(0)rdisk(0)partition(1)\WINNT35

[operating systems]

multi(0)disk(0)rdisk(0)partition(1)\WINNT35=”Windows NT
Workstation Version 3.51” /NoSerialMice

multi(0)disk(0)rdisk(0)partition(1)\WINNT35=”Windows NT
Workstation Version 3.51 [VGA mode]” /basevideo /sos
/NoSerialMice
```

NoSerialMice Syntax

/NoSerialMice	Disables the detection of serial mice on all COM ports.
/NoSerialMice:COMx	Disables the detection of serial mice on COM x, where x is the number of the port.
/NoSerialMice:COMx,y,z	Disables the detection of serial mice on COM x, y and z.

NOTE

The /NoSerialMice option is not case sensitive.

7.9 Falcon Fault Diagnosis

FAULT SYMPTOM	PROBABLE CAUSE	REPAIR ACTION
One or more lamps do not respond to HCU demand	Defective lamp.	Replace.
	Supply Fuse blown	Check vehicle JB lamp supply fuses F6 and F8 (6.3A(T))
	Telemetry Fuse blown	Check vehicle JB lamp telemetry fuses F28/30 and F32/34 (250mA(F))
	Vehicle JB connectors loose	Check and reconnect
	Tether and Surface cables not connected correctly	Check and connect
	Defective vehicle JB	Check 48 VDC output supplies
	Defective HCU cable or lights control potentiometer	Replace
	Defective SCU	Check PCB3
	Defective Surface PSU	Check 500 VDC output
Thrusters do not respond to HCU demands	No DC supply	Test DC supply and umbilical/tether connections
	Thruster enable switch to disable	Set to enable
	Thruster controls not configured	Configure (Ch 4)
	Communications failed surface/subsea	Restore
	Propellers fouled	Clear fouling
	Defective HCU cable	Replace
	Defective HCU or potentiometers	Replace
	Defective SCU PCBs: PCB3, PCB2, PCB 1	Replace
One thruster does not respond to HCU demand	Propeller fouled	Clear fouling
	Thruster cable disconnected	Reconnect
	Defective thruster	Replace with known working thruster to ascertain whether thruster or system defective
	Vehicle Supply Fuse blown	Check fuses vehicle JB: F2, F5, F7, F9, F11 (8A(T))
	Vehicle Telemetry Fuse blown	Check vehicle JB telemetry fuses: F13/14, F15/16, F17/18, F19/20, F21/22 (250mA(F))

Table 1. Falcon Fault Diagnosis

FAULT SYMPTOM	PROBABLE CAUSE	REPAIR ACTION
One group of thrusters do not respond to HCU demand	Propellers fouled	Clear fouling
