Seaeye Tiger

Technical Manual Book 1 of 2

System 880

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WARNING

System Compatibility Issues

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

SAAB 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 SAAB 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, SAAB 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 TIGER system 'as delivered' complies with the essential protection requirements of the EMC Directive 89/336/EEC.
- In order to ensure that the SEAEYE TIGER 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 TIGER 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 SAAB SEAEYE 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 TIGER 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 SAAB SEAEYE LTD equipment with the EMC Directive, or any field reports of EMC related faults, should be addressed to the Engineering Director at SAAB SEAEYE LTD.

SAAB

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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 Saab Seaeye Ltd.

The Technical Manual consists of the following:

BOOK ONE

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.

Operating Information - Provides a description of unit controls and indicators for easy reference. Instructions on how to assemble, install, configure and operate the system.

Functional Description - Provides functional descriptions and block diagrams of the power distribution, video and control systems.

Maintenance Information - Provides maintenance instructions on how to remove, dismantle, assemble and refit the major units, procedures and diagnostics.

Parts Lists - Provides the ROV system parts lists.

BOOK TWO

Technical descriptions and drawings - Provides a series of technical descriptions with associated drawings of the system units and printed circuit boards.

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ISSUE STATUS AND AMMENDMENTS

ISSUE STATUS	PAGES AFFECTED	DATE OF CHANGE	REASON FOR CHANGE

Table. 1 Manuual Issue Status

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WARRANTY STATEMENT

Products sold by SAAB SEAEYE 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 SM4 Thruster Motors : 24 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.

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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
HCU	Hand Control Unit
Hz	Hertz
IGFET	Insulated Gate Field Effect Transistor
I/O	Input/Output
JB	Junction Box
Kbd	Kilo baud
LIM	Line Insulation Monitor
SM4	Thrusters
MCB	Mains Circuit Breaker
MFIO	Multi-function Input/Output
NAV	Navigation Unit
TILT	Tilt Unit
PCB	Printed Circuit Board
PDU	Power Distribution Unit
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
SU	Surface Unit
TMS	Tether Management System
Toggle	Change to one of two states. Hardware or Software
VAC	Volts AC
VDC	Volts DC
W	Watts

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.

POSSIBLE DANGER TO PERSONNEL AND DAMAGE TO EQUIPMENT. THE ELECTRONICS POD WEIGHS APPROXIMATELY 16 KG RESPECTIVELY, AND CARE SHOULD THEREFORE BE TAKEN WHEN LIFTING THE POD FOR SLINGING PURPOSES.

DANGER TO PERSONNEL AND EQUIPMENT. THE 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.

DANGER TO PERSONNEL AND EQUIPMENT. LIM'S (LINE INSULATION MONITOR) DO NOT FUNCTION AS PERSONAL SAFETY PROTECTION DEVICES. A LIM MONITORS THE STATUS OF THE SYSTEM AND WARNS OF A POTENTIAL FAULT, THE LIM CAN CUT SUPPLY FEED TO HELP PROTECT PERSONAL AND EQUIPMENT, BUT THE REACTION TIME OF THE LIM IS GENERALLY TOO SLOW TO PREVENT ELECTRICAL SHOCK.

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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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.

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

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

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
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.

CHAPTER 1

SYSTEM OVERVIEW

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1. SYSTEM OVERVIEW

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

1.1 The Remotely Operated Vehicle System

The Remotely Operated Vehicle (ROV) system is extremely versatile and can be employed to carry out a variety of tasks including surveying, searching and inspections. A pilot on the surface controls the vehicle remotely by sending commands to the vehicle via an electrical umbilical and tether. The vehicle can be moved in any direction or by using the autopilot facility remain accurately on course and depth to provide a stable platform. The pilot can also control the vehicle's video system, lighting and any other equipment fitted depending on the system specification.

The system software can be configured to suit individual pilot requirements.

The ROV system (Fig. 1.23) consists of the following major units:

- Power Supply Unit (PSU).
- Surface Unit (SU).
- Hand Control Unit (HCU).
- System Monitor and a system keyboard.
- SML Telemetry Monitor Unit.
- Main Lift Umbilical and Vehicle Tether.
- Vehicle (Tiger 880).

1.2 Power Supply Unit

The Power Supply Unit (PSU) Type 9PSU-2, provides the power supplies required by the ROV system and incorporates a series of protection devices, interlocks and a cooling fan. The PSU, when switched on, initialises internal AC and DC supplies that are only distributed when they are remotely operated from the Surface Unit. The PSU requires a customer supplied power input of 380 VAC through to 475 VAC, selectable via internal links.

Detailed information can be found in Book Two Chapter 1 that contains a full description and circuit diagrams.

Figure. 1.1 Power Supply Unit

1.3 Surface Unit

The Surface Unit (SU) Type 10PDU-1 provides the switching and distribution of the PSU supplies and is the main interface for the ROV system surface units. Functions include:

- AC and DC supply switching and distribution.
- DC Current and voltage indication.
- Control of video and video overlay.
- A keypad for setting up system configuration.
- Plugs and sockets for system connection.
- ROV control systems.

Detailed information can be found in Book Two Chapter 3 that contains a full description and circuit diagrams.

Figure. 1.2 Surface Unit

1.4 Hand Control Unit

The Hand Control Unit (HCU) Type HC(D)/5 provides the interface between the operator and vehicle by a series of switches and controls. The HCU controls the following:

- Vehicle movement and speed.
- Tilt unit.
- Lighting.
- Thruster enable.
- Sonar enable.
- Video cameras.
- Auto depth and heading.

Detailed information can be found in Book Two Chapter 4 that contains a full description and circuit diagrams.

Figure. 1.3 Hand Control Unit

1.5 Monitor and Keyboard

A Type MON-15-DUAL monitor is delivered with the Tiger system for display of video images from the fitted cameras. The monitor also displays the system information as overlay data.

The keyboard Type RKD-120 allows the operator to interface with the system for configuration and connects to the Surface Unit.

Figure. 1.4 Monitor

1.6 SML Telemetry Monitor Unit

The Telemetry Monitor Unit and associated software is dual purpose; designed to monitor system telemetry as an aid to fault diagnosis and to transmit environmental data to external navigational/survey equipment. Extracted data from the telemetry is converted by the Data Converter from RS485 into RS232 format and received by an IBM compatible PC (not supplied) for subsequent display using the software provided. Environmental data from the PC can be transmitted via PC COM port 2 to external equipment for processing.

Figure. 1.5 Telemetry Monitor Unit

1.7 Umbilical and Tether

The Tiger system uses the Type ADU3 deck cable that consists of a 30 metre multi-cored cable and is used to route the power and telemetry from the Surface Control Unit to the winch. A 300metre ADU3 main lift cable is also supplied for connection from the winch to the TMS.

- TMS and Vehicle DC power.
- TMS and Vehicle AC power.
- Video signals.
- TMS and Vehicle telemetry.
- Sonar data.
- Auxiliary power and telemetry signals.
- Earths.

The ADU3 consists of the following cores:

- One fibre optic element with four G50/125/250µm.
- Three Twisted Pair 0.56 mm² cables with copper braid and foil wrapping.
- Three Twisted Pair Quad 0.56 mm² cables with drain wire, foil screen and PE jacket.
- Six cores 0.56 mm² cable with PE insulation.
- Drain wire and foil screen.
- Sixteen cores 3 mm² cables with XLPE insulation.
- Sixteen drain wires.
- TPE jacket.
- Two layers of galvanised steel wires.

The Tiger ROV uses the Type 5601 Tether, which is a multi-cored polyurethane tether cable and is the electrical communicating medium between the TMS and the vehicle.

1.8 Tether Management System

The purpose of the sub-sea TMS equipment is to afford protection to the ROV during both launch and recover situations in adverse sea states. The TMS is capable of operation in winds of Beaufort 8. An armoured lift cable provides the means for raising or lowering the launch system, and also provides electrical connections between the surface and sub-sea equipment. The lower end of the lift cable is terminated at a junction box assembly. The TMS is lifted by the launching system (LARS or Winch) using a latching system and a bullet. The bullet, which is secured to the TMS lifting shackle, engages into the latch lock arrangement. When the TMS is launched, the bullet is released from the latching system by hydraulically opening the latch and lowering the lift cable.

The TMS launch system may be deployed up to 0.7 km from the customer's winch/Launch System. The ROV may be deployed up to 140 m (dependent on the length of the tether cable) from the launch system by means of the tether connecting the ROV to the launch system. This tether is spooled onto a fixed bobbin, located in the top section of the TMS. The vehicle tether is bailed in and out by means of a motorised bailing system.

The TMS used with the Tiger is a Type TMS2T system consists of the following major units:

- Surface Unit electronics (incorporated into the ROV Surface Unit).
- TMS cage (TMS2).
- Tether (Type 5601).

The rectangular shaped launch frame, manufactured in three sections, is fabricated from stainless steel sections. The forward face of the frame is open, providing access to a polypropylene and D-rubber lined vehicle bay in which the ROV locates. The TMS cage consists of the following assemblies and components:

- TMS electronics pod.
- Hydrostatic release assembly.
- Tether bailing system.
- Lifting assembly.
- Pressure compensation system.
- Bail count sensor.
- SM4 bailing motor.
- Oil Filled Junction Box.

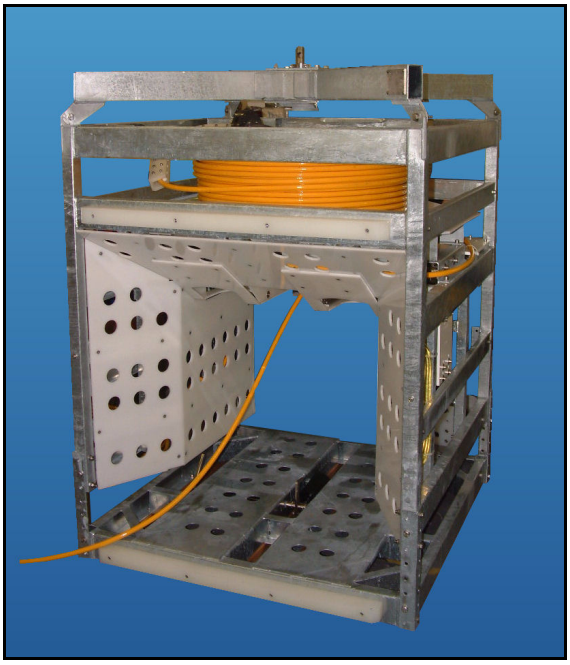

Figure. 1.6 Tether Management System

1.8.1 Bailing Foot Operated Switch Unit

The Seaeye Bailing Foot Switch Unit provides the interface between the operator and TMS Bailing system by a series of foot controlled switches. The unit controls the TMS bailing In/ Out.

Figure. 1.7 TMS Foot Switches

1.9 Tiger Vehicle

The Tiger 880 vehicle is constructed from a rugidised polypropylene and stainless steel chassis and contains the following equipment:

- Thrusters for propulsion.
- Watertight electronics pod.
- Tilt unit.
- 2 x Lamp Units.
- Compass.
- Depth sensor.

Figure. 1.8 Tiger Vehicle

1.9.1 Electronic Pod

The vehicle has an Electronics Pod (EPOD), Type 8EPM-3D, which is manufactured from anodised aluminium, and provides the housing for the vehicle electronics.

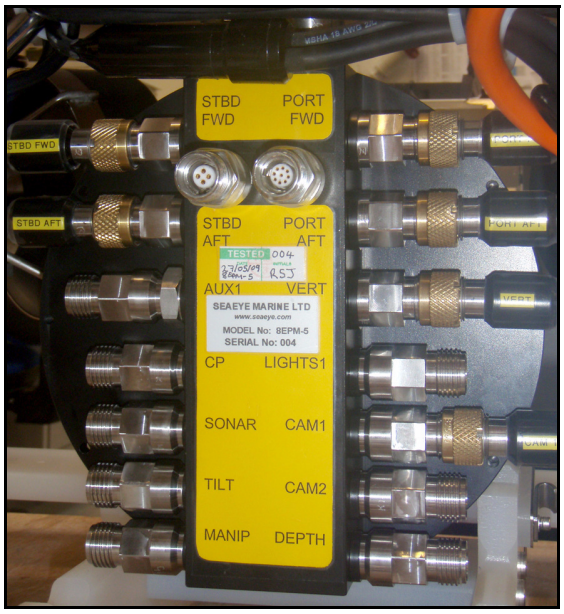

Figure. 1.9 Electronics Pod

1.9.2 Thrusters

The Tiger uses five DC brushless thruster motors Type SM4 for propulsion, four horizontal and one vertical providing full three-dimensional control.

The thruster motor (SM4) is a brushless DC motor encased in a hard anodised aluminium cylinder and filled with an insulating lubricating oil. The SM4 comprise of seven main assemblies:

- **S**haft Seal Cap – machined from hard anodised aluminium and contains the ceramic face seal and V-seal.
- Bearing Cap – contains contact bearings and is secured to the motor body.
- Gearbox – Epicyclic 5:1 reduction gearbox.
- Motor Body – machined from hard anodised aluminium, housing the motor stator and rotor shaft.
- End Cap – machined from hard anodized aluminium, the end cap houses the motor electronics and PCB's.
- Diaphragm Housing – an oil filled recess consisting of a rubber diaphragm and spring and part of the oil compensation assembly.
- Diaphragm Cover – secured to the diaphragm housing contains the diaphragm spring which acts against the cover to maintain pressure on the diaphragm assembly.

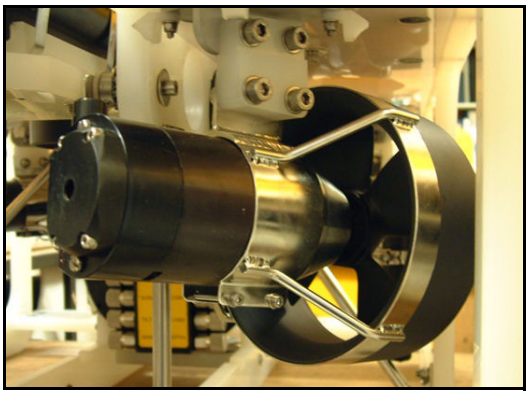

Figure. 1.10 Thruster Motor

SM4M Thruster Specification	
Nominal Voltage:	250 VDC
Nominal Current:	4.5 A (normal running)
Thrust @ 2000RPM:	25 kgf
Weight in Air:	3.7 kg (including propeller and nozzle)
Weight in Seawater:	2.2 kg (including propeller and nozzle)
Depth Rating:	Up to 2500 m
Control Signal:	PWM for Speed signal
Electronics	24 VDC @ 200 mA reversible for direction control
Connector:	7-Way Connector

Table 1.1 SM4 Thruster Specification

1.9.3 Tilt Assembly

The Tilt unit comprises of a tilt motor, platform and feedback mechanism and is used to mount the vehicle 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.

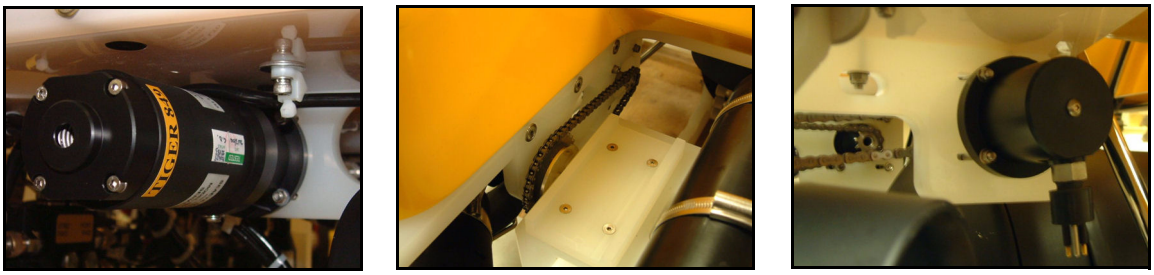

Figure. 1.11 Tilt Motor, Platform and Follow-up Assemblies

Tilt Motor Specification	
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 1.2 Tilt Motor Specification

The Tilt arrangement incorporates an adjustable clutch system. This is simply done by adding or subtracting belville washers to the adjustable mounting. Should the tilt platform encounter a restriction, the clutch will slip preventing the motor from damage.

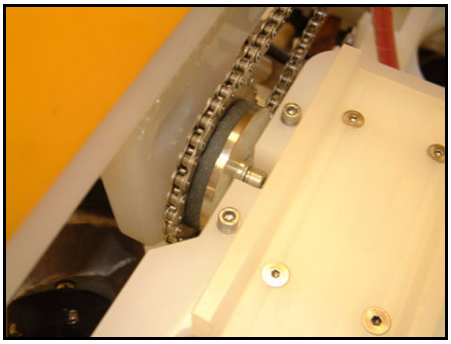

Figure. 1.12 Tilt Clutch Assembly

1.9.4 Light Units

The Tiger has one independently controlled lighting channel containing two fused 40W (equivalent to a 168W Halogen light) lamps Type LED-LAMP-01 fitted to the tilt platform. The Lamp Unit (LED-LAMP-01) is formed within a rugged enclosure and contains all the electronic control circuits for the LEDs. It provides a high intensity directional flood light for excellent illumination in under water environments.

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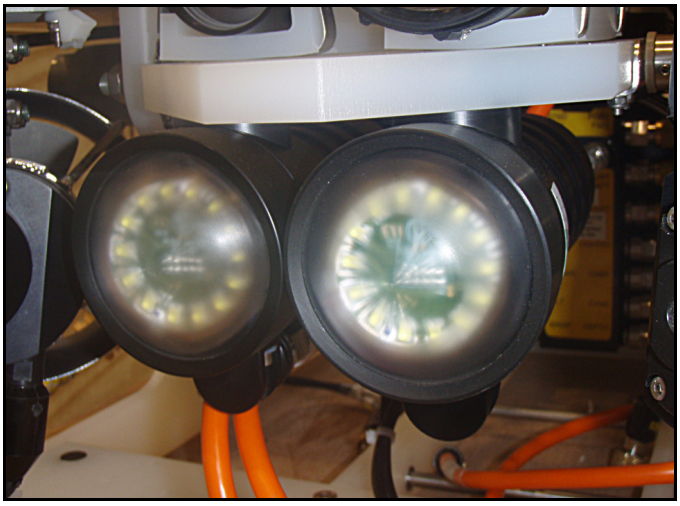

Figure. 1.13 Lamp Assembly

Lamp Specification	
Power	40W
Voltage	250 VDC
Operating Depth	3000 m
Weight	In Air 1.4 kg
In Seawater	0.45kg
Connector	3-Way Connector

Table 1.3 Lamp Specifications

1.9.5 Compass and Depth Unit

The 10CP6 compass unit located externally of the electronics pod and mounted on the vehicle chassis provides the vehicle heading data.It is connected to the 10CP-6 input bulkhead socket.

Figure. 1.14 Compass Unit with Depth Unit Socket Connection

The depth unit Type 10DP/2, which is interfaced to the EPOD via, the compass unit top mounted metal shell socket and is located on the vehicle chassis provides depth indication.

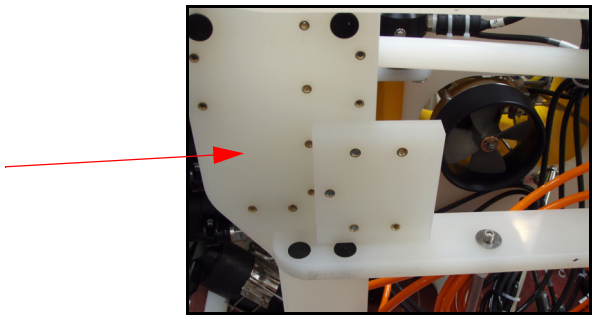

Figure. 1.15 Depth Sensor

1.10 System Specification

Surface Equipment		
Power Supply Unit 9PSU-2		
Type		9PSU-2

Table 1.4 Surface Equipment Specification

Surface Equipment		
Dimensions	Width	600 mm
	Height	1300 mm
	Depth	470 mm
Weight		226 kg
Electrical	Input	Three phase, 50/60 Hz, 220 - 475VAC at 14 KVA
Surface Unit 10PDU-1		
Type		10PDU-1
Dimensions (19” Rack fitment)	Width	484 mm
	Height	265 mm
	Depth	500 mm
Weight		19.7 kg
Weight		112 kg (including cables)
Hand Control Unit		
Dimensions	Width	300 mm
	Height	190 mm
	Depth	150 mm
Weight		2.78 kg
Monitor MON-15-DUAL		
Monitor Type		15” - Dual Input, 2 x 10” - Video, 2 x 15”
Dimensions (19” Rack fitment)	Width	350 mm
	Height	300 mm
	Depth	400 mm
Weight		13.38 kg

Table 1.4 Surface Equipment Specification (Continued)

Vehicle	
Serial number	880
Length	1100 mm
Width	705 mm
Height	805 mm

Table 1.5 Tiger 880 Specifications

Vehicle	
Weight in air	Approx. 108 kg (Un-ballasted with skid for fresh water) Approx. 174 kg (ballasted with skid for fresh water) Refer to system records for exact weights
Depth rating	1000 msw
Forward thrust	62 kgF
Lateral thrust	43 kgF
Vertical thrust	22 kgF
Lighting	One lighting channel (2 x 150W lamps)
Depth sensor	Accuracy ± 0.1% FSD
Compass	Accuracy ± 1º
Autopilot	Heading and depth hold

Table 1.5 Tiger 880 Specifications (Continued)

1.11 Associated Documentation

Documentation included with the Tiger 880 System includes:

- Tiger 880 Book Two - Technical descriptions and diagrams.
- Data sheets.
- Vehicle records.
- QA documentation.s.
- TMS handbooks.
-