	Thruster control not configured	Configure (Ch 4)
	Thruster cables disconnected	Reconnect
	Vehicle Supply Fuse blown	Check fuses vehicle JB: F2, F5, F7, F9, F11 (8A(T))
	Vehicle Telemetry Fuse blown	Check vehicle JB telemetry fuses: F13/14, F15/16, F17/18, F19/20, F21/22 (250mA(F))
	Defective HCU cable	Replace
	Defective HCU, joystick or potentiometers	Replace
Tilt does not respond to HCU demand	Tilt unit fouled	Clear platform
	Tilt limit switches	Adjust or replace
	Vehicle Supply Fuse blown	Check fuses vehicle JB: F4 (2A(T))
	Vehicle Telemetry Fuse blown	Check vehicle JB telemetry fuses: F23/24 (250mA(F))
	Defective Tilt feedback potentiometers or motor drive	Replace or adjust
	Defective HCU cable	Replace
	Defective HCU TILT rotary control	Replace
No video image or overlay data displayed	No AC supply	Test AC supply and umbilical connection
	Defective SCU Video PCBs	Replace
	Monitor set up, leads	Check control settings and leads
No Video image from cameras	No AC supply	Test AC supply and umbilical connections
	No camera supplies	Investigate
	Defective SCU PCBs: PCB3, PCB2, PCB1, MVT75-75	Replace
	Defective camera	Replace
	Video Node fuse blown	Replace – Vehicle JB Video Node F1 (2A(T))
Poor Video image	Poor connection	Check/clean
	Monitor setting	Check
	Incorrect video comp/Fibre optic attenuation	Chapter 6
	Defective video PCBs	Replace

Table 1. Falcon Fault Diagnosis (continued)

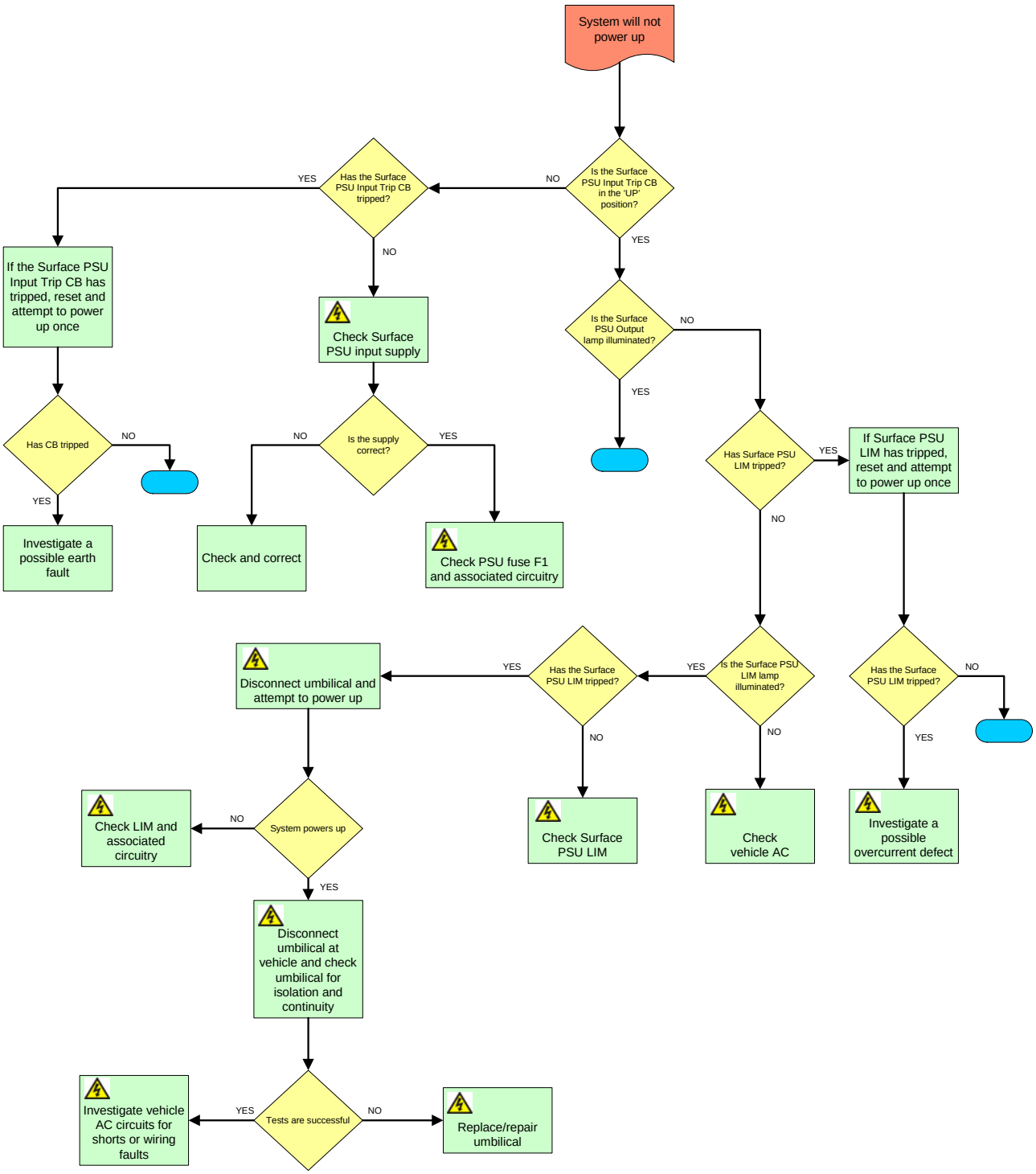


Fig. 3. Falcon Power Fault Diagnosis Flow Chart

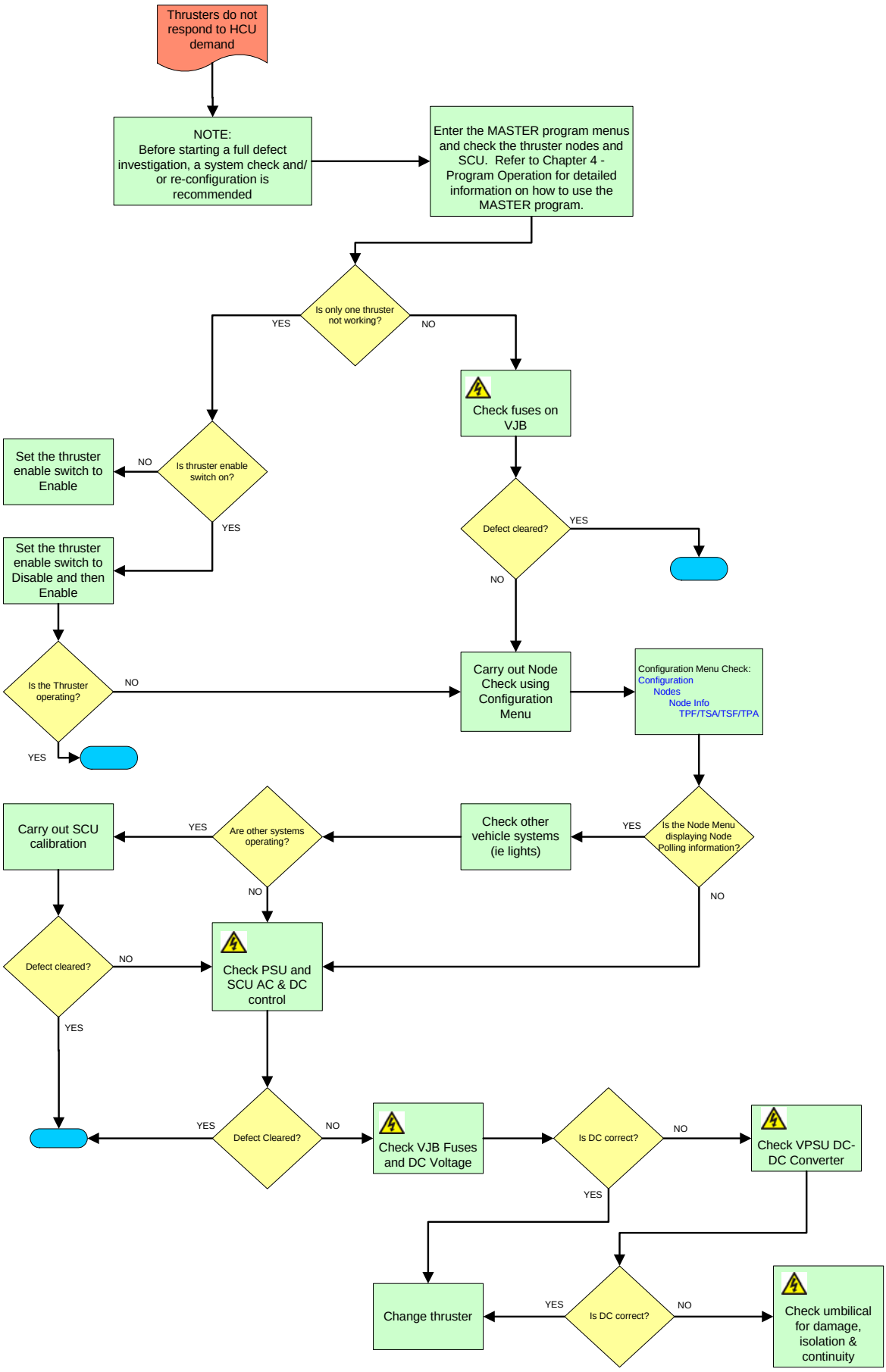


Fig. 4. Falcon Thruster Fault Diagnosis Flow Chart

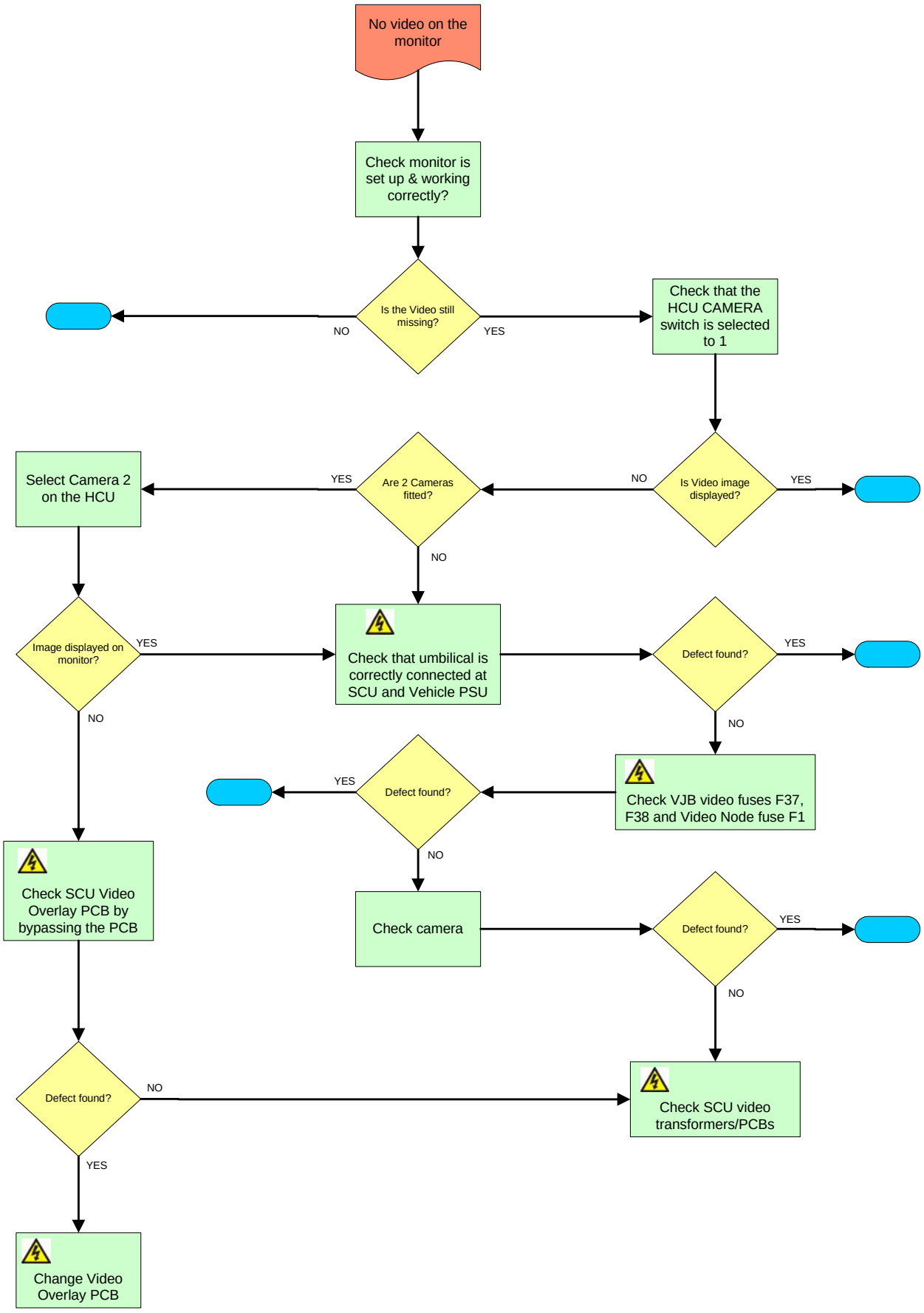


Fig. 5. Falcon Video Fault Diagnosis Flow Chart

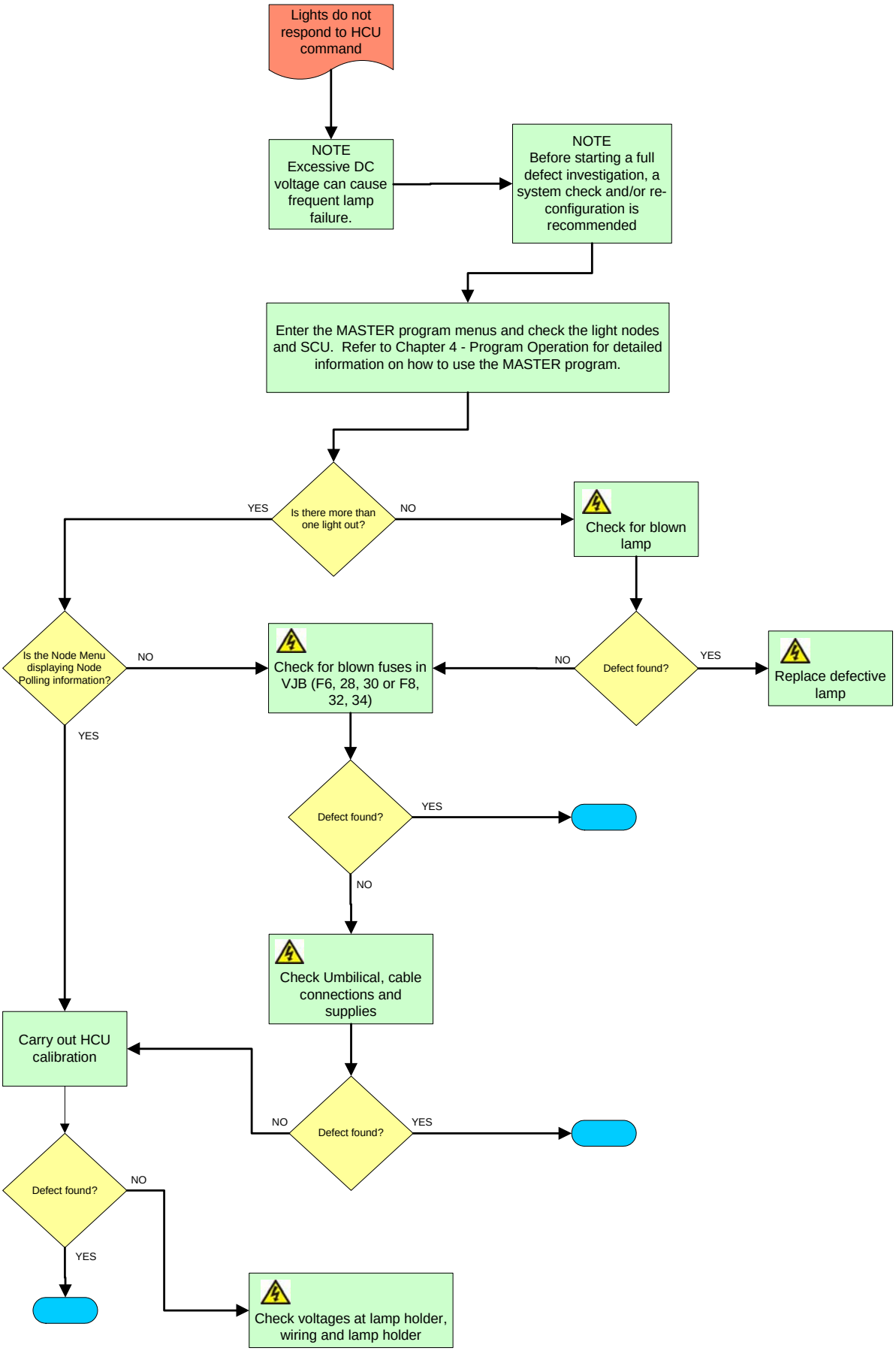


Fig. 6. Falcon Lights Fault Diagnosis Flow Chart

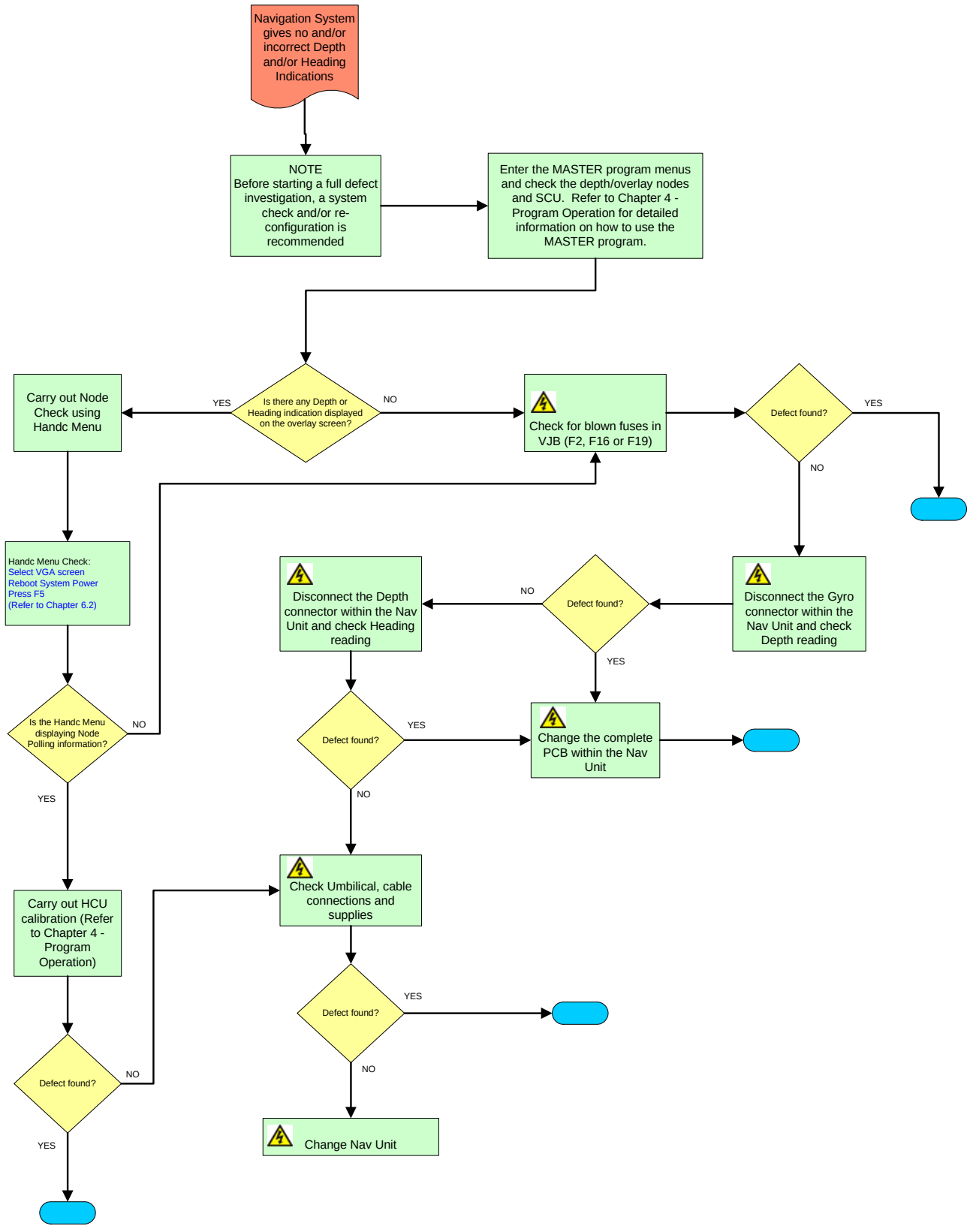


Fig. 7. Falcon Navigation Unit Fault Diagnosis Flow Chart

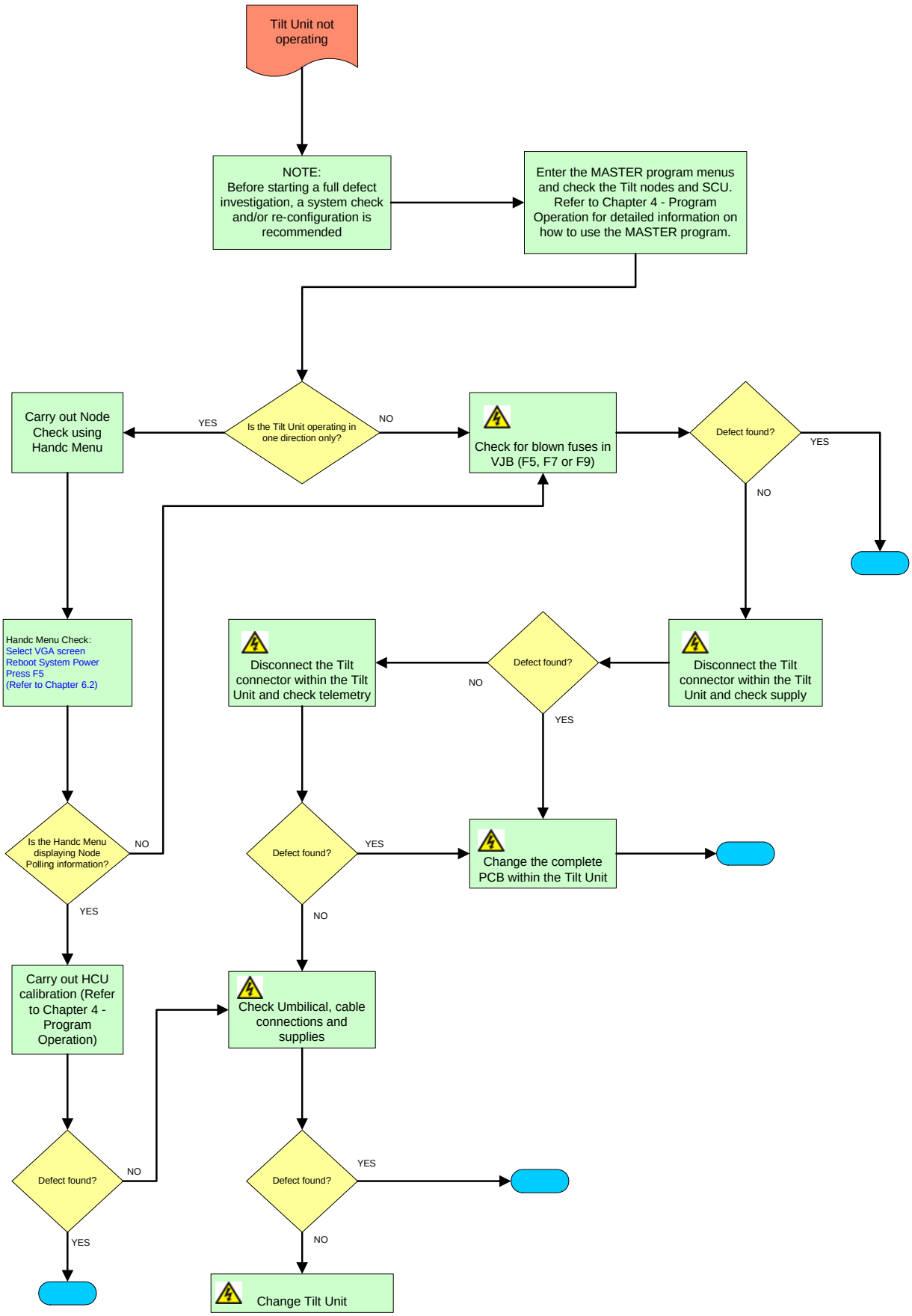


Fig. 8. Falcon Tilt Unit Fault Diagnosis Flow Chart

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CHAPTER 8

PARTS

Contents

Tables

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8. PARTS

This Chapter lists the Falcon DR System Serial Number 1290 parts and consumables.

8.1 Falcon DR System 1290 Spares Kit

Part	Description / Size	Qty
304-4622	Connector Cable Terminal Plug 5way 8A	6
6101P	PCB Falcon Aux PSU	1
6102P	PCB Falcon Video Node	1
6111P	PCB Falcon Video Overlay V.2	1
6112P	PCB Falcon Junction Box V.2	1
6114P-1	PCB Falcon Video Node with Z&F (6076)	1
FKIT-1200	Fuse kit for Falcon System	1
ICOP-6054VE	PC104 386 CPU Module c/w DOC8MB+Dr-DOS	1
JD75/28V	Lamp 28v 75w to fit M10 lamp base	6
ML64-1500	Falcon Penetrator to FAWL connector	1
NYLON1.3	Nylon Lock wire 150m Monofilament 1.3mm	5
OKIT1200	O Ring Kit – Falcon System	1
P01780	MCT01 Propeller	2
P01880	Falcon penetrator backing nut	5
P01964	SI-MCT C Spanner	2
P02733	Falcon penetrator spanner	1
SI-LAMP01	Lamp Unit RS485 75w 48v	1
SI-MCT01	Thruster 48v RS485 c/w Propeller/Nozzle (1000m)	1
SI-NAV02	Navigation Unit RS485 (1000m rated)	1
SI-TILT01	Falcon Tile Motor Assembly RS485	1
ZMM-DX	PCB IO Card PC104	1

Table 1. Falcon DR System Spares Kit

8.2 Falcon FO Spares Kit

Part	Description / Size	Qty
PK1-FO-BCR	Fibre Optic Bulkhead	1
6032P	Falcon Fibre Optic ROV JB PCB	1
907-0002-06	907 Mux Console	1
907-0001-06	907 Mux Console	1

Table 2. Falcon FO Spares Kit

8.3 Consumables

Part Number	Description	Usage
MOLY111	MOLYKOTE 111 100G	O-rings
AQUA-LUBE	GREASE	Fastenings
16-2196	GREASE FOOD LUBE 2	Tilt Motor Bellows

Table 3. Falcon Consumables

8.4 Falcon DR System ROV Chassis Parts

Part	Description / Size	Qty
528-176	M6 NYLON WASHER	21
580-077	CABLE MOUNTING CRADLE M6 HOLE	6
7060-W049	STAR GRIP M6 BLUE WITH SS INSERT	6
CH069	CHASSIS FIXTURE BUTTON	16
CH072	COUNTERSUNK SS CHASSIS WASHER	42
GELMK-10	CLEVIS JOINT END M10 LHT WITH PIN & CLIP / E SERIES LEFT HAND THREAD M10	7
GERMK-10	CLEVIS JOINT END M10 RHT / E SERIES RIGHT HAND THREAD M10	7
P01885	10DP/2 MOUNT	1
P01946	SEAEYE CHASSIS NAME PLATE	2
P02282	FALCON FAIRING	1
P02372	FALCON CHASSIS TIE BAR T BRACKET	4
P02373	FALCON CHASSIS TIE BAR ANGLE BRACKET	1
P02374	FALCON CHASSIS TIE BAR HORIZONTAL	2
P02381	FALCON CHASSIS CROSS TRAY	2
P02382	FALCON CHASSIS CROSS TRAY MOUNTING / BRACKET	4
P02389	FALCON CHASSIS TIE BAR INSERT L/H	7
P02390	FALCON CHASSIS TIE BAR INSERT R/H	7
P02510	FALCON TXFRM POD ANGLE BRACKET	1
P02511	FALCON CHASSIS TIE BAR ANGLE	1
P02540	12CH FWD CROSS TRAY GUARD	1
P02541	12CH AFT CROSS TRAY GUARD	1
P02621	FAIRING STAND OFF SHORT	2
P02639	SI-JB01 MOUNTING CLAMP	4
P02755	FALCON TOOLING CHANNEL	1
P03039	SEAEYE FALCON RUBBING STRAKE FORWARD	2
P03055	LEAD BALLAST FOR FALCON	2
P03202	FALCON LIFT POINT EXTENDED	1
P04930	FALCON 1000 CHASSIS SIDE RAIL STARBOARD	1

Table 4. Falcon DR ROV Chassis Parts List

Part	Description / Size	Qty
P04931	FALCON 1000 CHASSIS SIDE RAIL - PORT	1
P04932	FALCON 1000 CHASSIS TOP DECK	1
P04933	FALCON 1000 CHASSIS LAMP HOLDER	2
P04934	FALCON 1000 CHASSIS TXFRM MOUNT	1
P04938	FALCON 1000 ADDITIONAL BUOYANCY - FRONT	1
P04939	FALCON 1000 ADDITIONAL BUOYANCY - REAR	2
P04940	FALCON 1000 MAIN BUOYANCY FOAM	1
P04947	FALCON 1000 CHASSIS CHAIN TENSIONER	2
P04958	FALCON 1000 LAMP TILT STUB SHAFT BEARING	2
P04959	FALCON 1000 MAIN SHAFT MOUNTING BLOCK	2
P04960	FALCON 1000 LAMP TILT STUB SHAFT	2
P04961	FALCON 1000 LAMP TILT MAIN SHAFT	2
P04963	FALCON 1000 FRONT FOAM FIXING POST	2
P04964	FALCON 1000 JB MOUNTING CLAMP EXTENDED	4
P04965	FALCON 1000 LAMP TILT SPACER	2
P04966	FALCON 1000 TILT MECHANISM ASSEMBLY	1
P04967	FALCON 1000 TILT MECH LAMP CHAIN / ???LINKS (???MTRS)	2
P04971	FALCON 1000 LAMP HOLDER TIE PLATE	2
P04972	FALCON 1000 CHASSIS TIE BAR DIAGONAL	4
P04973	FALCON 1000 CHASSIS TIE BAR VERTICLE	1
POLY4031	VINYL RUBBING STRAKE	4
SPROCKET01	10 TOOTH 8MM PITCH SS SPROCKET	2
STF007	NUT NYLOK M6 A4	20
STF012	WASHER PLAIN M6 A4 FORM "A"	21
STF021	WASHER PENNY M6	2
STF025	WASHER COIL SQUARE SECTION M6 A4	2
STF048	SCREW SKT CAP M6 X 40 A4	2
STF059	SCREW SKT CSK M6 X 50 A4 SS / M6 X 50 A4 SS	10
STF076	SCREW SKT CSK M6 X 35 A4	24
STF161	SCREW SKT BUTTON HEAD M6 X 20 A4	3
STF179	SCREW SKT BUTTON M3 X 8 A4	4
STF410	M6 X 50 SOCKET SET SCREW A4	4

Table 5. Falcon DR ROV Chassis Parts List (continued)

8.5 MCT1 Thruster Assembly

Refer to drawing number S0216921:

Item	Part No.	Description	Qty.
1	525-751	M5 Nylon Washer	9
2	P01794	MCT1 Thruster Nozzle	1
3	P01897	MCT1 Thruster Propellor Retainer	1
4	P02167	MCT1 Thruster Front End Assembly GA	1
5	P02168	MCT1 Thruster Body Assembly GA	1
6	P02170	MCT1 Thruster Prop Assembly GA	1
7	P02308	MCT1 Thruster Mount Plate	1
8	STF011	M5 Plain Washer Stainless A4	9
9	STF024	M5 Spring Washer Stainless A4	9
10	STF025	M6 Spring Washer Stainless A4	1
11	STF038	M5 x 12 Socket Screw Stainless A4	3
12	STF042	M5 x 30 Socket Screw Stainless A4	4
13	STF117	M5 x 12 Button Screw Stainless A4	2
14	STF128	M6 x 12 Socket Screw Stainless A4	1

Table 6. MCT1 Thruster Parts List

8.6 SI-LAMP03 Lamp Assembly

Refer to drawing S0281831:

Item	Part No.	Description	Qty.
1	304-4609	3 Way Header	1
2	304-4622	5 Way Header	1
3	517-630	Spacer Hex Brass M/F M3 x 8 mm	3
4	526-574	M3 Shakeproof Washer Mild Steel	3
5	560-338	M3 Plain Washer Mild Steel	5
6	560-580	Pan Head Screw Pozi M3 x 6 Mild Steel RS560-580	3
7	200012	O Ring 1.78 sec x 9.25 id	1
8	200143	O Ring 2.62 sec x 61.60 id	1
9	200320	O Ring 5.34 sec x 27.94 id	1
10	311320340050	Cylindrical Tube Spacer od=6, id=3.2 x 3	2
11	6095P	Seaeye Falcon Lamp Populated PCB	1
12	JD75-M2E11	75W Lamp Holder	1
13	JD75-28V	75W Lamp Bulb	1
14	ML44-1100	Falcon Whip 1100mm Assembly Detail	1
15	P02324	Falcon Lamp retaining Collar	1
16	P02325	Falcon Lamp Glass Cover	1
17	P02326	Falcon New Lamp – Insert	1
18	P02327	Falcon Lamp – New Base	1
19	PBE105M	Lamp Glass and O Ring 206345	1
20	STF024	M5 Spring Washer Stainless A4	2
21	STF041	M5 x 25 Socket Screw Stainless A4	2
22	STF097	M3 x 8 Pan Head Pozi Screw	2

Table 7. SI-LAMP03 Single Lamp Assembly Parts List

8.7 Single Function Manipulator Assembly

Refer to drawings S0349841, S0349842, S0349843, S0349844, S0349845:

Item	Part No.	Description	Qty.
1	149-641	M3 X 10 CSK SCREW BZP	2
2	189-620	M3 STAINLESS STEEL WASHER A4	2
3	456-4845	SILENCER G3/8” STAINLESS GRADE 316	2
4	525-751	M5 NYLON WASHER	2
5	526-552	M2 SPRING WASHER R.S. 526-552	3
6	526-574	M3 SHAKEPROOF WASHER MILD STEEL	2
7	527-729	M5 X 6 NYLON SLOTTED CHEESE HEAD SCREW	2
8	200007	O RING 1.78 SEC X 3.69 ID	1
9	200015	O RING 1.78 SEC X 14.00 ID	1
10	200107	O RING 2.62 SEC X 5.23 ID	2
11	200123	O RING 2.62 SEC X 29.83 ID	2
12	28L28-416E164	MOTOR 24V ESCAP TRIDENT	1
13	6128P	SINGLE FUNCTION MANIP PCB ASSEMBLY	1
14	AKW0037	THRUST BEARING AXK1024 10 X 24 X 2.0	2
15	AKW0865	THRUST WASHER AS1024 10 X 24 X 1.0	4
16	B207052002	KNIFE BLADE STAINLESS STEEL	1
17	BH2MP	BIRNS 2 PIN MALE CONNECTOR	1
18	EP051	7/16” ACETAL INSULATING WASHER	1
19	GP22-0025	GEARHEAD 25:1 TRIDENT	1
20	OB1263	M2 X 8 PAN HEAD SCREW	3
21	P03474	SINGLE FUNCTION MANIP LEAD SCREW	1
22	P03479	SINGLE FUNCTION MANIP JAW	3
23	P03482	SINGLE FUNCTION MANIP BODY	1
24	P03486	SINGLE FUNCTION MANIP JAW HOLDER	1
25	P03489	SINGLE FUNCTION MANIP JAW CONNECTOR	1
26	P03490	SINGLE FUNCTION MANIP JAW BUSH	6
27	P03491	DOWEL PIN DIA. 5 X 16	6
28	P03492	SINGLE FUNCTION MANIP MOTOR RETAINER	1
29	P03565	SINGLE FUNCTION MANIP CENTRAL BUSH	6
30	P03568	SINGLE FUNCTION MANIP 14 MM ID SLEEVE BEARING	1
31	P03569	SINGLE FUNCTION MANIP CUTTER JAW	1
32	P03570	SINGLE FUNCTION MANIP CUTTER SADDLE	1

Table 8. Single Function Manipulator Assembly Parts List

Item	Part No.	Description	Qty.
33	P03571	SINGLE FUNCTION MANIP BLADE HOLDER	1
34	P03604	SINGLE FUNCTION MANIP LOCK RING	1
35	P03614	SINGLE FUNCTION MANIP FILTER SPACER	2
36	P03620	SINGLE FUNCTION MANIP THUMB SCREW	1
37	P03627	DOWEL PIN DIA. 3 X 12	2
38	P04120	SINGLE FUNCTION MANIP 1000M LID	1
39	ROLL02	1/16” X ¼” STAINLESS STEEL ROLL PIN	2
40	STF011	M5 PLAIN WASHER STAINLESS A4	1
41	STF037	M5 X 8 SOCKET SCREW STAINLESS A4	1
42	STF038	M5 X 12 SOCKET SCREW STAINLESS A4	2
43	STF088	PAN HEAD SCREW POZI M3 X 10 STAINLESS STEEL	2
44	STF167	M2 PLAIN WASHER STAINLESS A4	3
45	STF224	M6 X 8 SET SCREW A4	9
46	STF300	2 MM X 8 MM STAINLESS STEEL SPIROL PIN	1
47	WSW000140-WUAQ3	SCAPER 14 MM ID	1
48	Y18-S11-A6	M5 BLEED SCREW STAINLESS STEEL	1

Table 9. Single Function Manipulator Assembly Parts List (continued)

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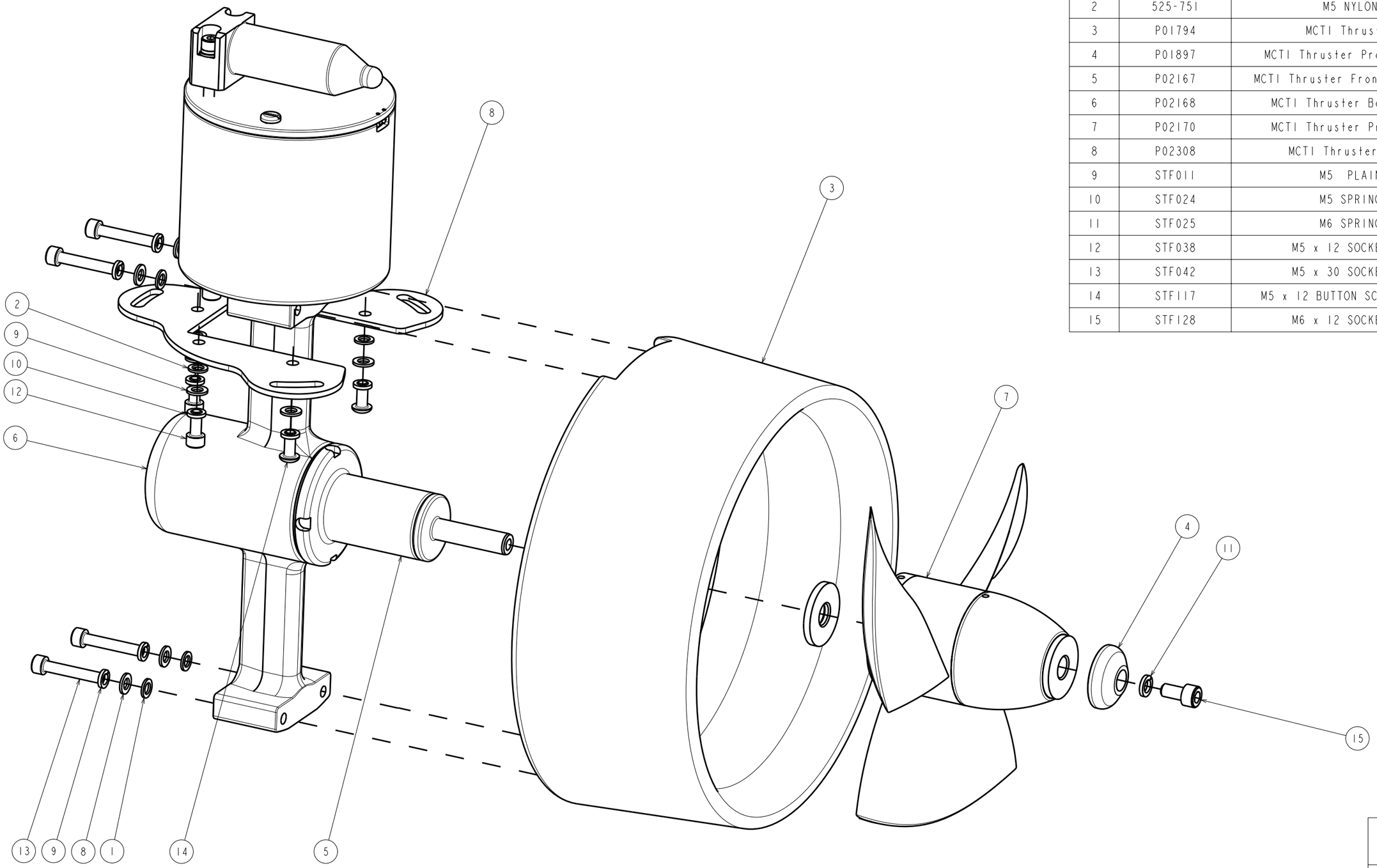


Item	Part No.	Description	Qty.