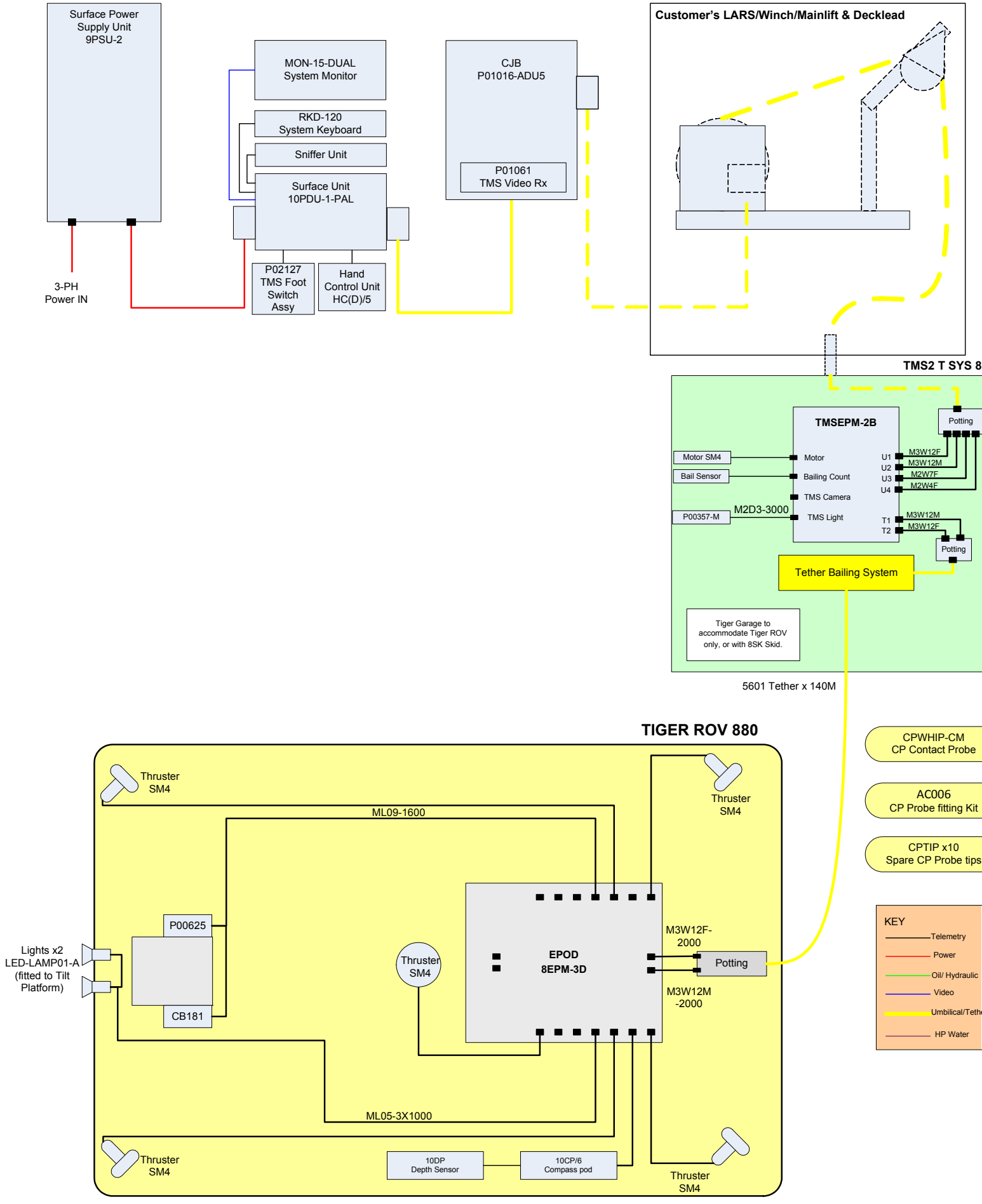

Figure. 1.16 Tiger 880 System Configuration

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CHAPTER 2

CONTROLS AND

INDICATORS

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2. CONTROLS AND INDICATORS

This Chapter provides a description of Tiger 880 System 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 Power Supply Unit (PSU), 3-Phase Power Supply Unit, Surface Unit (SU) and Hand Control Unit (HCU). Their functions are listed in the following tables and their location identified on the switch and indicator layout diagrams.

2.2 PSU Controls and Indicators

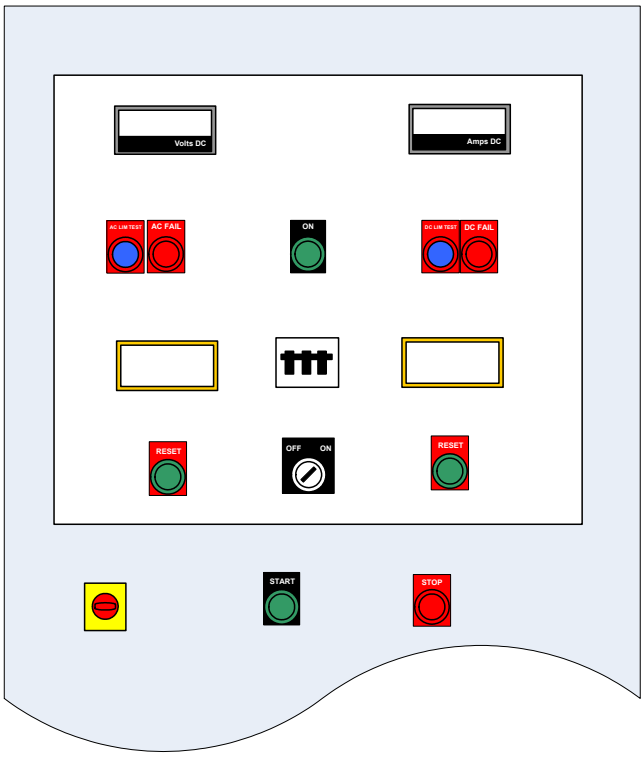

Figure. 2.1 PSU Front Panel

CONTROL/INDICATOR	FUNCTION
Mains Isolator rotary switch	When set to ON (clockwise), applies the external three phase power supply to the PSU. The switch is mechanically disabled when the PSU door is open.
AC circuit breaker	When set to ON (up), AC supplies are made available for routing to the PSU output when the SU AC SURFACE switch is made. Provides over-current protection for the input supply.
ON indicator	Illuminates GREEN when AC power is available.

Table 2.1 PSU Controls and Indications

CONTROL/INDICATOR	FUNCTION
AC Line Insulation Monitor (LIM)	Trips the subsea AC supplies when a line-line or line-earth fault condition is detected by the LIM across the AC power conductors when below the resistance setting of that LIM.
AC FAIL indicator	Illuminates RED when a fault condition has been detected by the LIM circuits, shutting down the subsea AC supply. NOTE. The AC FAIL indicator illuminates when the SU VEHICLE AC switch is OFF.
AC LIM TEST press button switch	When operated, tests for correct functionality of the AC LIM.
AC RESET press button switch	When operated the Subsea AC supplies are reset and extinguishes the AC FAIL indicator (provided no AC earth fault condition exists).
Key-operated switch	When set to ON (clockwise), allows the START switch to be made (the key cannot be removed in this position). When set to OFF (anticlockwise), the switch acts as an interlock for the START switch (in this position the key can be removed for safety reasons preventing the START switch from being operated).
START press button switch	When operated in conjunction with the Key-operated switch energises the PSU DC supplies. NOTE. DC supplies are distributed when the SU MASTER DC switch is selected to ON.
STOP press button switch	When operated de-energises the PSU DC supplies.
DC Line Insulation Monitor (LIM)	Trips the DC supplies when a line-line or line-earth fault condition is detected by the LIM across the DC power conductors when below the resistance setting of that LIM.
DC FAIL indicator	Illuminates RED when a fault condition has been detected by the LIM circuits, shutting down the DC supply. NOTE. The DC FAIL indicator illuminates when the SU MASTER DC switch is OFF.
DC LIM TEST press button switch	When operated, tests for correct functionality of the DC LIM.
DC RESET press button switch	When operated the DC supplies are reset and extinguishes the DC FAIL indicator (provided no DC earth fault condition exists).
DC Voltmeter	Provides a digital readout of the DC voltage.
DC Ammeter	Provides a digital readout of the DC current drawn by the system.

Table 2.1 PSU Controls and Indications (Continued)

2.3 SU Controls and Indicators

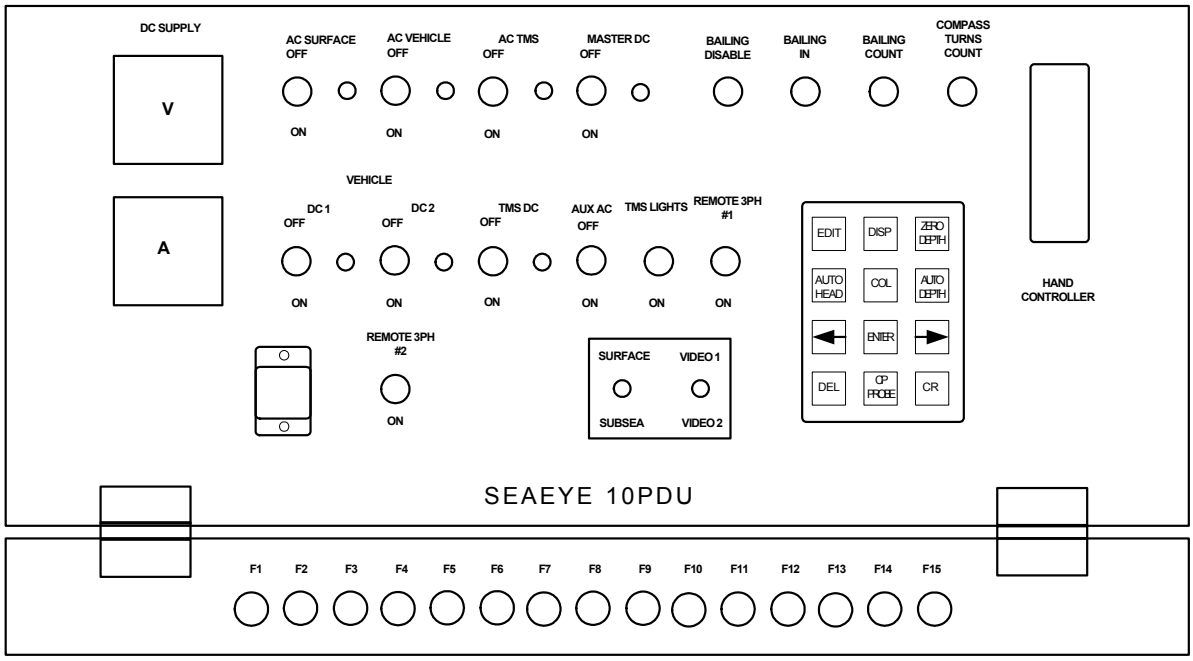

Figure. 2.2 Surface Unit Front Panel

CONTROL/INDICATOR	FUNCTION
AC SURFACE toggle switch	Routes the PSU Auxiliary AC output to the SU when set to ON (down).
AC SURFACE indicator LED	Illuminates RED when AC SURFACE switch is set to ON.
AC VEHICLE toggle switch	When set to ON (down), supplies the vehicle with subsea AC (provided the AC SURFACE is switched ON).
AC VEHICLE indicator LED	Illuminates RED when AC VEHICLE switch is set to ON.
AC TMS toggle switch	When set to ON (down), supplies the TMS with AC (provided the AC SURFACE switch is set to ON).
AC TMS indicator LED	Illuminates RED when AC TMS switch is set to ON.
AUX AC toggle switch	When set to ON (down), provides remote switching for a relay in the vehicle EPOD to control 220 VAC for specific customer requirements. NOTE. The AC VEHICLE switch must be set to ON).
3 PHASE REMOTE #1 toggle switch (Not used on the Tiger ROV)	When set to ON (down), provides an auxiliary output power supply.