1	200033	O RING (1.78 x 50.52)	1
2	525-751	M5 NYLON WASHER	9
3	P01794	MCT1 Thruster Nozzle	1
4	P01897	MCT1 Thruster Propellor Retainer	1
5	P02167	MCT1 Thruster Front End Assembly GA	1
6	P02168	MCT1 Thruster Body Assembly GA	1
7	P02170	MCT1 Thruster Prop Assembly GA	1
8	P02308	MCT1 Thruster Mount Plate	1
9	STF011	M5 PLAIN WASHER	9
10	STF024	M5 SPRING WASHER	9
11	STF025	M6 SPRING WASHER	1
12	STF038	M5 x 12 SOCKET CAP SCREW	3
13	STF042	M5 x 30 SOCKET CAP SCREW	4
14	STF117	M5 x 12 BUTTON SCREW STAINLESS A4	2
15	STF128	M6 x 12 SOCKET CAP SCREW	1

DRAWING APPROVED FOR MANUFACTURE

THIS DRAWING MUST BE RETURNED TO SEAEYE MARINE LIMITED ON COMPLETION OF MANUFACTURE

ISSUE	ECR\DCR REF.	DRAWN BY	DATE	APPROVED
2	ECR0777	JMR	30-Jun-04	SVY
1	ORIGINAL	JMR	23-May-01	ARK

Seaeye

IF IN DOUBT ASK
DO NOT SCALE

GENERAL TOLERANCES
ALL DIMS IN MM
±0.1 U.O.S.

MATERIAL
AS PER
COMPONENT PARTS

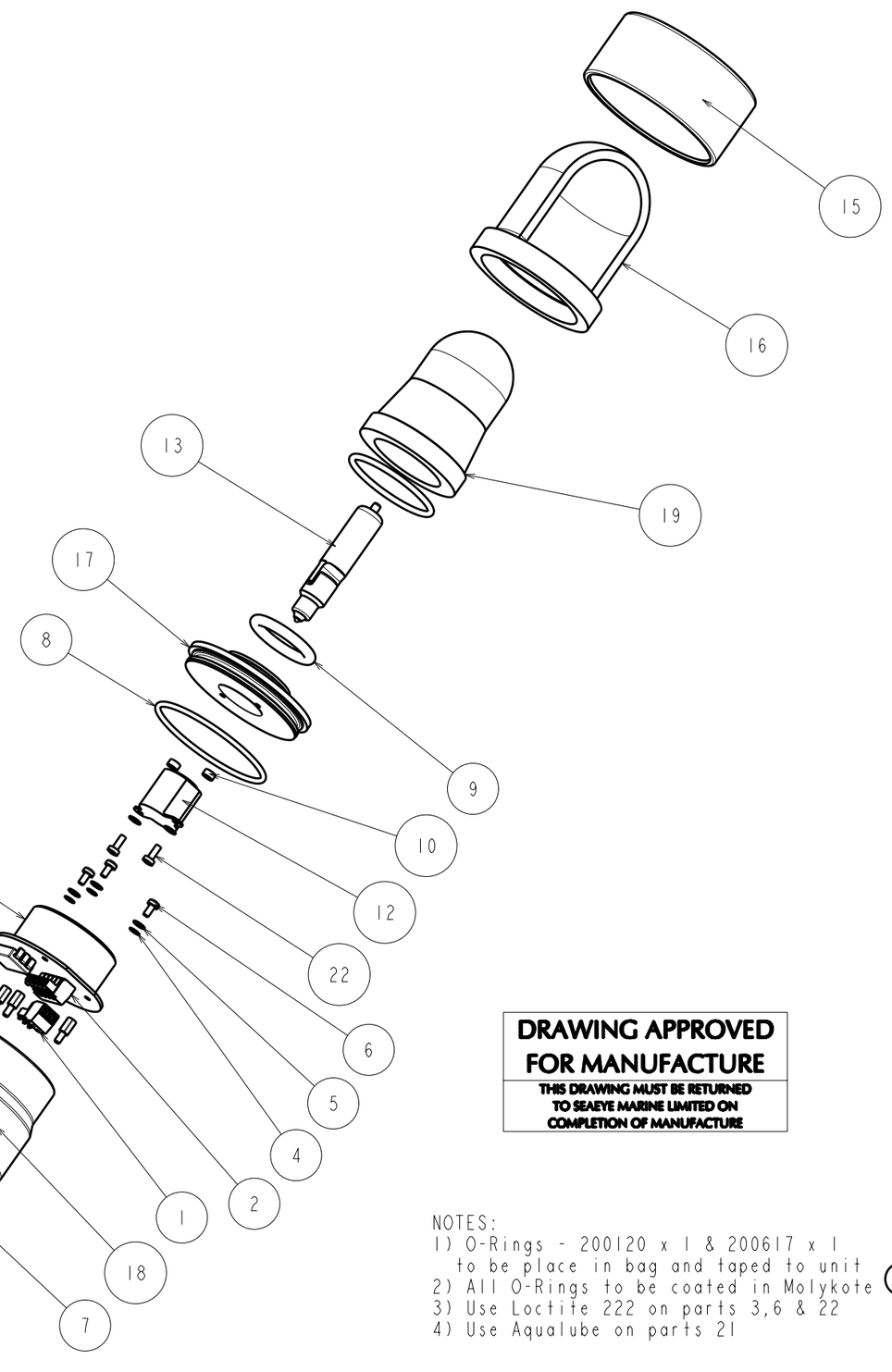
FINISH: BREAK ALL SHARP EDGES

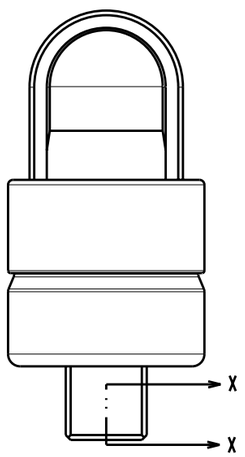
WEIGHT IN AIR: 4.660 kgs

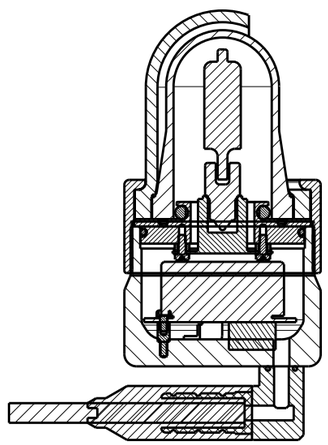
TITLE:
MCT1
THRUSTER
GENERAL ASSEMBLY

CAD MODEL REF:	P02169		
TOTAL NO. OF SHEETS:	1		
DWG NO.	**ISSUE**	**SHEET**	
S02169	2	1	

Item	Part No.	Description	Qty.	
1	304-4609	3 way header	1	(3)
2	304-4622	5 way header	1	(3)
3	517-630	Spacer Hex Brass M/F M3 x 8mm	3	
4	526-574	M3 Shakeproof Washer Mild Steel	3	
5	560-338	M3 Plain Washer Mild Steel	5	
6	560-580	Pan Head Screw Pozi M3 x 6 Mild Steel RS560-580	3	
7	200012	O RING (1.78 x 9.25)	1	
8	200143	O RING (2.62 x 61.60)	1	
9	200320	O Ring 5.34 Sec x 27.94 id	1	
10	311320340050	Cylindrical Tube Spacer od=6, id=3.2 x 3	2	
11	6095P	Seaeye Falcoon Lamp Populated PCB	1	
12	JD75-M2E11	75W Lamp Holder	1	
13	JD75_28V	75W Lamp Bulb	1	
14	ML44-1100	Falcon whip 1100mm assembly detail	1	
15	P02324	Falcon Lamp Retaining Collar	1	
16	P02325	FALCON LAMP GLASS COVER	1	
17	P02326	FALCON NEW LAMP - INSERT	1	
18	P02327	FALCON Lamp - New Base	1	
19	PBE1_5M	Lamp Glass & O-Ring 206345	1	(3)
20	STF024	M5 SPRING WASHER	2	
21	STF041	M5 x 25 SOCKET CAP SCREW	2	
22	STF097	M3 x 8 Pan Head Pozi Screw	2	







SECTION X-X

DRAWING APPROVED FOR MANUFACTURE

THIS DRAWING MUST BE RETURNED TO SEAEYE MARINE LIMITED ON COMPLETION OF MANUFACTURE

NOTES:
1) O-Rings - 200120 x 1 & 200617 x 1 to be place in bag and taped to unit
2) All O-Rings to be coated in Molykote (3)
3) Use Loctite 222 on parts 3,6 & 22
4) Use Aqualube on parts 21

ISSUE	ECR\DCR REF.	DRAWN BY	DATE	CHECKED
3	DCR 644	ALP	25-Jul-02	SVY
2	ECR 621	TG	25-Jul-02	ARK
1	Original	jmr	26-Nov-01	ARK

Seaeye

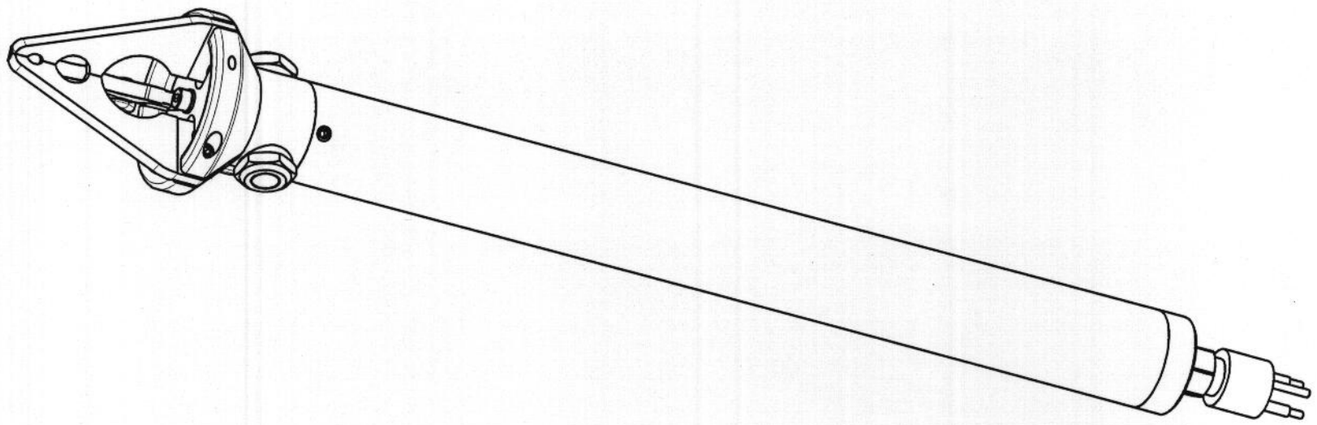
IF IN DOUBT ASK DO NOT SCALE

GENERAL TOLERANCES	MATERIAL
All Dimensions In mm ±0.1 U.O.S.	As Per Component Parts
FINISH:	Break all Sharp Edges
WEIGHT IN AIR:	0.868 Kg

TITLE: SI-LAMP01 Single Lamp Assembly

CAD MODEL REF:	SI_LAMP01	
TOTAL NO. OF SHEETS:		1
DWG NO.	**ISSUE**	**SHEET**
S02818	3	1

Item	Part No.	Description	Qty.