Table 2.2 Surface Unit Controls and Indications

CONTROL/INDICATOR	FUNCTION
3 PHASE REMOTE #2 toggle switch (Not used on the Tiger ROV)	When set to ON (down), provides remote switching.
MASTER DC toggle switch	Acts as a remote switch for the PSU DC supplies. When set to ON (down), routes DC to the SU for distribution.
VEHICLE DC1, VEHICLE DC2 & TMS DC toggle switches	When set to ON (down), applies DC to the ROV and TMS. The switches must be pre-selected prior to operating the MASTER DC switch.
DC Indicator LEDs	Illuminate RED when the DC switches are to ON.
DC Voltmeter	Provides an analogue readout of system DC voltage.
DC Ammeter	Provides an analogue readout of current drawn by the system.
SURFACE/SUBSEA video select toggle switch	When set to SURFACE (up), video overlay only is routed to the front panel OVERLAY socket. When set to SUBSEA (down), the video overlay and video is genkeyed and routed to the OVERLAY socket.
VIDEO 1/VIDEO 2 select toggle switch	When set to VIDEO 1 (up), video from a camera connected to the video 1 path is routed to the OVERLAY output socket and video from a camera connected to the video 2 path is routed to the DIRECT VIDEO output socket. NOTE. The SURFACE/SUBSEA switch must be set to SUBSEA. When set to VIDEO 2 (down), the camera connected to the video 1 path is routed to the DIRECT VIDEO output socket and the camera connected to the video 2 path is routed to the OVERLAY output socket. NOTE. The SURFACE/SUBSEA switch must be set to SUBSEA
Surface Unit Keypad	Provides operator interface with the SU CPU. Full keypad functions are detailed in Chapter 4.
BAILING DISABLE/ENABLE toggle switch	When set to DISABLE (up), disables the TMS bailing motor preventing inadvertent tether bailing. When set to ENABLE (down), enables the TMS bailing motor control.
BAILING IN/OUT centre biased three position toggle switch	When set to the BAIL IN position (up), the bailing motor bails in the tether. When set to BAIL OUT (down), the bailing motor bails out the tether.
BAILING COUNT RESET push button switch	When operated, resets the bailing arm turns counter to zero (displayed on the system monitor).
TURNS COUNT RESET push button switch	When operated, resets the umbilical turns counter to zero (displayed on the system monitor).
TMS LIGHTS toggle switch	When set to ON (down), lights are switched on at full brilliance. When set to OFF (up), lights are off.

Table 2.2 Surface Unit Controls and Indications (Continued)

2.4 HCU Controls and Indicators

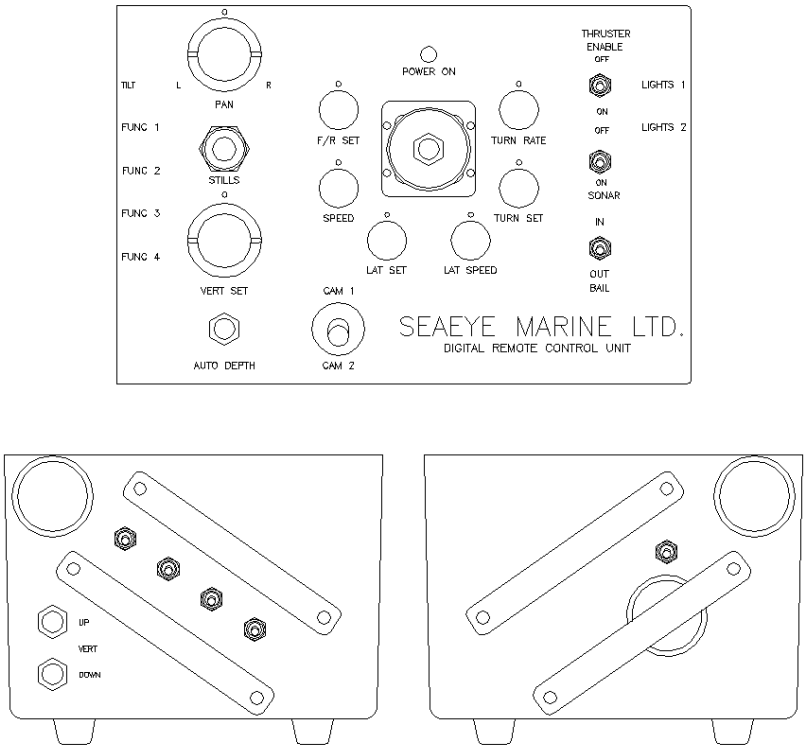

Figure. 2.3 Hand Control Unit Front Panel

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.
F/R SET potentiometer control	Rotating the control clockwise or anticlockwise of the centre marked position trims the thruster motors to provide an amount of forward or reverse thrust respectively. This amount of preset trim (± 50% of full speed) may be used to offset the effects of submarine currents or tidal activity or to maintain the vehicle in forward or rearward motion.
SPEED potentiometer control	Trims the speed of the thruster motors. Rotating the control clockwise or anticlockwise of the centre marked position increases or decreases motor speed respectively. Fully anticlockwise represents 25% maximum speed, centre position 50% and fully clockwise 100%.

Table 2.3 HCU Controls and Indications

CONTROL/INDICATOR	FUNCTION
LAT SET potentiometer control	Provides lateral preset thruster trim similar to the F/R SET control.
LAT SPEED potentiometer control	Adjusts the speed of the thruster motors responsible for the lateral motion of the vehicle with respect to the lateral movement of the joystick (Gain Control).
TURN SET potentiometer control	Provides rotational thruster trim for offsetting the vehicle against unbalanced drag similar to the F/R SET control.
TURN RATE potentiometer control	Adjusts the speed of the thruster motors responsible for the turning motion of the vehicle with respect to the turning movement of the joystick (Gain Control).
VERTICAL SET control	Rotating the control clockwise or anticlockwise causes the vehicle to ascend or descend respectively.
VERT UP/DOWN pushbuttons	Operating these controls allows the operator maximum vertical thrust for ascending or descending. This control can be used to move the vehicle quickly 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/height, 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 50% overrides the autopilot until the control is less than 50% when the vehicle will return to the previous depth.
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 50% overrides the autopilot until it is returned to less than 50% when the vehicle will return to the previous heading.
STILLS pushbutton switch	When operated triggers the optional Stills camera on the vehicle. Each operation of the switch causes the camera to take a single frame. NOTE. At least 8 seconds must elapse between takes.
LIGHTS 1 potentiometer control	Rotating the control clockwise increases light intensity and anticlockwise dims the lights until they switch off.
LIGHTS 2 potentiometer (Not used on Tiger 880)	Operates similar to LIGHTS 1 potentiometer.
LIGHTS 2 toggle switch (Not used on Tiger 880)	When set to ON (down), lights 2 turns on at the brightness set by the LIGHTS 2 potentiometer.
TILT control potentiometer	Operates the TILT unit up and down, tilt position is displayed on the system monitor.
PAN control potentiometer (Not used on Tiger 880)	Operates the PAN unit to either port or starboard, pan position is displayed on the system monitor.
FUNC toggle switches	Function switches can be assigned functions depending on customer requirements.

Table 2.3 HCU Controls and Indications (Continued)

CONTROL/INDICATOR	FUNCTION
CAM1/CAM2 toggle switch	When operated switches between Camera 1 and Camera 2.
THRUSTER ENABLE 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 250 VDC SUPPLY TO THE THRUSTER MOTORS
BAILING IN/OUT centre biased three position toggle switch	When set to the BAIL IN position (up), the bailing motor bails in the tether. When set to BAIL OUT (down), the bailing motor bails out the tether.

Table 2.3 HCU Controls and Indications (Continued)

CHAPTER 3

ASSEMBLY AND

INSTALLATION

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3. ASSEMBLY AND INSTALLATION

This Chapter details the instructions for receipt and installation of the Tiger 880 ROV system. On completion of installation a series of installation tests are carried out prior to the vehicles first operational dive. The installation tests ensure that the system is working correctly and allows the operator to become familiar with the units and controls.

3.1 Introduction

The system (Fig. 3.8) 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 immersed, the **Pre and Post Operational Checks** (Task 1 and 2, Chapter 7) are to be carried out and 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 and ensuring the vehicle can be stored operational and ready for its next dive. Fig. 3.9 provides a flow chart of the installation process.

3.2 Adverse Effects of Extreme Climactic Conditions

Saab Seaeye 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 subsea equipment (ROV, TMS, etc) and black anodised enclosures, which if left exposed to direct sunlight (especially in equatorial latitudes and the tropics) may experience destructive temperatures. Similarly, equipment left exposed in Polar Regions will suffer performance degradation and/or irreparable damage. 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 direct exposure and if possible stowed "indoors".

CAUTION.

Reparable 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.

3.2.1 Receipt

Unpack the system in a dry clean environment and check the contents and serial numbers against the delivery note. Should any discrepancy be noted, contact SAAB SEAEYE 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 handbook.

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

3.3 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. At the earliest opportunity after the installation checks, the Subsea AC and DC power supplies are to be checked for correct compensation (Chapter 7).

CAUTION.

Danger of damage to equipment. If installing in extreme heat conditions, remove the vent plug from the electronics pod to prevent excessive pressure build up.

The Tiger 880 System is pre-installed into the Control Cabin. However, if setting up in a new area, ensure that the surface equipment is set up in a dry and clean environment.

1. Position the Power Supply Unit, Surface Unit, equipment racks and monitor(s) on a stable, clean and dry platform.
2. Check all leads and cables for damage and bent pins.
3. Confirm the external electrical supply to be used with the system is disconnected and isolated.
4. Connect the following cables and leads to their respective units taking care not to damage their pins (Fig. 3.8):
   - Power Supply Unit, Surface Unit cables.
   - Keyboard.
   - HCU lead and Manipulator HCU lead.
   - Monitor power and video leads.
   - All other equipment cables.
5. Visually examine the vehicle to ensure all equipment is secure and undamaged.
6. Visually examine vehicle lamps and ensure lamp covers are undamaged.

3.3.1 9PSU-2 Three-Phase Transformer Installation

The 9PSU 3-Phase transformer is pre-installed into the 9PSU when the system is fitted into the Control Cabin. However, if moving the 9PSU to another location, the 3-Phase Transformer should be removed and fitted in accordance with the following procedures.

WARNING.

POSSIBLE DANGER OF INJURY AND DAMAGE TO EQUIPMENT. THE THREE-PHASE PSU WEIGHS APPROXIMATELY 78KG, AND CARE SHOULD THEREFORE BE TAKEN WHEN LIFTING IT.

1. Ensure the external supply is isolated.
2. Gain access to the inside of 9PSU.

3. Using a suitable lifting arrangement, carefully lift the three-phase transformer up and into the 9PSU and manoeuvre in position ensuring the transformer and PSU base securing holes are aligned.
4. Remove the PSU front panel access plate (Fig. 3.1) and secure the transformer to the PSU base using the bolts supplied with the spares kit.