1	149-641	M3 x 10 CSK Screw BZP	2
2	184-7894	Stanley Knife Blade - Heavy Duty 10pk	1
3	189-620	M3 PLAIN WASHER A4	2
4	456-4845	Silencer G3/8" Stainless Steel Grade 316	2
5	525-751	M5 Nylon Washer	2
6	526-552	M2 Spring Washer R.S. 526-552	3
7	526-574	M3 Shakeproof Washer Mild Steel	2
8	527-729	M5 x 6 Nylon Slotted Cheese HD Screw	2
9	200007	O RING (1.78 x 3.69)	1
10	200015	O RING (1.78 x 14.00)	1
11	200107	O RING (2.62 x 5.23)	2
12	200123	O RING (2.62 x 29.83)	2
13	28L28-416E164	Motor 24V ESCAP TRIDENT	1
14	6128P	Single Function Manip PCB Assembly	1
15	AKW0037	THRUST BEARING AXK1024 10x24x2.0	2
16	AKW0865	Thrust Washer AS1024 10x24x1.0	4
17	BH2MP	Birns 2 Pin Male Connector	1
18	EP051	7/16 UNF Insulating Washer	1
19	GP22-0025	Gearhead 25:1 TRIDENT	1
20	OB1263	M2 X 8 Pan HD Screw	3
21	P03474	Single Function Manip Lead Screw	1
22	P03479	Single Function Manip Jaw	3
23	P03482	Single Function Manip Body	1
24	P03486	Single Function Manip Jaw Holder	1
25	P03489	Single Function Manip Jaw Connecter	1
26	P03490	Single Function Manip Jaw Bush	6
27	P03491	Dowel Pin dia 5 X 16	6
28	P03492	Single Function Manip Motor Retainer	1
29	P03565	Single Function Manip Central Bush	6
30	P03568	Single Function Manip 14mm ID Sleeve Bearing	1
31	P03569	Single Function Manip Cutter Jaw	1
32	P03570	Single Function Manip Cutter Saddle	1
33	P03571	Single Function Manip Blade Holder	1
34	P03604	Single Function Manip Lock Ring	1
35	P03614	Single Function Manip Filter Spacer	2
36	P03620	Single Function Manip Thumb Screw	1
37	P03627	Dowel Pin dia 3 X 12	2
38	P04120	Single Function Manip 1000M Lid	1
39	ROLL02	1/16"x1/4" SS Roll Pin	2
40	STF011	M5 PLAIN WASHER A4	1
41	STF037	M5 x 8 SOCKET CAP SCREW	1
42	STF038	M5 x 12 SOCKET CAP SCREW	2
43	STF088	Pan Head Screw Pozi M3 x 10 Stainless Steel	2
44	STF167	M2 PLAIN WASHER A4	3
45	STF224	M6 x 8 Set Screw A4	9
46	STF300	2mm X 8mm St/St Spirol Pin	1
47	WSW000140-WUAQ3	Scraper 14mm ID	1
48	Y18-S11-A6	BLEED SCREW	1



WEIGHT IN AIR: 1.44 kgs
WITH CUTTER OPTION: 1.54 Kgs

ISSUE	ECR\DCR REF.	DRAWN BY	DATE	CHECKED
4	ECR0954	S Young	07-Jul-05	
3	ECR0913	S Young	11-Feb-05	
2	ECR0858	S Young	20-May-04	
1	Original	S Young	29-Jan-04	

MATERIAL N/A

Break all Sharp Edges N/A

SEE NOTE ABOVE

TITLE: SINGLE FUNCTION MANIP ASSEMBLY

GENERAL TOLERANCES ALL DIMS IN MM ±0.1 U.O.S.

FINISH:

WEIGHT IN AIR:

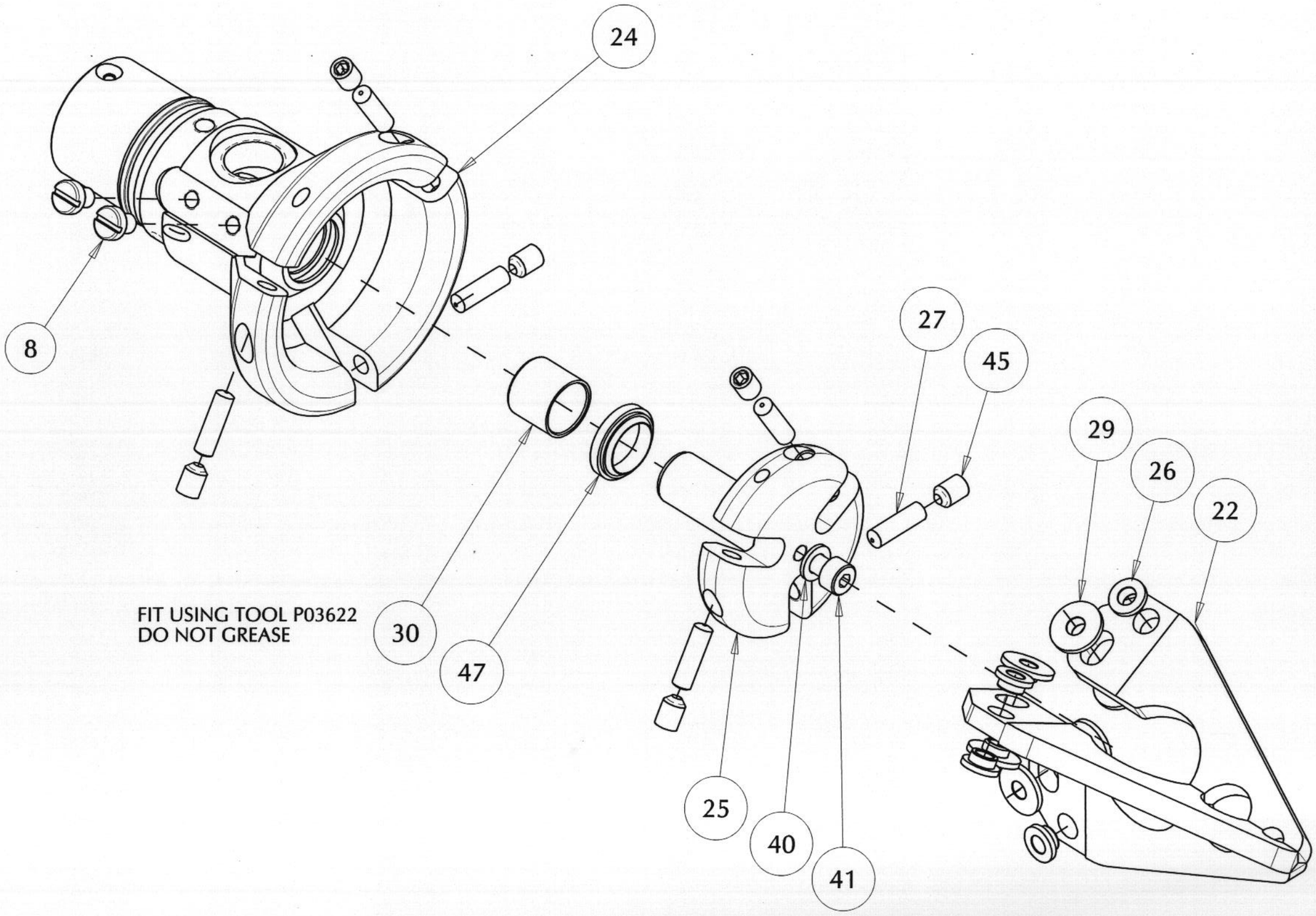
Seaeye

IF IN DOUBT ASK
DO NOT SCALE

CAD MODEL REF: GRIPSTICK01

TOTAL NO. OF SHEETS: 5

DWG NO.	ISSUE	SHEET
S03498	4	1



ISSUE	ECR\DCR REF.	DRAWN BY	DATE	CHECKED
4	ECR0954	S Young	07-Jul-05	ARL
3	ECR0913	S Young	11-Feb-05	
2	ECR0858	S Young	20-May-04	
1	Original	S Young	28-Jan-04	

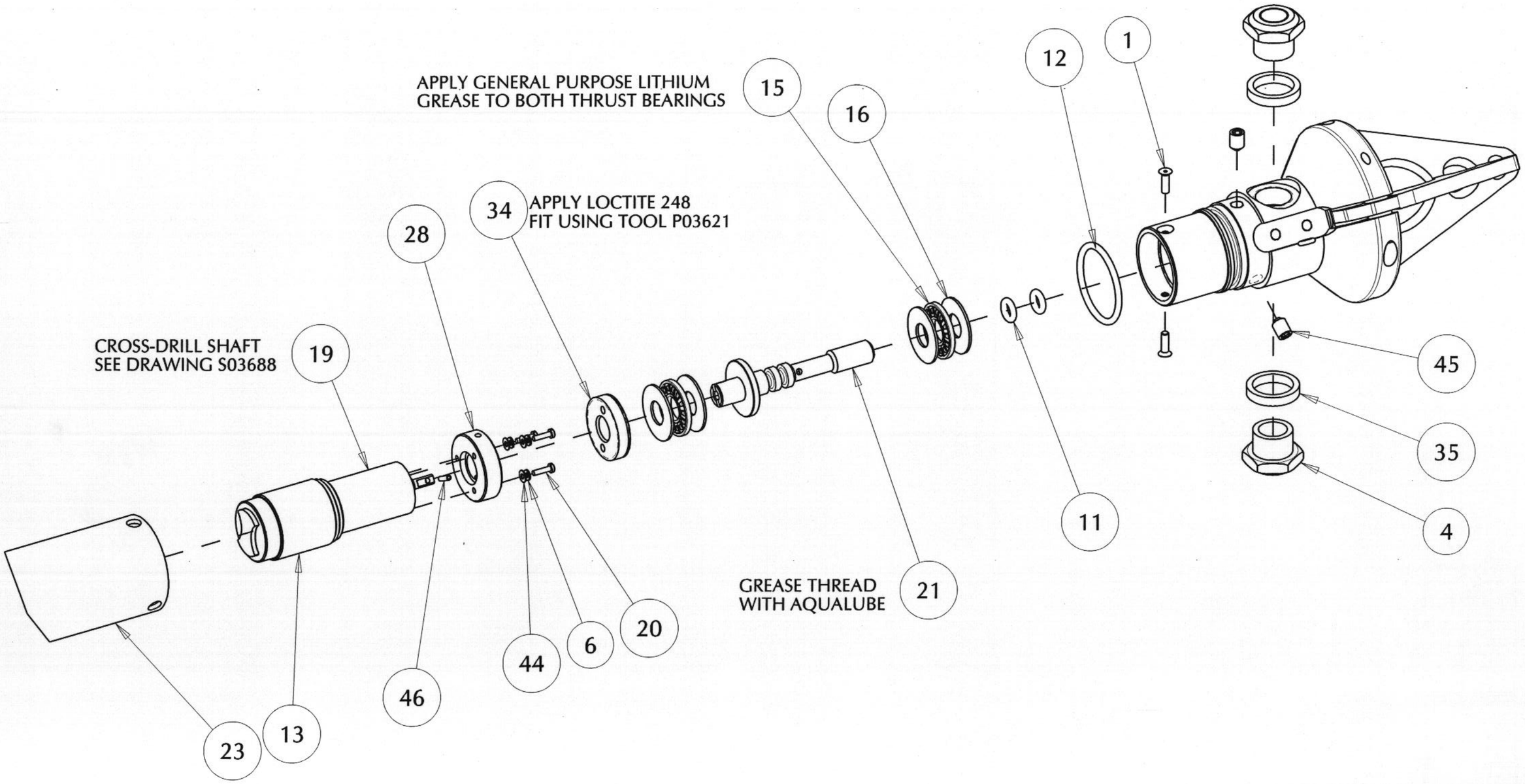
Seaeye

IF IN DOUBT ASK
DO NOT SCALE

GENERAL TOLERANCES	MATERIAL
ALL DIMS IN MM ±0.1 U.O.S.	N/A
FINISH:	Break all Sharp Edges N/A
WEIGHT IN AIR:	SEE SHEET 1

TITLE:
SINGLE FUNCTION
MANIP ASSEMBLY

CAD MODEL REF:	GRIPSTICK01	
TOTAL NO. OF SHEETS:		5
DWG NO.	ISSUE	SHEET
S03498	4	2



ISSUE	ECR\DCR REF.	DRAWN BY	DATE	CHECKED
4	ECR0954	S Young	07-Jul-05	ARV
3	ECR0913	S Young	11-Feb-05	
2	ECR0858	S Young	20-May-04	
1	Original	S Young	28-Jan-04	

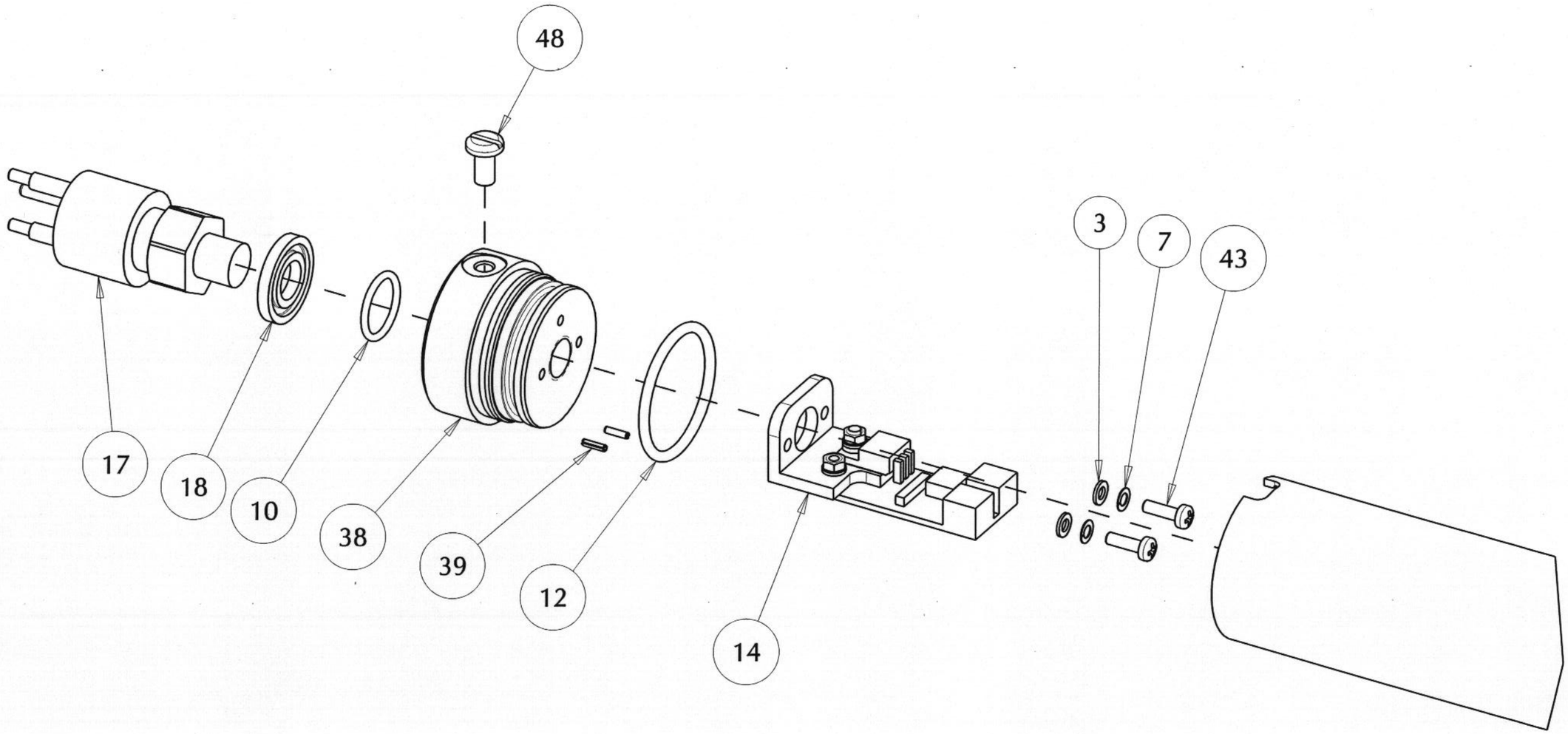
Seaeye

IF IN DOUBT ASK
DO NOT SCALE

GENERAL TOLERANCES	MATERIAL
ALL DIMS IN MM ±0.1 U.O.S.	N/A
FINISH:	Break all Sharp Edges N/A
WEIGHT IN AIR:	SEE SHEET 1

TITLE:
SINGLE FUNCTION MANIP ASSEMBLY

CAD MODEL REF:	GRIPSTICK01	
TOTAL NO. OF SHEETS:		5
DWG NO.	ISSUE	SHEET
S03498	4	3



ISSUE	ECR\DCR REF.	DRAWN BY	DATE	CHECKED
4	ECR0954	S Young	07-Jul-05	ARK
3	ECR0913	S Young	11-Feb-05	
2	ECR0858	S Young	20-May-04	
1	Original	S Young	28-Jan-04	

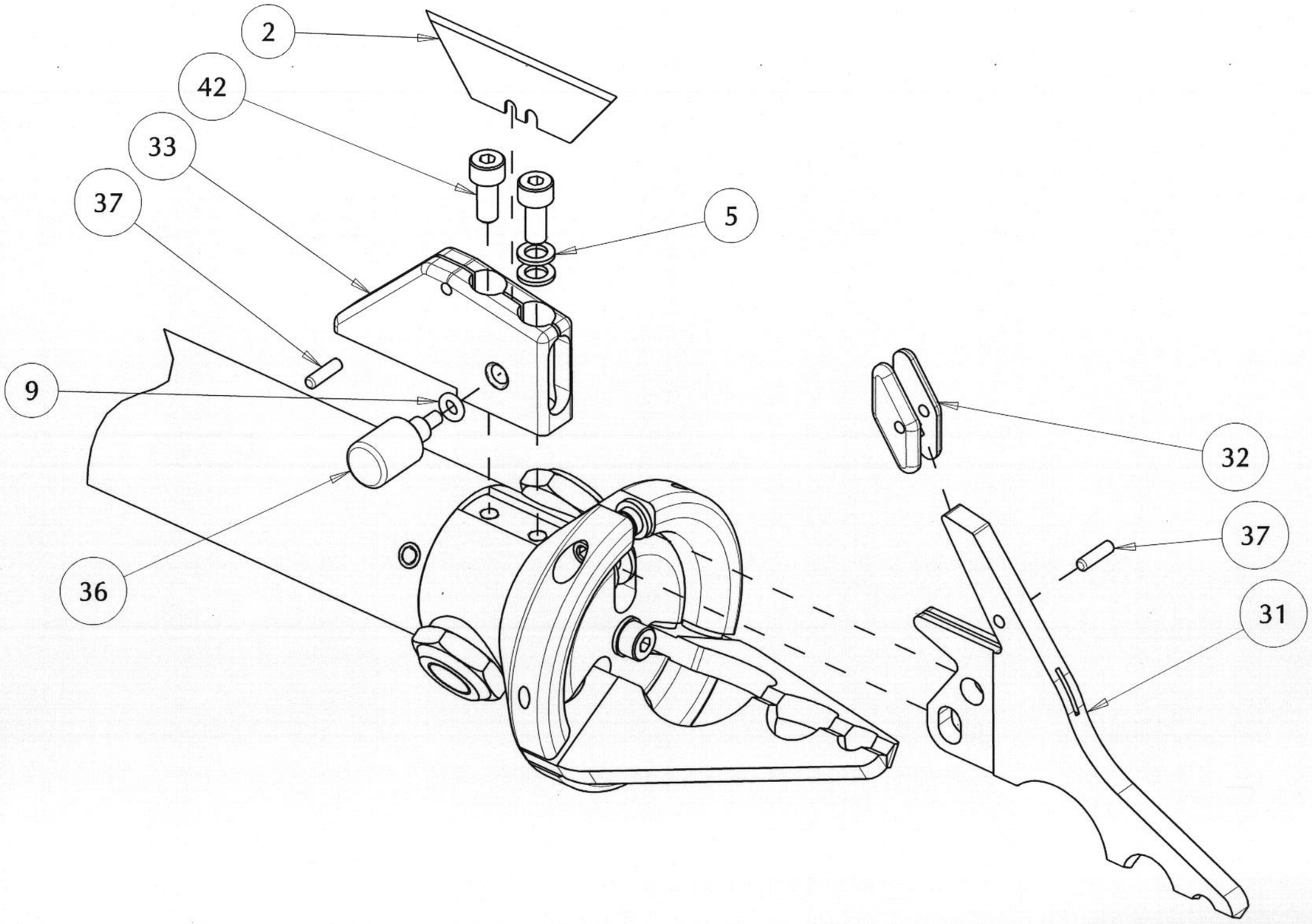
Seaeye

IF IN DOUBT ASK
DO NOT SCALE

GENERAL TOLERANCES	MATERIAL
ALL DIMS IN MM ±0.1 U.O.S.	N/A
FINISH:	Break all Sharp Edges N/A
WEIGHT IN AIR:	SEE SHEET 1

TITLE:
SINGLE FUNCTION
MANIP ASSEMBLY

CAD MODEL REF:	GRIPSTICK01	
TOTAL NO. OF SHEETS:		5
DWG NO.	ISSUE	SHEET
S03498	4	4



ISSUE	ECR\DCR REF.	DRAWN BY	DATE	CHECKED
4	ECR0954	S Young	07-Jul-05	ARK
3	ECR0913	S Young	11-Feb-05	
2	ECR0858	S Young	20-May-04	
1	Original	S Young	29-Jan-04	

Seaeye

IF IN DOUBT ASK
DO NOT SCALE

GENERAL TOLERANCES	MATERIAL
ALL DIMS IN MM ±0.1 U.O.S.	N/A
FINISH:	Break all Sharp Edges N/A
WEIGHT IN AIR:	SEE SHEET 1

TITLE:
SINGLE FUNCTION MANIP
ASSEMBLY CUTTER OPTION

CAD MODEL REF:	GRIPSTICK01	
TOTAL NO. OF SHEETS:		5
DWG NO.	ISSUE	SHEET
S03498	4	5

APPENDIX 1

DATA SHEETS

The following are manufacturers data sheets that have been provided for the Falcon DR System Serial Number 1290.