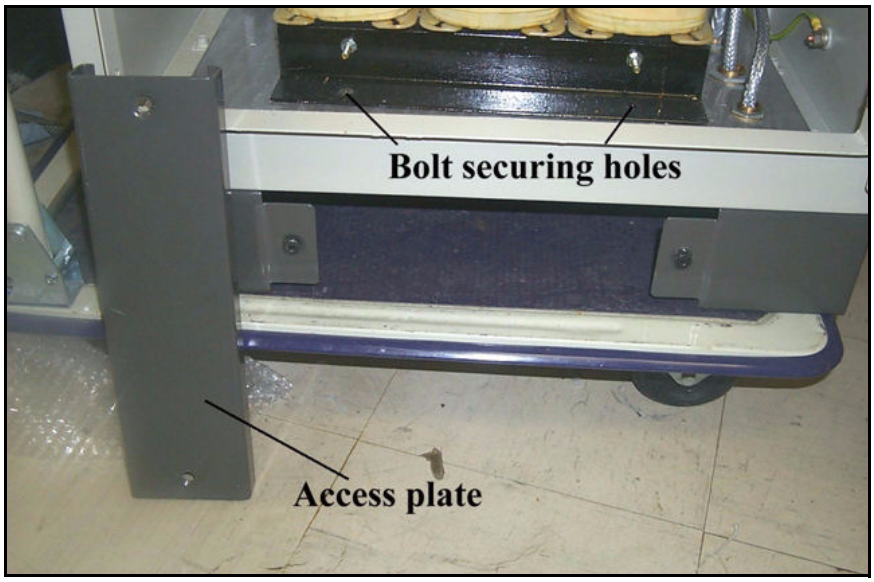

Figure. 3.1 9PSU Front Panel Access Plate

5. Carefully, route the transformer cables to the three-phase transformer terminal block and connect the wires (Fig. 3.2) in accordance with the drawing supplied in the pocket located inside the 9PSU.

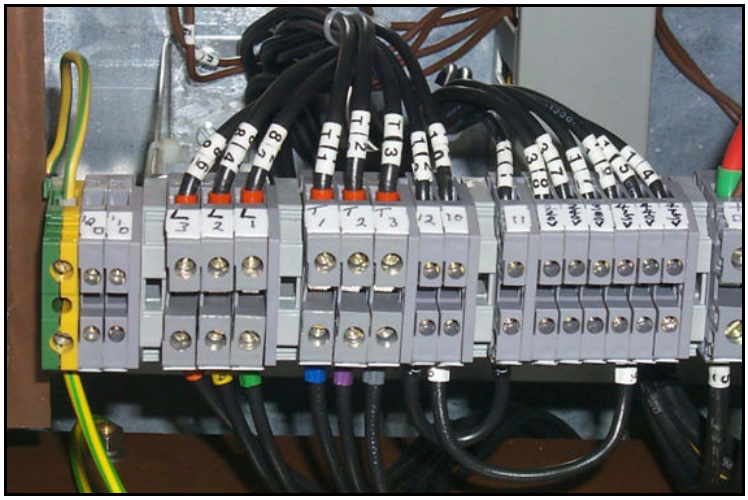

Figure. 3.2 9PSU Terminal Block

3.3.2 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 umbilical/tether has not been supplied or terminated by Saab Seaeye Limited, it is advised that the cables are checked for insulation and continuity against the drawings 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.

3.3.3 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 tappings are factory set to match a three-phase supply voltage of 410 VAC.

Gain access to the inside of the PSU and locate the three-phase and single-phase transformers.

Adjust the links if necessary of both transformer primary windings to correspond to the nearest voltage measured above.

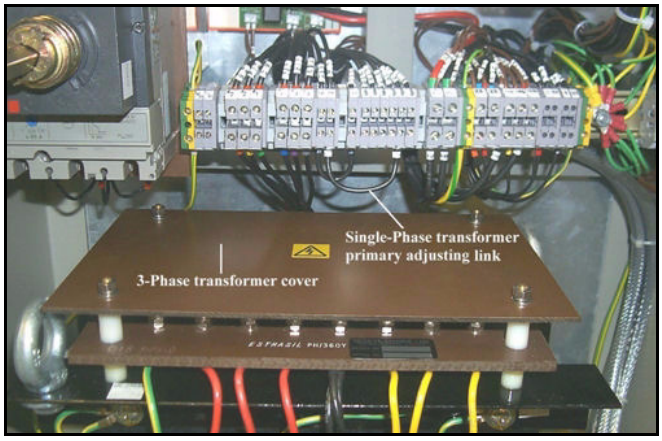

Figure. 3.3 Single-Phase Transformer Selector Link

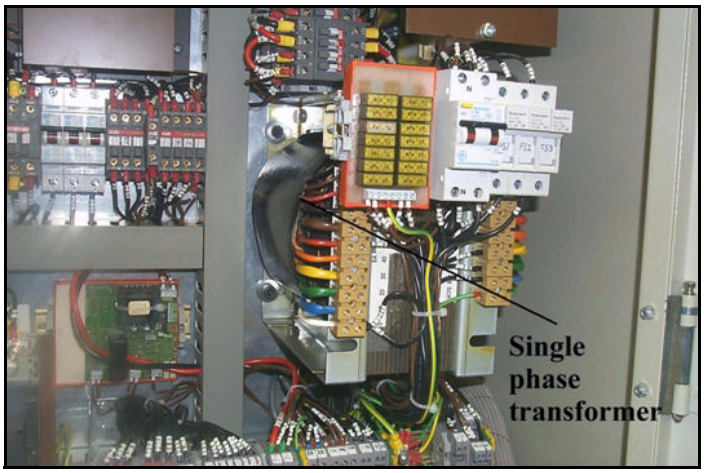

Figure. 3.4 Single-Phase Transformer

To adjust the primary links of the 3-Phase transformer, first remove four 10 mm nuts and remove the transformer cover (Fig. 3.5).

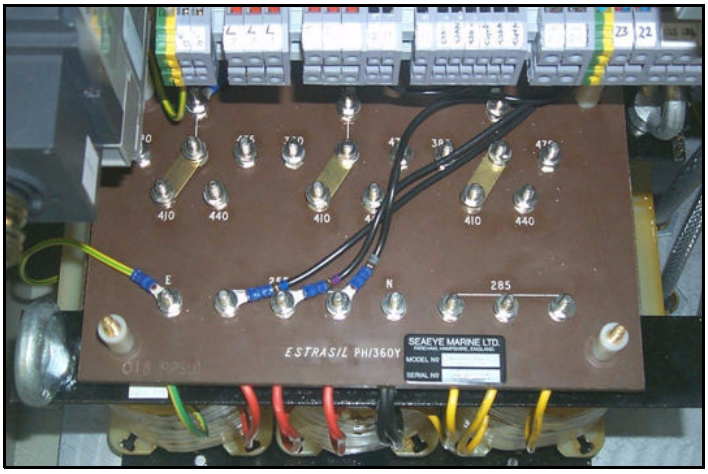

Figure. 3.5 Three-Phase Transformer Selector Links

Replace the transformer cover and secure with the four 10 mm nuts.

3.3.4 Tether Connection

To fit the umbilical or tether cable to the Tiger 880, ensure the Kellams grip is along the umbilical cable outside the vehicle by approximately five metres.

1. Start to feed the umbilical through the opening in the buoyancy foam at the top of the vehicle and carefully route the cable along the inside of the chassis starboard side, along the forward chassis edge and back along the port side and around the rear of the electronics pod. Continue to route the cable along the starboard side following the bight already routed, along the port side and up towards the foam opening.

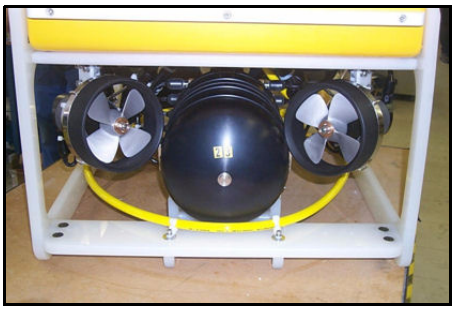

Figure. 3.6 Tether Routing

2. Ensure all the connectors are perfectly clean and dry and smear a light film of silicone grease to the umbilical/tether connector threadforms.
3. Electrically connect the umbilical/tether to the electronics pod.
4. Secure the umbilical/tether with cable ties ensuring that the thrusters, tilt platform and any other moving parts are not fouled.
5. Pre-stretch the Kellams grip over the umbilical/tether ensuring a little slack in the cable between the grip and the vehicle, such that the load is taken by the Kellams grip not the cable.
6. Secure the other end of the Kellams grip with a Tie-wrap to prevent it slipping along the umbilical cable.
7. Attach the Kellams grip to the vehicle lifting point using the shackle.
8. Secure the shackle pin eye to the shackle bracket with a tie wrap to prevent the pin from coming loose during operational use.

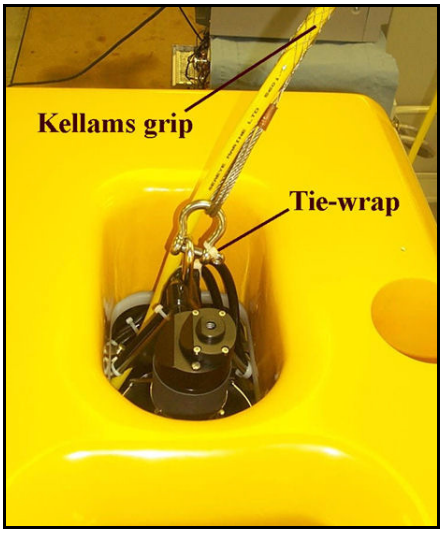

Figure. 3.7 Kellams Grip Fitment

9. Connect the PSU power in connector to the external AC power supply.

3.4 Installation Tests

3.4.1 Initial Preparation

Set the following unit switch and control settings:

HCU

- ☐ LIGHTS 1 and LIGHTS 2 controls — Fully anticlockwise
- ☐ VERTICAL SET control — Centre position
- ☐ F/R SET control — Centre position
- ☐ SPEED control — Centre position
- ☐ LAT SET control — Centre position
- ☐ LAT SPEED — Centre position
- ☐ TURN SET control — Centre position

☐	TURN RATE control	Centre position
☐	THRUSTER ENABLE switch	Set to OFF
☐	SONAR switch	Set to OFF
☐	CAM switch	Set to CAM 1
☐	TILT control	Centre position
☐	PAN control	Centre position
☐	Joystick	Operate in all axes and ensure joystick returns to the centre position on release

SU

☐	ROV MASTER DC switch	Set to OFF
☐	AC VEHICLE switch	Set to OFF
☐	AC SURFACE switch	Set to OFF
☐	AC TMS switch	Set to OFF
☐	VIDEO switch	Set to SURFACE
☐	BAILING DISABLE/ENABLE	Set to DISABLE

3.4.2 Powering Up

Connect and switch on the external power supply.

Set the following unit switch and control settings:

PSU

☐	Mains Isolator	Set to ON
☐	AC circuit breaker	Set to ON
☐	Key-operated switch	Set to ON
☐	START switch	Operate

SU

☐	AC SURFACE switch	Set to ON
☐	AC SURFACE indicator	Confirm illuminated

3.4.3 Installation System Tests

NOTE.

The system is supplied fully configured, however, if any equipment (PCBs, tilt motors etc.) has been changed from the factory-supplied condition it is necessary to carry out a full system configuration as detailed in Chapter 4.

Confirm the system monitor displays video overlay and prompts:

“DO YOU WISH TO CONFIGURE THE SYSTEM?”

☐	At the SU keypad	Respond NO
☐	HCU POWER indicator	Confirm illuminated

Remove the vehicle camera lens cap(s).

Set the following unit switch and control settings:

SU

☐	AC VEHICLE switch	Set to ON
☐	AC VEHICLE indicator	Confirm illuminated
☐	VIDEO switch	Set to SUBSEA

Confirm the system monitor displays images received from the camera with video overlay (OVERLAY socket) and without overlay (DIRECT VIDEO socket).