- Seaeye CAM04N Camera.
- Seaeye Gripstick GRIPSTICK02.
- Imagenex 881A Sonar.
- Hydro-Lek Manipulator System.
- A-Isometer (LIM).

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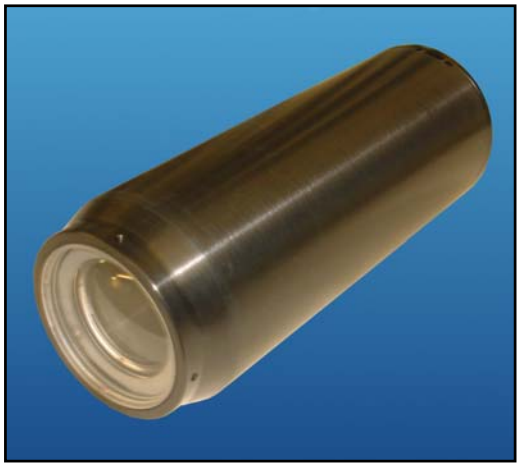
Colour Camera (CAM04N)



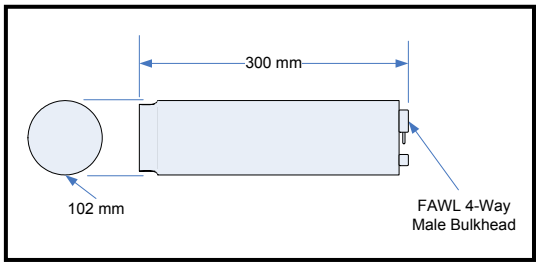
Features

- High Resolution
- Low Light
- Rugged Construction
- Water Corrected View Port
- Wide Viewing Angle
- Integral Coax Driver
- Wide Selection of Industry Standard Connectors
- NTSC Format (PAL format available)

A purpose designed high resolution colour professional underwater television camera unit within a marine grade aluminium housing, hard anodised black. The camera has a wide angled lens with auto-iris and fixed focus. The housing incorporates a water corrected acrylic view port.

Specifications

Pick-up element	½ ” Interline transfer C.C.D. Sensor
Scanning Frequency:	15.625kHz by 50Hz
Sync:	Internal
Video Output:	1V peak to peak, 75ohm
Video S/N Ratio:	Better than 50dB
Resolution:	540 Television Lines
Sensitivity:	0.35 Lux
Lens Mount:	“C” Mount
Power Requirement:	24 VDC (± 10%) 4W
Lens Type:	½” Aspherical 3.8 mm lens, wide angle, fixed focus (Field of view: 91° in water)
Iris:	Automatic
Mount:	C/CS Mount
Length Overall (Max):	300 mm (including connectors)
Overall Diameter:	102 mm
Weight in Air:	2.75 kg
Weight in Seawater:	500g
Depth Rating:	2000 metres



Note: Specifications may change without prior notice.

Seaeye Marine Ltd
Seaeye House, Lower Quay Road,
Fareham, Hampshire, PO16 0RQ, United Kingdom
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Fax: +44 (0) 1329 289001
Email: rovs@seaeye.com
Web: www.seaeye.com

Rev. 1.0

Manipulator (GRIPSTICK01)

Features

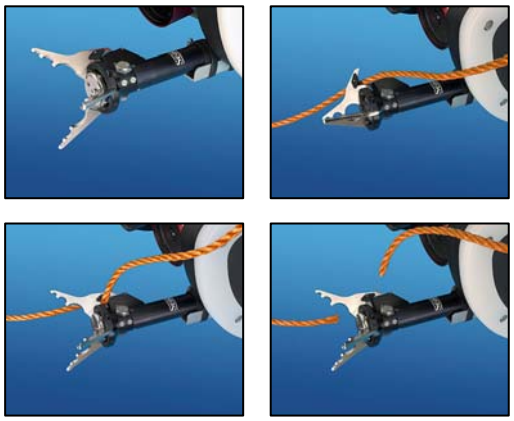
- 3-jaw design eliminates need for a rotate function
- Razor sharp soft line cutter will cut 9mm rope
- Cutter uses standard off-the-shelf craft-knife blades
- Easy to change blade – no tools required
- Cutter can be quickly removed and replaced with standard jaw
- Robust hard-anodised aluminium body construction
- Hard-wearing stainless steel jaws
- Not oil filled
- On board over-current protection

This clever single function manipulator has three, 100 mm stainless steel jaws enabling vertical or horizontal objects to be grasped without the need of the rotate function required with traditional two jaw manipulators. Particularly useful for freeing trapped umbilicals, light recovery tasks or attaching a line, we recommend this device as the first choice of accessory to add to a small ROV. This tool can also we used to cut 9 mm diameter rope with the simple installation of a craft or 'Stanley Knife' blade that remains fully protected while the jaws are closed. The robust hardwearing jaws and all other moving parts are manufactured from 316 stainless steel.

A first choice accessory for the Seaeye Falcon that can also be fitted to other manufacturer's ROVs.

Specifications

Depth Rating:	300 msw (compensated option to 3,000msw)
Nominal Voltage:	24VDC
Maximum Current:	0.86A (Internally limited)
Maximum Grip Diameter:	145mm
Grip at Jaw Tip:	6 – 10 Kgf
Force at Cutter:	30 Kgf
Weight in Air:	1.54 kg with Cutter
	1.45 kg without Cutter
Weight in Sea Water:	0.82 kg with Cutter
	0.76 kg without Cutter
Body Length:	520mm (Allow additional 120 mm for connector)
Body Diameter:	41mm
Connector:	2-Way - Power



Note: Specifications may change without prior notice.

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Rev. 2.0

IMAGENEX MODEL 881A
DIGITAL MULTI-FREQUENCY IMAGING SONAR

APPLICATIONS:

- ROV, AUV, & UUV
- Offshore Oil & Gas
- Sunken Timber Recovery
- Diving Support
- Surveying
- Search & Recovery
- Inspection
- Underwater Archaeology
- Scientific Research

FEATURES:

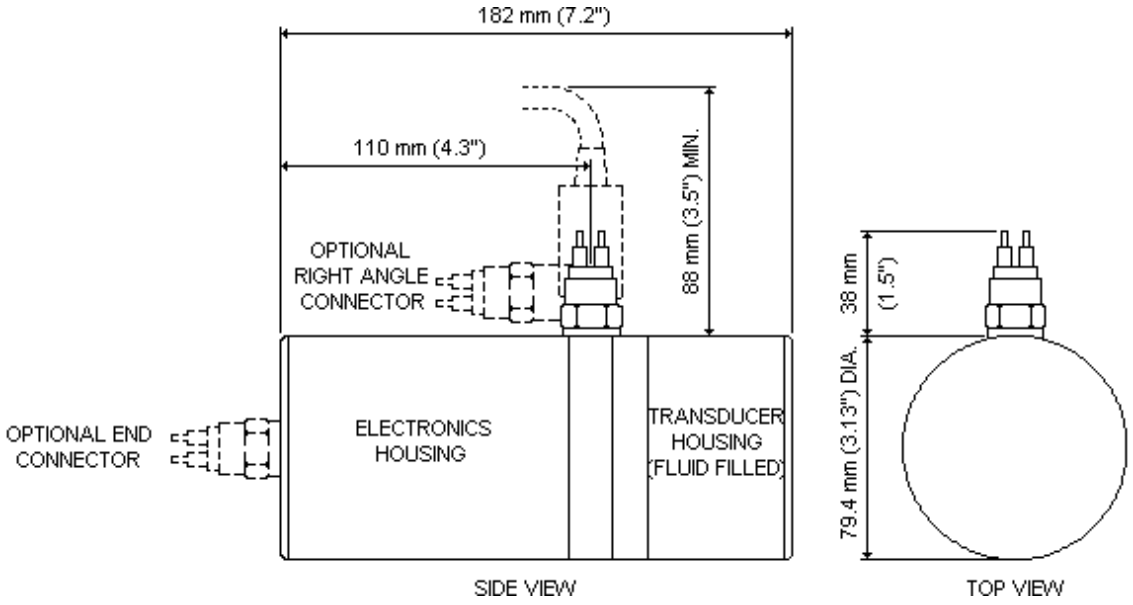
- Programmable
- Multi-frequency
- High performance
- Lower cost
- Low power
- Simple set-up and installation
- Digital telemetry
- 1 to 200 m operation
- Compact size
- Communication format available to user

Now with Multi-frequency Sonar, operators can generate highly detailed full-scale images with just one unit. The 881A is a programmable multi-frequency digital imaging sonar that you can operate using default frequency settings or customize the configurations for your own situation. High performance, lower cost, low power and simple set-up and installation, make this sonar perfect for the largest ROV's to the smallest inspection ROV's, plus AUV or UUV applications.