If additional cameras are fitted to the vehicle, operate the VIDEO 1/VIDEO 2 switch and confirm a video image from the camera is displayed on the monitor with video overlay.

Confirm all camera images can be displayed.

Set the following unit and control settings:

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

SU

☐	DC1 and DC2 switches	Set to ON
☐	ROV MASTER DC switch	Set to ON
☐	DC indicators	Confirm illuminated

HCU

☐	TILT control	Operate over full range and confirm vehicle camera platform rotates through its full range and its movement is unobstructed.

CAUTION.

POSSIBLE DAMAGE TO THRUSTER MOTOR. THRUSTERS MUST NOT BE OPERATED FOR LONGER THAN ONE MINUTE IN AIR OR MOTOR V-SEAL DAMAGE MAY OCCUR.

HCU

☐	THRUSTER ENABLE switch	Set to ON
☐	F/R SET, LATERAL SET	Adjust until horizontal and TURN SET controls thrusters are stationary
☐	VERTICAL SET control	Adjust until vertical thrusters are stationary

CAUTION.

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

☐	LIGHTS 1	Operate and confirm lamps illuminate

HCU

□ JOYSTICK	Operate in all axes and confirm thrusters respond to joystick demand
□ THRUSTER ENABLE switch	Set to OFF
□ JOYSTICK	Operate in all axes and confirm thrusters do not operate to joystick demand

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

NOTE.

When carrying out the compass swing check, the compass reading may be incorrect if the vehicle is surrounded by metal structures.

Slowly rotate the suspended vehicle and confirm that the compass rose responds to vehicle movement.

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

Set the following unit switch and control settings:

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.

HCU and SU Keypad

□ THRUSTER ENABLE switch	Set to ON
□ AUTO HEADING switch	Operate and confirm “A” is displayed in the compass data area as overlay on the system monitor.
□ Vehicle	Rotate the vehicle and ensure the thrusters oppose rotation.
□ AUTO HEADING switch	Operate and confirm the “A” is no longer displayed
□ AUTO DEPTH switch	Operate and confirm “A” is displayed in the depth data area as overlay on the system monitor. Operate the switch again and confirm the “A” is no longer displayed

Repeat the auto heading and depth test using the surface unit keypad.

Taking care to avoid contact with the thruster motors, jerk the suspended vehicle and confirm the gyro responds by operating the thrusters momentarily.

Set the following unit switch setting:

HCU

□ THRUSTER ENABLE switch	Set to OFF

Test all other fitted equipment, sonars, manipulators, cutting tools, etc., as detailed in the manufacturer's handbook.

3.4.4 Powering Down

Set the following unit switch and control settings:

SU

☐	MASTER DC switch	Set to OFF
☐	MASTER, VEHICLE and TMS DC indicators	Confirm extinguished
☐	VEHICLE DC switches	Set to OFF
☐	TMS DC switch	Ensure set to OFF
☐	AC VEHICLE switch	Set to OFF
☐	AC VEHICLE indicator	Confirm extinguished
☐	AC TMS switch	Ensure set to OFF
☐	AC TMS indicator	Confirm extinguished
☐	AC SURFACE switch	Set to OFF
☐	AC indicator	Confirm extinguished

PSU

☐	STOP switch	Operate
☐	Mains Isolator	Set to OFF

Switch off and isolate the external power supply.

Lower the vehicle and replace the vehicle lens cap(s).

3.5 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 Chapter 7 – Maintenance Tasks.

The following maintenance tasks may be required to be carried out depending on the equipment supplied:

- DC compensation (Chapter 7 Task 5).
- AC compensation (Chapter 7 Task 11).
- Video compensation (Chapter 7 Task 7).
- System Configuration (Chapter 4).

The DC and AC compensations should be carried out at the first available opportunity after the system operator is familiar with controlling the vehicle.

3.6 Ballast and Trim

CAUTIONS.

Possible damage to equipment. Ensure that all vent plugs are fitted securely and shut prior to immersing the vehicle in water.

Possible poor vehicle handling. Incorrect trim will cause poor vehicle 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 covers are 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 requirements.

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

3.7 First Dive

On completion of this chapter the vehicle is ready to swim. It is advised however, that the operator should familiarise himself with the rest of the manual, paying special attention to Chapter 4-Operational Use and carry out a full system configuration procedure. The operator should also be aware of the Pre and Post dive check lists detailed in Task 1 and 2, Chapter 7-Maintenance Tasks.

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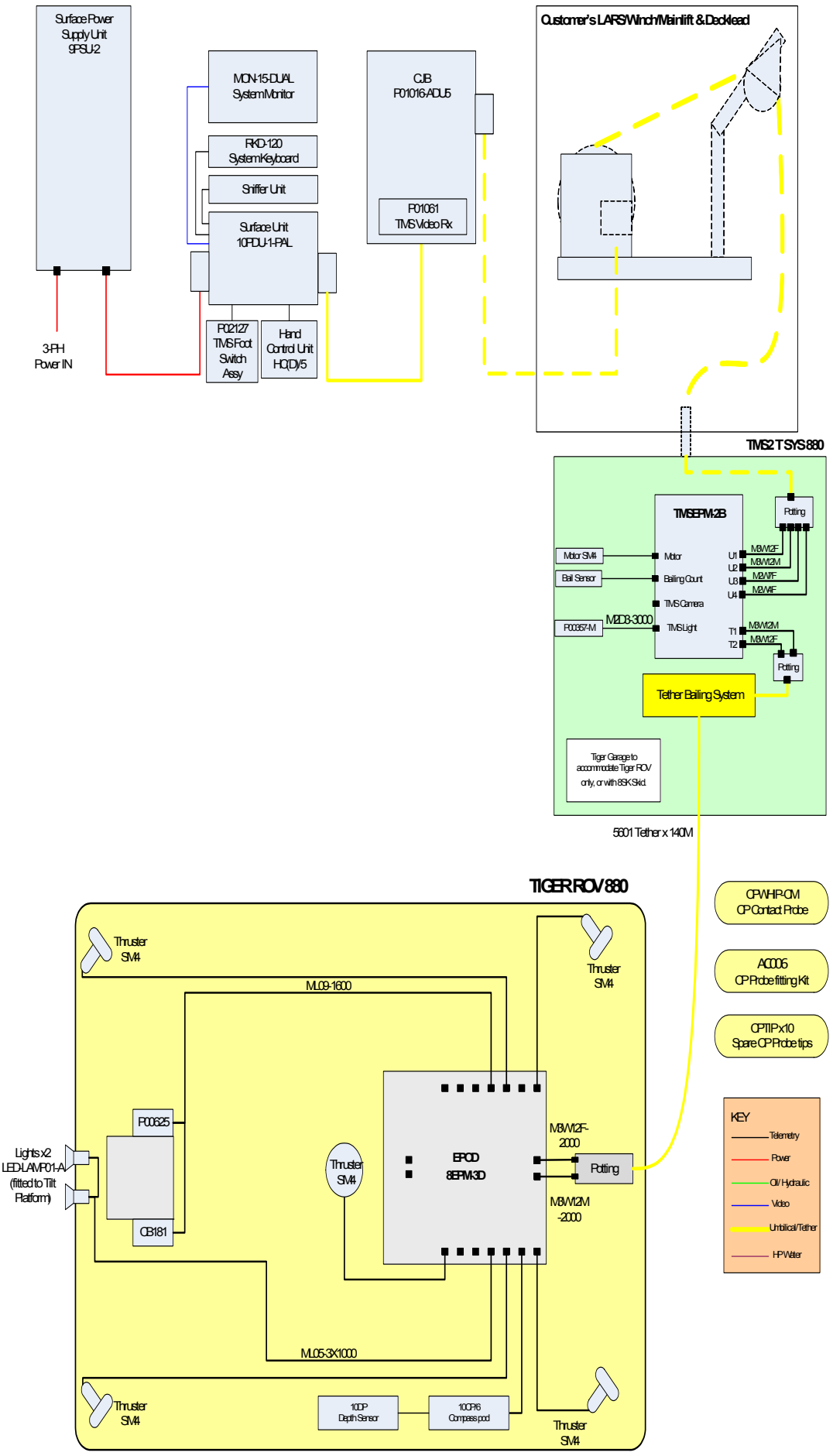

Figure. 3.8 Tiger 880 System Configuration

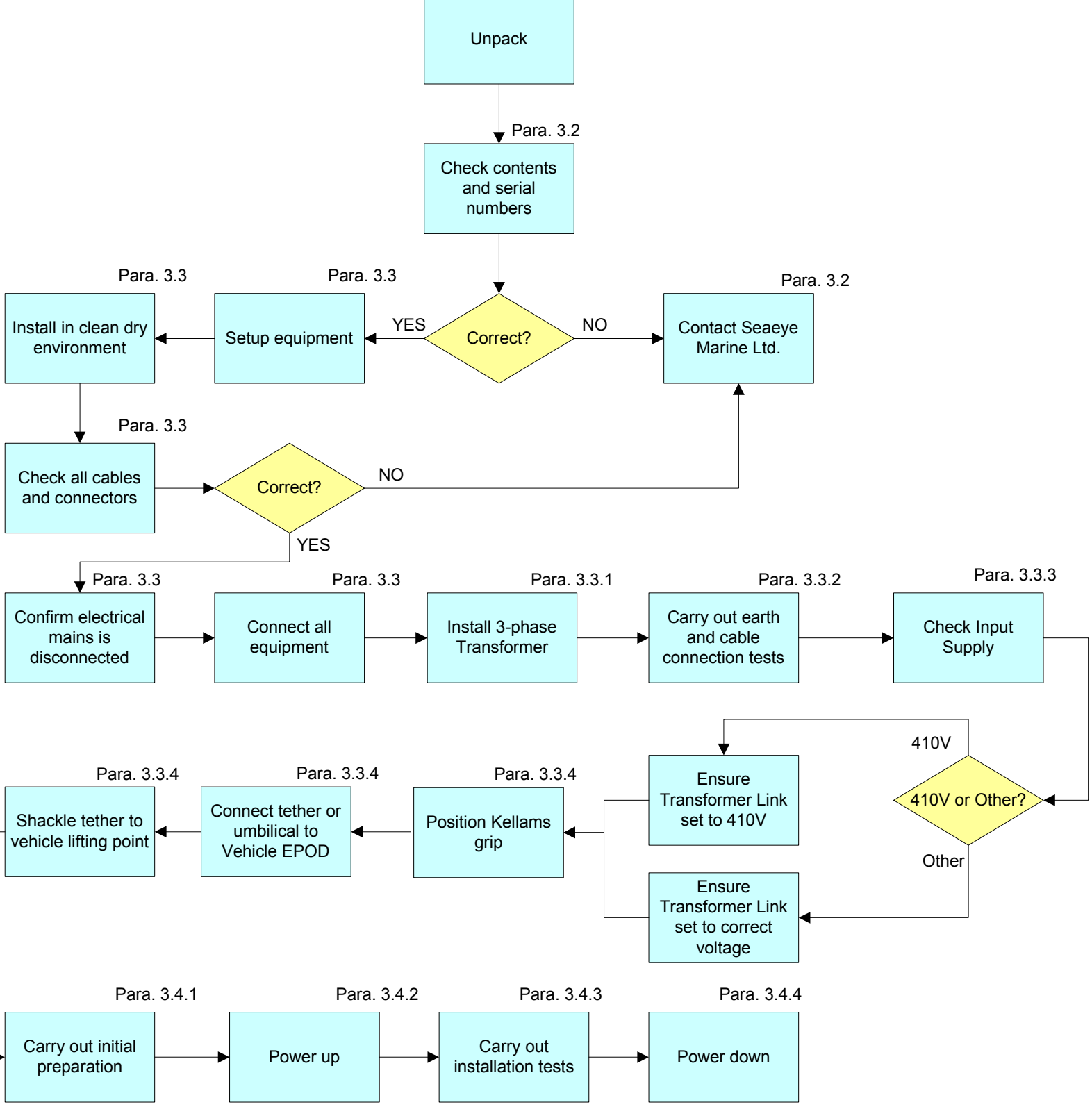

Figure. 3.9 Installation Process

CHAPTER 4

OPERATIONAL USE

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4. OPERATIONAL USE

This Chapter describes the various modes of operation, how they are accessed and how to move between them. The chapter further explains the overlay information on the display and how to enter the time and date and edit text on the various pages and explains the meaning of the various error messages that can be displayed.

4.1 Introduction

The modes of operation can be accessed by operation of the keys on the Surface Unit (SU) keypad (Fig. 4.1) and their explanation is given in Table 4.1.

Figure. 4.1 Surface Unit Front Panel Keypad

KEYPAD	
Key	Function
EDIT	Selects the system title page or free text page and permits editing of the data stored in those pages.
DISP	Displays the system title page or free text page.
ZERO DEPTH	When selected displays the Zero Depth prompt.
AUTO HEAD	Toggles the system autopilot auto-heading function on and off.
COL	Cycles through the available overlay graphic colours.
AUTO DEPTH	Toggles the system autopilot auto-depth function on and off.
<	Used in conjunction with the ENTER key to select characters when editing the Title page.
ENTER	Used in conjunction with the arrow keys when editing the Title page.
>	Used in conjunction with the ENTER key to select characters when editing the Title page.
DEL/NO	Deletes characters when in Text Edit Mode. Also used to respond NO to system prompts.
CP PROBE	Toggles the CP probe display on and off.
CR/YES	Carriage return key when in Text Edit Mode. Also used to respond YES to system prompts.

Table. 4.1 Surface Unit Keypad Functions

The system can be operated in one of the following four modes:

- Configuration Mode.
- Text Edit mode.
- Display Mode.
- Flying Mode.

To move between the modes the keypad keys are operated as shown in Fig. 4.2.

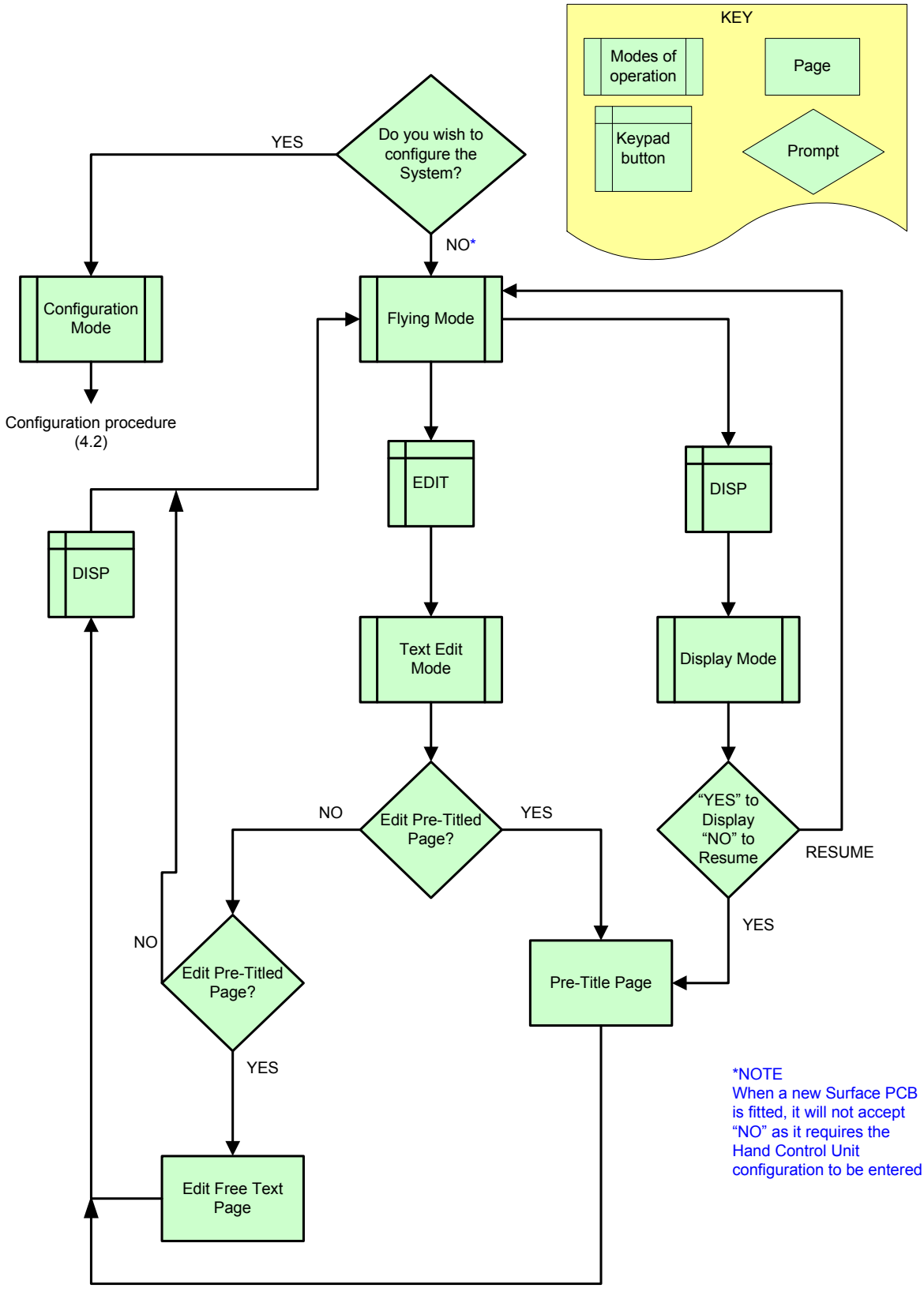

Figure. 4.2 Modes of Operation

NOTE.

The system must be previously configured before access is allowed into Text, Display and Flying Mode.

If a keyboard is installed, text can be written on the screen using the uppercase characters and ASCII symbols and the following keyboard functions are supported:

- Cursor control left/right/up/down using the keyboard arrow keys.
- The HOME key sends the cursor to the top left corner of the screen.
- DEL clears the character beneath the cursor.
- CTRL D enters Display Mode.
- CTRL E enters Text Edit Mode.
- CTRL C displays CP voltage.
- CTRL B changes overlay background colour.
- CTRL Z displays the ZERO DEPTH prompt.
- CTRL W wipes the screen.
- CTRL P displays/removes the Pan icon.

NOTE.

Prior to system switch on the keyboard must be plugged in.

4.2 System Configuration Mode

When system AC power is applied to the SU, the ROV system defaults to Configuration Mode. System Configuration Mode allows the system to set internal reference levels for maximum, mid-range and minimum control settings and to allow the operator to preselect certain features according to operator requirements. A full system configuration is required under the following circumstances:

- Post installation.
- HCU replacement.
- Change of CPU EPROMs.
- Change of PCBs.

CAUTION.

Possible danger to personnel or equipment. Do not apply DC power to the vehicle during system configuration.

With system AC power applied, the monitor displays images from the vehicle video camera and a configuration prompt as follows:

“DO YOU WISH TO CONFIGURE THE SYSTEM?”

Responses to the control system prompts are made using the SU front panel keypad (Fig. 4.2). If the system has previously been configured, responding NO to the prompt causes the system to enter Flying Mode. However, if the system has not been configured a NO response is not accepted until a YES response is made. Responding YES starts the configuration process and on completion configuration data is stored in non-volatile memory.

4.2.1 System Configuration Mode Procedure

For a full system configuration proceed as follows:

1. Ensure the external power supply is to ON.
2. Set the following unit switch and control settings:

PSU

- ☐ Set the PSU Mains Isolator to ON.
- ☐ Set the PSU AC circuit breaker to ON.

SU

- ☐ Set the SU AC SURFACE and AC VEHICLE switches to ON.

3. Confirm the Monitor displays:

“DO YOU WISH TO CONFIGURE THE SYSTEM?”

4. Operate the CR/YES key
5. Confirm the Monitor displays:

“DO YOU WISH TO CONFIGURE THE HAND CONTROLLER?”

6. Operate the CR/YES key.
7. Confirm the Monitor displays:

“SET CONTROLS TO DOWN/PORT/REVERSE/MINIMUM-PRESS A KEY.”

8. Set the following unit switch and control settings:

HCU

☐ LIGHTS 1 & 2 controls	Set fully anticlockwise
☐ VERTICAL SET control	Set fully anticlockwise
☐ F/R SET control	Set fully anticlockwise
☐ SPEED control	Set fully anticlockwise
☐ LAT SET control	Set fully anticlockwise
☐ LAT SPEED control	Set fully anticlockwise
☐ TURN SET control	Set fully anticlockwise
☐ TURN RATE control	Set fully anticlockwise
☐ THRUSTER ENABLE switch	Ensure set to OFF
☐ SONAR switch	Ensure set to OFF
☐ TILT control	Set to full down position.
☐ PAN control	Set to full port position (L)

NOTE.

Vehicle will not respond to control.

☐ Joystick	Operate to bottom left-hand corner of its travel and hold. Rotate anticlockwise and hold.

9. Operate any key.
10. Confirm the Monitor displays:

“SET CONTROLS TO UP/STARBOARD/FORWARD/MAXIMUM-PRESS A KEY.”

11. Set the following unit switch and control settings:

HCU

☐ LIGHTS 1 & 2 controls	Set fully clockwise
☐ VERTICAL SET control	Set fully clockwise
☐ F/R SET control	Set fully clockwise
☐ SPEED control	Set fully clockwise
☐ LAT SET control	Set fully clockwise
☐ LAT SPEED control	Set fully clockwise
☐ TURN SET control	Set fully clockwise
☐ TURN RATE control	Set fully clockwise
☐ TILT control	Set to full up position.
☐ PAN control	Set fully starboard position (R)

NOTE.

Vehicle will not respond to control.

☐ Joystick	Operate to top right-hand corner of its travel and hold. Rotate clockwise and hold.

12. Operate any key.
13. Confirm the Monitor displays:

“SET CONTROLS TO CENTRE POSITION - PRESS A KEY.”

14. Set the following unit switch and control settings:

HCU

☐ LIGHTS 1 & 2 controls	Set to central position
☐ VERTICAL SET control	Set to central position
☐ F/R SET control	Set to central position
☐ SPEED control	Set to central position
☐ LAT SET control	Set to central position
☐ LAT SPEED control	Set to central position
☐ TURN SET control	Set to central position
☐ TURN RATE control	Set to central position
☐ TILT control	Set to central position.

NOTE.

Vehicle tilt table will not respond to control.

☐ Joystick	Release and confirm returns to its central position.

15. Operate any key.

NOTE.

The HCU is now configured.

16. Confirm the Monitor displays:

“DO YOU WISH TO CONFIGURE TILT CONTROL?”