HARDWARE SPECIFICATIONS:	
FREQUENCY	310 kHz, 675 kHz, or 1 MHz (default settings) -Other frequencies can be selected through programmable software configurations (Tunable from 280 kHz to 1.1 MHz in 5 kHz steps)
TRANSDUCER	Imaging type, fluid compensated
TRANSDUCER BEAM WIDTH	310 kHz: 4° x 40° 675 kHz: 1.8° x 20° 1 MHz: 0.9° x 10°
RANGE RESOLUTION	1 m – 4 m: 2 mm (0.08") 5 m & up: 10 mm (0.4")
MIN. DETECTABLE RANGE	150 mm (6")
MAX. OPERATING DEPTH	1000 m and 3000 m available
MAX. CABLE LENGTH	1000 m on typical twisted shielded pair (RS-485)
INTERFACE	RS-485 serial interface @ 115.2 kbps (or optional RS-232)
CONNECTOR	Side mounted, four conductor, wet mateable (Impulse MCBH-4-MP-SS) Optional right angle or end mount connector
POWER SUPPLY	20 – 36 VDC at less than 5 Watts
DIMENSIONS (for both depth ratings)	79.4 mm (3.125") diameter x 182 mm (7.125") length
WEIGHT: In Air **In Water**	1000 m unit: 1.5 kg (3.3 lbs) 3000 m unit: 2 kg (4.4 lbs) 1000 m unit: 0.6 kg (1.3 lbs) 3000 m unit: 1.1 kg (2.4 lbs)
MATERIALS	1000 m unit: 6061-T6 Aluminum & Polyurethane 3000 m unit: Titanium, Polyurethane & 300 series stainless steel
FINISH	Hard Anodize

SOFTWARE SPECIFICATIONS:	**Win881A.exe**
WINDOWS™ OPERATING SYSTEM	Windows™ 95, 98, Me, NT*, 2000*, XP*
MODES	Sector, Polar and Side Scan
RANGE SCALES	1 m, 2 m, 3 m, 4 m, 5 m, 10 m, 20 m, 30 m, 40 m, 50 m, 60 m, 80 m, 100 m, 150 m, 200 m
TRAIN ANGLES	0° – 357°, 3° increments
SECTOR SIZE: **SECTOR MODE** **POLAR MODE**	 0° – 180°, 3° increments 0° – 357°, 3° increments, or Continuous rotation
STEP SIZES	Slow (0.3°), Medium (0.6°), Fast (0.9°), Faster (1.2°), Fastest (2.4°)
GRID TYPES	Polar and rectangular
FILE FORMAT	(filename).81a
RECOMMENDED MINIMUM COMPUTER REQUIREMENTS:	100 MHz Pentium 16 MB RAM 1 GB Hard Disk 800 x 600 x 256 colour graphics

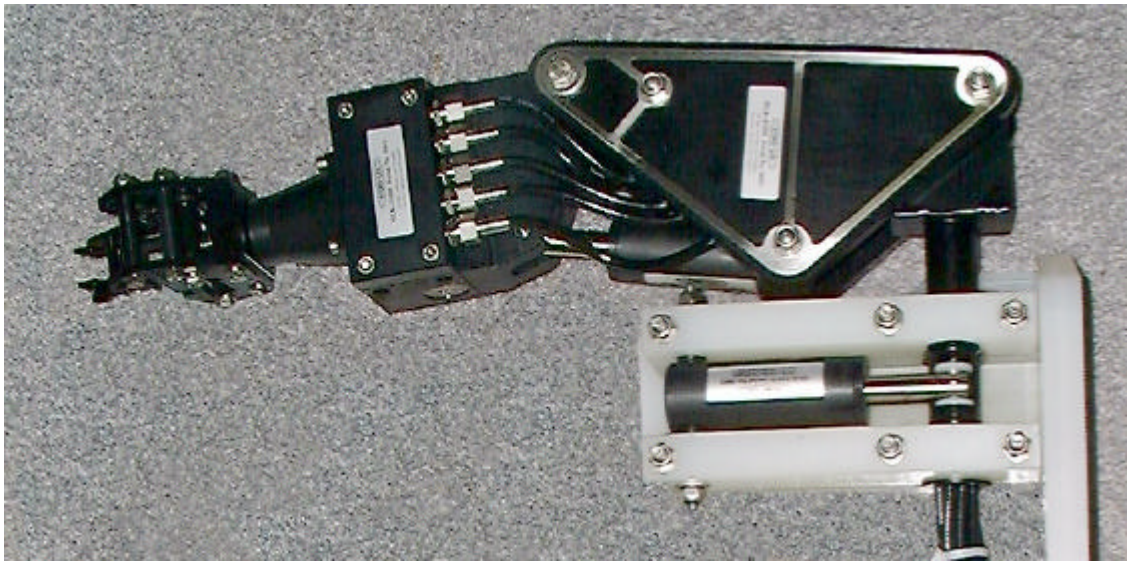
* Requires Win881A.exe v2.00 or higher (Free upgrade available for older versions – Contact Imagenex)



ORDERING INFORMATION:		
1000 m UNIT	Standard	881-000-400
3000 m UNIT	Standard	881-000-401
RS-232	Option	-006
End mount connector	Option	-009
Right angle connector	Option	-010
Interface source code in “C” (TEST881A.C)	Option	-018

HYDRO-LEK

INNOVATIVE DESIGN ENGINEERING



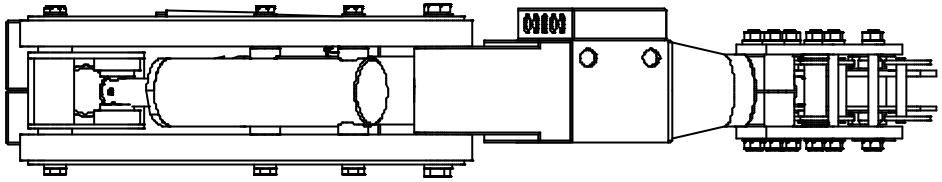
HLK-43000 5 Function Mini Gauntlet Manipulator:

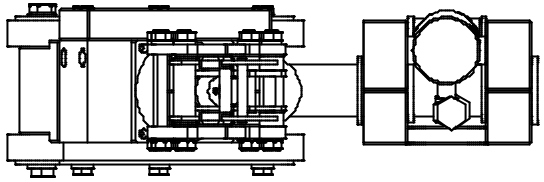
The HLK-43000 5 Function Mini Manipulator is unique in that it has no aluminium parts. The construction of plastic and stainless steel has kept the arm rugged and tough with the capability of lifting 10Kg at full reach, yet retaining a very light weight in water. The unique 5 function arrangement gives excellent dexterity for a small arm and enhances the operational capability of the new range of smaller ROV's

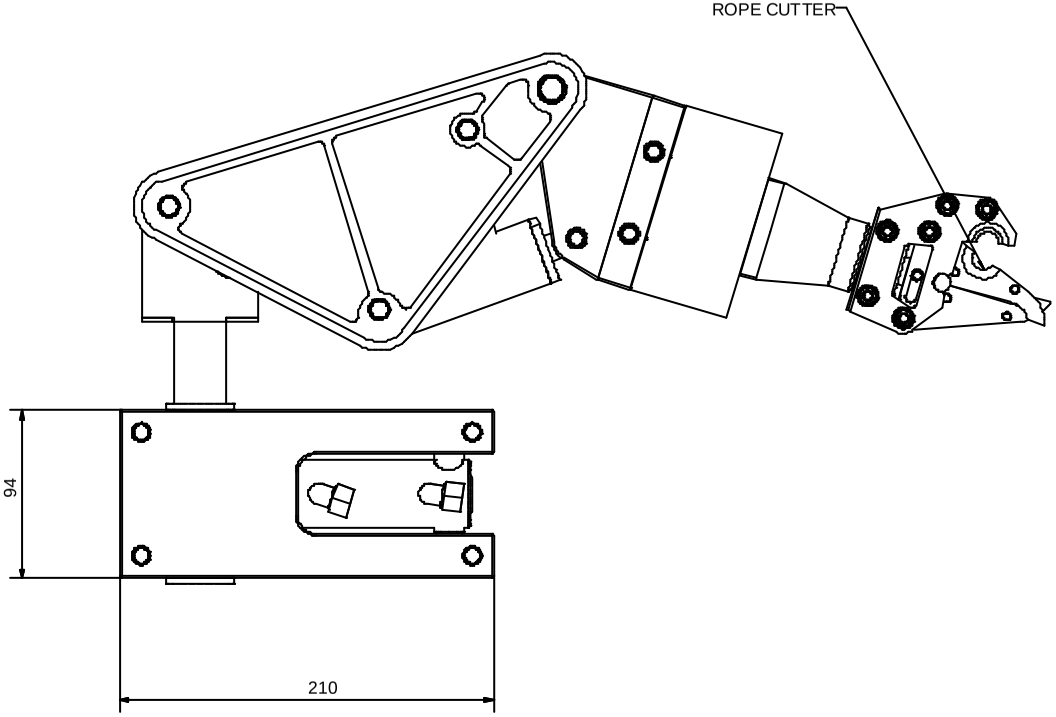
Specification:

Dimensions	**Length of arm**	**553mm**
	Length of slew plate	**210mm**
	Height	**97mm**
	Width	**232mm**
Capacities	**Rotate**	**180º**
	Torque at 80 bar	**8Nm**
	Lift capacity at 80 bar	**10Kg**
Weight	**Weight in air**	**5Kg**
	Weight in water	**3Kg**
Construction	**316 Stainless Steel Jaws**	
	High Density Polyethylene	

Hydro-Lek Ltd. Unit 4 Weller Drive Hogwood Lane Ind. Estate Finchampstead Berks U.K. RG40 4QZ
Telephone: +44(0) 1189 736903 Fax: +44(0) 1189 736915
Web Site: http://www.hydro-lek.com Email: enquiries@hydro-lek.com







TECHNICAL SPECIFICATION

GENERAL DESCRIPTION

LENGHT (max)	553mm
WIDTH (min)	232mm
HEIGHT	97mm

CAPACITIES

ARM ROTATE	90˚
JAW ROTATE	180˚
TORQUE AT 80 BAR	8NM
LIFT CAPACITY AT FULL REACH AT 80 BAR	10Kg
MAX WORKING PRESSURE	140BAR

WEIGHT

WEIGHT IN AIR	5Kg
WEIGHT IN WATER	3Kg

CONSTRUCTION

316 STAINLESS STEEL EPOXY HARD COATED

HIGH DENSITY POLYETHELENE

Designed by	Checked by	Approved by - date		Date	
Gary Lavery				17/12/2003	

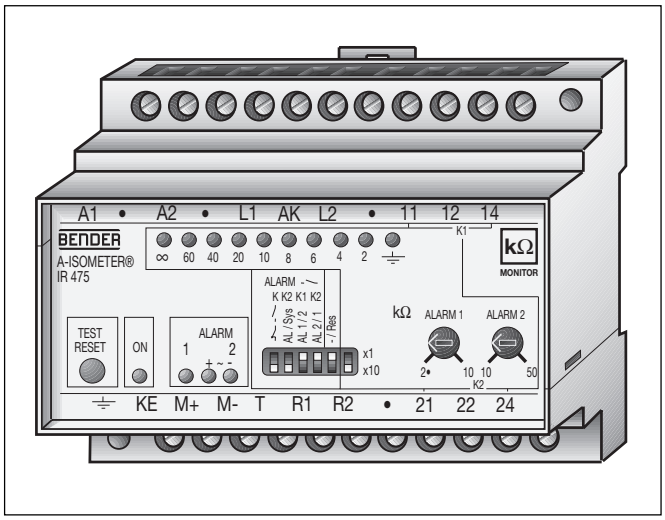
Hydro-Lek Limited, Unit 4, Weller Drive
Hogwood Lane Industrial Estate
Finchampstead, Berks. RG40 4QZ
Tel: 0118 9736903 Fax: 0118 9736915

Manipulator Assembly

HLK-43000 | Edition 0 | Sheet 1 / 1

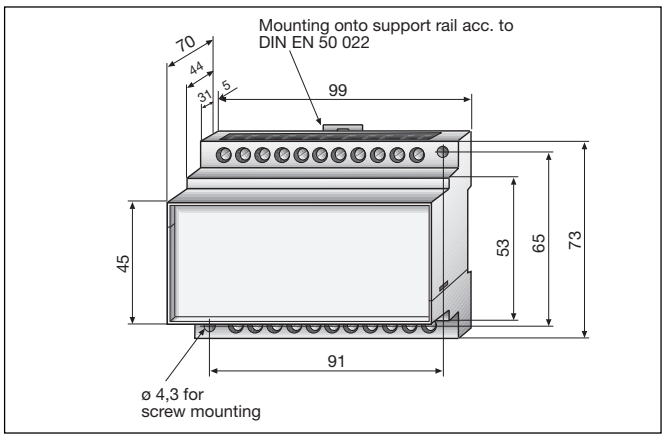
A-ISOMETER ® IR475LY...

Insulation Monitoring Device for IT AC Distribution Systems with galvanically connected DC Circuits and for IT DC Systems (Isolated Power)



- Insulation monitoring of IT AC, DC and AC/DC systems (isolated power) up to AC 690 V or DC 400 V
- Nominal voltage expandable via coupling devices
- Connection monitoring
- Alarm or system fault alarm, selectable
- AMP measuring method (patent pending)
- automatic adaptation to the system
- continuously adjustable response values 2...50 kΩ resp. 20...500 kΩ
- Power On LED, alarm LED, LED bar graph kΩ indicator
- Test and reset button
- 2 alarm relays with one change-over contact each
- N/O or N/C operation, selectable
- Fault memory, selectable
- transparent dust cover for ingress protection
- protective separation between circuits according to DIN VDE 0106 T 101

Dimension diagram



Product description

The A-ISOMETER ® IR475LY... monitors the insulation resistance of IT systems (isolated power) up to AC 690 V or DC 400 V. The device can be used universally in AC, DC and AC/DC systems.

The A-ISOMETER is particularly suited for DC and AC systems with galvanically connected DC circuits. DC components or capacitances against earth (e.g. EMC) up to 20 µF do not influence the measuring result. The AMP measuring method guarantees reliable insulation monitoring of AC/DC systems as well as pure AC or DC systems.

Function

Within the A-ISOMETER a pulsating AC measuring voltage is generated. The positive pole is connected to the system to be monitored via the terminals L1/L2. The negative pole is connected to earth via an electronic circuitry and the terminals ⏚ /KE. The connections are monitored continuously. If one of these connections is interrupted, the alarm LEDs flash and the alarm relays switch.

The measuring pulse consists of positive and negative pulses of the same amplitude. The pulse duration depends on the respective leakage capacitances and insulation resistance of the system to be monitored.

The measuring circuit is closed via ohmic insulation faults. When the insulation value falls below the pre-set response value, the alarm LEDs "ALARM" illuminate and the alarm relays switch. The alarm LEDs "ALARM 2" indicate either "AC earth fault" or "DC earth fault".

Insulation faults in DC circuits which are directly connected to the AC system are only monitored when the rectifiers carry a load of at least 5 to 10 mA.

If the fault indication is to be stored, the terminals R1/R2 have to be bridged by an external reset button (NC contact) or the DIP switch has to be set to <Res>. The fault memory can be reset by pressing the front-mounted <TEST/RESET> button for a short time or by using an external reset button, provided that the insulation resistance is at least 25% above the pre-set response value.

The correct function of the measuring circuit, the alarm LEDs and the alarm relays can be checked by using the test button.

The alarm relay 21-22-24 can optionally be used for fault alarm or system fault alarm (interruption of the connecting leads L1/L2 resp. ⏚ /KE, failure of the electronic measuring circuit). Both alarm relays can indicate both Alarm 1 as well as Alarm 2.

The response range can be selected by using the DIP switch x1 (2...10 kΩ, 10...50 kΩ) or x10 (20...100 kΩ, 100...500 kΩ). Scaling of the LED bar graph kΩ indicator is also related to the pre-set multiplier, e.g. x1 (4 = 4 kΩ), x10 (4 = 40 kΩ).

Technical Data IR475LY-...

Insulation coordination acc. to IEC 664-1	
Rated insulation voltage	AC 630 V
Rated impulse withstand voltage / contamination level	6 kV/3
Voltage test acc. to IEC 255	3.75 kV
Network being monitored	
Rated mains voltage U_N	DC 0...400 V or AC 15...400 Hz, 0...690 V
Operating range U_N	0 ... 1.2 x U_N
Supply voltage	
Supply voltage U_S	AC or DC (see ordering details or nameplate)
Max. power consumption	3.5 VA
Response value	**x1 / x10** .
Response value R_{ALARM1}	2 ... 10 / 20 ... 100 kΩ
Response value R_{ALARM2}	10 ... 50 / 100 ... 500 kΩ
Response time (R_E=0,5 x R_{ALARM}, C_E=1µF)	
Range 6 ... 500 kΩ	< 8...12 sek.
Range 2 ... 6 kΩ	< 8...35 sek.
System leakage capacitance	max. 50 µF
Measuring circuit	
Measuring voltage U_M (peak value)	20 V
Measuring current I_M	100 µA
Internal DC resistance R_I	200 kΩ
Impedance Z at 50 Hz	180 kΩ
Max. admissible stray DC voltage	DC 800 V
Outputs	
Measuring instrument SKMP*	120 kΩ
Current output	0 ... 400 µA
Max. load	25 kΩ
Contact circuit	
Switching components	2 x 1 change-over contacts
Safety separation of circuits acc. to DIN VDE 0106 T 101:	
(max. rated insulation voltage acc. to IEC 664-1)	
Contact circuits / U_N	320 V
Contact circuits / U_S	630 V
U_S / U_N	320 V
Set of contacts / set of contacts	250 V
Contact class	IIB acc. DIN IEC 255 part 0-20
Rated contact voltage	AC 250 V/DC 300 V
Admissible number of operations	12000 cycles
Limited making capacity	UC 5 A
Limited breaking capacity	
AC 230 V, cos phi = 0.4	AC 2 A
DC 220 V, L/R = 0.04 s	DC 0.2 A
Operating principle	N/O or N/C operation
Adjustment by factory	N/O operation
Type tests	
Test of the Electromagnetic Compatibility (EMV):	
Immunity against electromagnetic interferences acc. EN 50082-2	
Emissions acc. to EN 50081:	
Emissions acc. to EN 55011/CISPR11	class B[1)]
Mechancal tests:	
Shock resistance acc. to IEC 68-2-27	15 g/11 ms
Bumping acc. to IEC 68-2-29	40 g/6 ms
Vibration strength acc. to IEC 68-2-6	10 ... 150 Hz/0,15 mm - 2 g
Environmental conditions	
Ambient temperature, during operation	-10°C ... +55°C
Storage temperature range	-40°C ... +70°C
Climatic class acc. to IEC 721	3K5, except condensation and formation of ice
General data	
Operation class	permanent operation
Type of connection	screw terminals
Wire cross section	
single wire	0.2 ... 4 mm²
fine braid	0.2 ... 2.5 mm² (AWG 24 - 12)
Rapid mounting	Rail acc. DIN EN 50 022
Protection class EN 60529	
Internal components/Terminals	IP 30 / IP 20
Type of casing	X470
Flammability class	UL94V-0
Weight approx.	430 g

* Explanation:
R_E = insulation resistance between system and earth (total resistance)
C_E = leakage capacitance between system and earth (total leakage capacitance)
SKMP = meter scale centre point

Important information:

The IR475LY-... is suited for both single- and three-phase AC as well as DC systems. As indicated in the wiring diagram, there are several ways of connection. From the metrological point of view, it is irrelevant whether the connections L1 and L2 are connected to one or two different system conductors or to the N-conductor. L1 and L2 have to be led separately. Consider the maximum rated voltage when connecting the device. The terminals KE and ⏚ have also to be led separately !

A response error of max. +/- 1 kΩ is possible within the setting range 2 ... 6 kΩ.

Operation in combination with coupling devices:

The A-ISOMETER® can be used in combination with the coupling devices AGH204S (up to AC 1.5 kV) and AGH520S (up to AC 6 kV) only within the range of 20 ... 500 kΩ. For this purpose, the range selector has to be set to **x10** ! Connection monitoring is not possible when using the device with coupling devices ! Therefore the connections L1 and L2 have to be bridged.

Standards

The A-ISOMETER ® IR475LY... complies with the standards DIN 57 413 T8/VDE0413 T8/02.84 (*Isolationsüberwachungsgeräte für Wechselspannungsnetze mit galvanisch verbundenen Gleichstromkreisen und für Gleichspannungsnetze*), Draft of IEC 1557-8 (*Insulation monitoring devices for IT systems*); 1996, prEN 50197-8:1994 (*Isolations-überwachungsgeräte für IT-Wechselspannungsnetze, für IT-Wechsel-spannungsnetze mit galvanisch verbundenen Gleichstromkreisen und für IT-Gleichspannungsnetze*), Draft of ASTM F-25.10.11 (*Standard Specification for Electrical Insulation Monitors for Monitoring Ground Resistance in Ungrounded Active AC Electrical Systems Having Large DC Components or DC Electrical Systems*).

Ordering details

Type	Supply voltage U_S	Art. No.
IR475LY-4 [1)]	AC 230 V	91 068 038
IR475LY-411 [1)]	AC 24 V	91 068 039
IR475LY-412 [1)]	AC 42 V	91 068 040
IR475LY-413 [1)]	AC 90 ... 132 V*	91 068 041
IR475LY-415 [1)]	AC 400 V	91 068 042
IR475LY-416 [1)]	AC 500 V	91 068 047
IR475LY-417 [1)]	AC 690 V	91 068 043
IR475LY-421 [2)]	DC 9,6 ... 84 V*	91 068 037
IR475LY-423 [2)]	DC 77 ... 286 V*	91 068 044

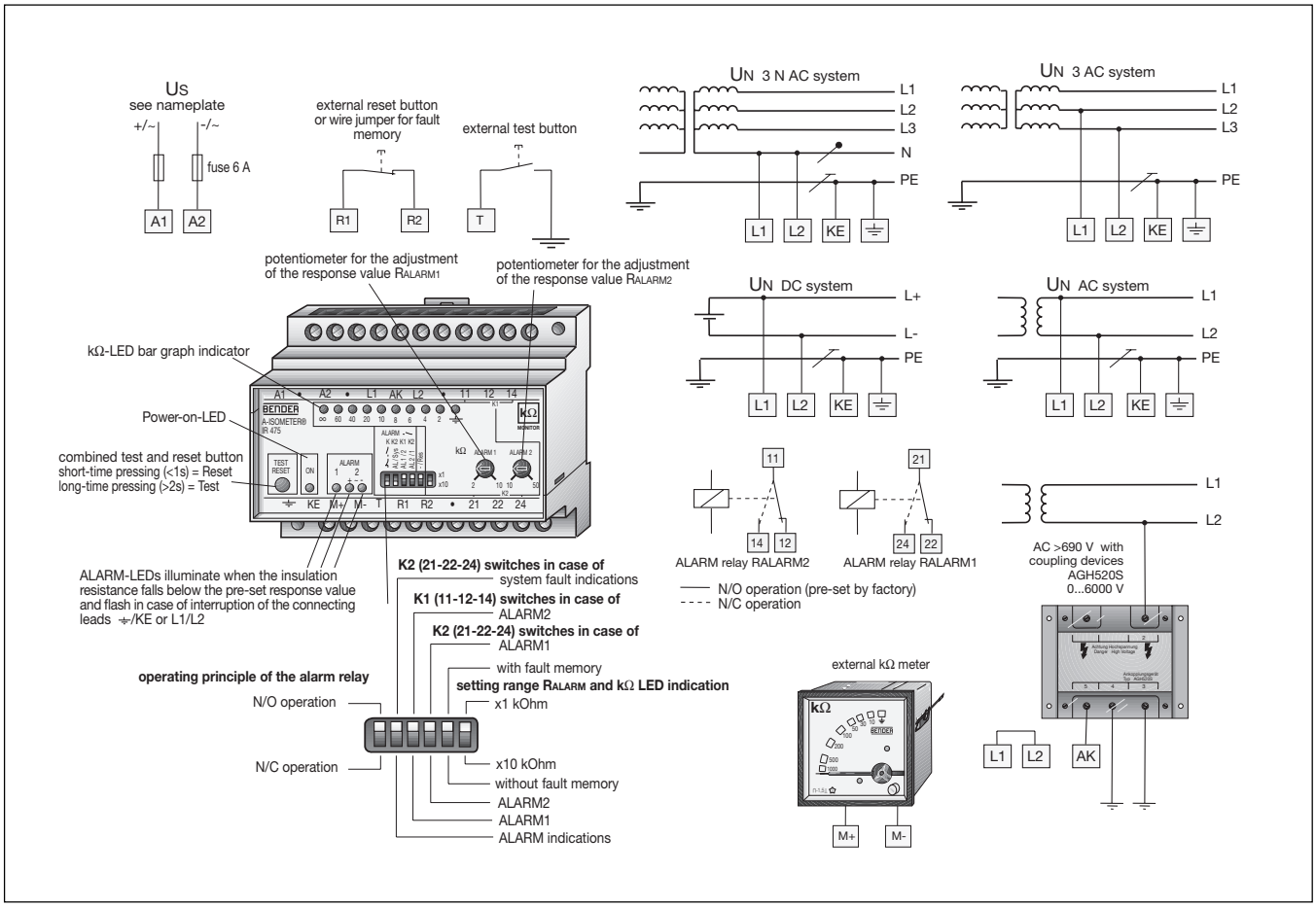
Other supply voltages on request
*Operating range of the supply voltage

1) **Class B devices** are suitable for household and industrial use.

2) **Class A devices** are designed for industrial use. For any other use, it may be necessary to take additional measures for interference suppression.

continued on page 1.3/9.3 E ➪

Wiring diagram



Safety instructions

Only one insulation monitoring device may be used in each interconnected system.

In any case, there must be a connection between L1/L2 for connection monitoring (e.g. via the winding of the isolating transformer).

Connection monitoring is essential to guarantee the safety measure. This function remains deactivated when L1/L2 or KE/⏚ are bridged.

In order to check the proper connection of the device, it is recommended to carry out a functional test using a genuine earth fault, e.g. via a suitable resistance, before using the A-ISOMETER.

Attention

When insulation or voltage tests are to be carried out, the device must be isolated from the system for the test period.

Please check for correct system voltage !

Electrical equipment shall only be installed by a skilled person in consideration of the current safety regulations.

Warning

For short-circuit protection, the connection to the supply voltage has to be equipped with a protective device according to IEC 364-4-473 (a fuse of 6A is recommended).

Short-circuit protection for network coupling and connection monitoring according to IEC 364-4-473 is not necessary when the wiring has been installed short-circuit and earth-fault proof; i.e. that the risk of a short-circuit is reduced to the absolute minimum.

For checking the connection of the measuring circuit to the system to be monitorted, the A-ISOMETER is equipped with connection monitoring. The following fault indications are possible:

Fault indications	alarm-LEDs 1	Alarm 2 +(~)	Alarm 2 -	alarm relays 11-12-14	alarm relays 21-22-24
Alarm2 AC faults		x	x		x
Alarm2 DC faults L+		x			x
Alarm2 DC faults L-			x		x
Alarm1 AC faults	x	x	x	x	x
Alarm1 DC faults L+	x	x		x	x
Alarm1 DC faults L-	x		x	x	x
Interruption ⏚/E or L1/L2	o	o	o	x	x
Systemfault (DIP2 to Sys)					x

o = flashing
x = continuous indication

Warning

If one of these indications occurs, the connections have to be checked by a skilled person immediately.

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