17. Operate SU keypad CR/YES key.
18. Confirm the Monitor displays:

“MOVE TILT MECHANISM TO UPPER POSITION – PRESS A KEY.”

19. Operate the HCU TILT rotary control until the vehicle tilt platform reaches the required upper position ensuring during movement the platform has sufficient clearance and is not fouled.
20. Operate any key.
21. Confirm the Monitor displays:

“MOVE TILT MECHANISM TO LOWER POSITION - PRESS A KEY.”

22. Operate the HCU TILT rotary control until the vehicle tilt platform reaches the required lower position ensuring during movement the platform has sufficient clearance and is not fouled.
23. Operate any key.
24. Confirm the Monitor displays:

“MOVE TILT MECHANISM TO CENTRE POSITION - PRESS A KEY.”

25. Operate the HCU TILT rotary control until the vehicle tilt platform reaches its central position.
26. Operate any key.

NOTE.

The tilt platform end-stops and central position are now configured.

27. Confirm the Monitor displays:

“DO YOU WISH TO CONFIGURE THE PAN CONTROL?”

28. Operate SU keypad DEL/NO key.
29. Confirm the Monitor displays:

“DO YOU WISH PAN ICON TO BE DIPLAYED?”

30. Operate SU keypad DEL/NO key.
31. Confirm the Monitor displays:

“DO YOU WISH TO INITIALISE THE COMPASS?”

32. Operate the SU keypad DEL/NO key (Refer to Chapter 7 Task 8 for the compass initialisation procedure).
33. Confirm the Monitor displays:

“DO YOU WISH THE DEPTH DISPLAYED IN METRES? – PRESS YES OR NO.”

34. Operate the SU keypad as required:

□ DEL/NO key	Operate if depth in feet required
□ CR/YES key	Operate if depth in metres required

35. Confirm the Monitor displays:

"DEPTH RATING: ENTER=1000/1250m, YES=600m, NO=300m, ADEPTH=AUTO."

36. Operate the SU AUTO DEPTH key.

37. Confirm the Monitor displays:

"CP TYPE: – YES=CONTACT, NO=PROXIMITY."

38. Operate the SU DEL/NO or CR/YES key according to the type of probe fitted.

39. Confirm the Monitor displays:

"DO YOU WISH TO CONFIGURE THE SYSTEM?"

40. Operate the SU keypad DEL/NO key.

NOTE.

The system is now configured for operational use.

41. Confirm the system monitor displays camera images and flying mode and overlay data is updated.

NOTE.

At switch on the system may return the following error message:

"ERROR READING CONTROL SYSTEM BATTERY BACKED RAM – POWER DOWN."

This indicates that the configuration parameters will not be properly stored and the procedure should be repeated after cycling the system AC power.

END OF SYSTEM CONFIGURATION PROCEDURE.

Once the system has been configured the operator is able to respond NO to the initial configuration prompt allowing the system to enter Flying Mode.

4.3 Text Edit Mode

Text Edit Mode is accessed from Flying Mode by operating the EDIT key on the SU front panel keypad (Fig. 4.1). This mode consists of two user editable text pages, which can be selected by responding to system generated prompts on the system monitor. The two pages are as follows:

4.3.1 Pre-Titled Page

The Title Page is in white text on a black background. The Pre-titled Page comprises fixed text and user-editable data fields. The following fixed text is displayed:

- Company.
- Location.
- Dive Number.
- Objective.
- Operator.
- Date and Time.

This mode allows the operator to input characters adjacent to the fixed text. Characters available are displayed on the top line of the system monitor as a text banner. The banner cursor (symbol circumflex, ^) selects the required character by moving the cursor horizontally, by operating the SU keypad arrow keys or keyboard if fitted.

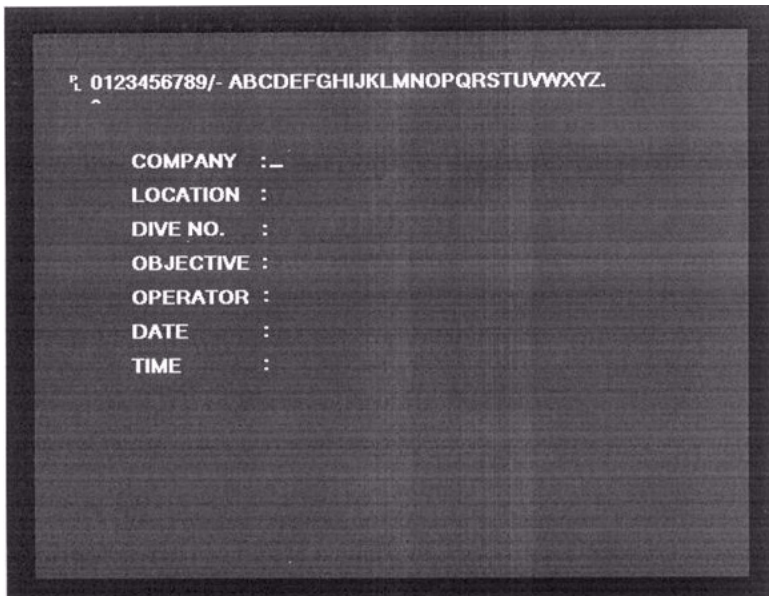

Figure. 4.3 Pre Titled Page

A second cursor (symbol underscore, _) is the user editable field cursor and is displayed at the first character of the first editable data field.

Operating the SU keypad ENTER key causes the chosen banner character to be written into the data field, indicated by the field cursor in the data field. Once the character is written, the cursor position is automatically incremented.

Operating the CR/YES key causes the field cursor to move to the next editable field and operating the DEL/NO key moves the cursor back a space deleting the character.

To move the field cursor to a previous line, the cursor is moved to the left most position and the ENTER key operated.

Date and Time are in European format and are edited as follows:

- **Date**. (Displayed top left corner of the flying screen). When the field cursor initially enters the Date field, it automatically positions below the Day component of the field and can be changed by operating the keypad < and > keys. Once the correct day is displayed, operating the ENTER key the field cursor advances to the MONTH component of the data field and again can be changed by operating the < and > keys. The YEAR is similarly edited. If the date entered is invalid, an "INVALID DATE" prompt is displayed and the operator is required to repeat the date entry procedure.
- **Time (**Displayed top right corner of the flying screen). Once the date has been correctly entered, the field cursor advances to the Time field. The time is entered in a similarly manner as the Date is entered. The seconds cannot be edited and will reset to zero when the Time field is correctly set.

When all the fields have been edited the data is stored for subsequent recall in display mode. Data input to the Date and Time fields are used to reset the system clock. Operating the DISP key at any time reverts to Flying Mode. Only when the Time field is completed are the fields stored for recall. Termination of the Edit Mode using the DISP key reverts to the previous contents and the Time and Date are not updated.

4.3.2 Free Text Page

The Free Text Page is initially blank and is used for storing notes relating to the system or current dive, and may be recalled in flight on the system monitor using Display Mode. The page can be edited using an external keyboard.

On exiting Free Text Page the text is stored into the non-volatile RAM for subsequent recall in flight using Display Mode. Operating the DISP key at any time causes the system to revert to Flying Mode.

4.4 Flying Mode

This is the system default mode and used for the operational flight of the vehicle. Flying Mode is automatically entered when responding NO to the prompt “DO YOU WISH TO CONFIGURE THE SYSTEM?” on initial power up.

In Flying Mode, the monitor displays video images derived from the vehicles camera together with overlay data. The overlay system status information is as follows:

- Numerical display of compass reading in degrees.
- Numerical display of vehicle depth in metres or feet.
- Numerical display of vehicle altitude in metres or feet.
- Analogue compass rose display of heading information.
- Tilt platform information.
- Compass status byte.
- CP probe voltage reading (if fitted).
- Date and Time.
- Selection of Auto-heading lock.
- Selection of Auto-depth/altitude lock.
- Umbilical turns counter.
- TMS tether bailing arm revolutions (if fitted).
- Text can be typed onto the screen during Flying mode for recording purposes and erased by the CTRL W clear screen keys.

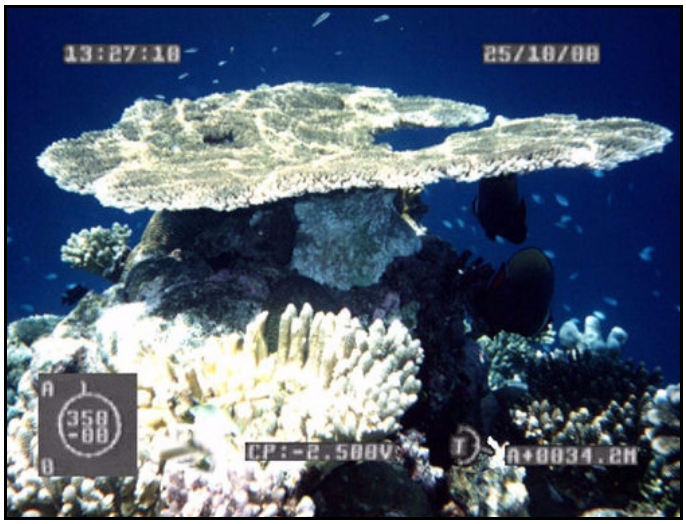

Figure. 4.4 Flying Mode Display

The system overlay colour may be changed according to operator preference by repeatedly pressing the SU front pad COL key. The colours available are:

- White on black (default).
- White on video.
- Black on video.
- No overlay displayed.

4.4.1 Compass Information

The compass block at the bottom left hand corner of the screen consists of the following data:

- Status Byte. In normal operation the compass status byte is not displayed. In certain circumstances the following characters may be displayed:
  - I - Initiation program ready – displayed during compass calibration.
  - R - Initiation program running – displayed during compass calibration.
  - 0 - Compass un-calibrated.
  - 1 - Not at West of North at calibration start.
  - 2 - Magnetic field too strong.
  - 3 - Magnetic field too weak.
  - 4 - Deviation correction too great.
- The analogue compass rose is displayed within the compass block and comprises an outer circle, with north situated at 12 o'clock position and a marker which is driven around the perimeter of the rose to represent vehicle heading.
- The following text is displayed within the compass block:
  - When Auto Head is selected to ON an "A" appears at the top left corner of the compass block.
  - Within the analogue compass rose is a three digit number representing heading and below a two digit number prefixed by either a "+" or a "-" indicating complete compass revolutions (umbilical turns). A positive sign (+) indicates North to East rotation and a negative sign (-) indicates North to West rotation. This indication assists the operator with preventing twisting of the umbilical.

The compass requires calibrating when additional metal equipment has been fitted to the vehicle, compass replacement or loss of compass calibration (indicated by an "O" on the overlay). A full compass calibration procedure is detailed in Chapter 7 Task 8.

Operating the AUTO HEAD key toggles the auto heading function and an "A" indicator is displayed in the compass block.

4.4.2 Depth Information

It is recommended before every dive a SET ZERO DEPTH is carried out.

Vehicle depth can be displayed in either feet (F) or metres (M). The letter "A" indicates that Auto depth is selected to ON. Depth may be displayed as a measurement relative to sea surface (e.g. – 55 M) or to a ZERO DEPTH reference point. When in ZERO DEPTH mode the depth readout is prefixed by a "+" sign when ascending above the reference point and a "-" sign when descending below the zero depth reference point. Operation of the ZERO DEPTH key displays the following prompt:

"YES SETS ZERO DEPTH, NO RESUMES PRESS ENTER TO SET DEFAULT."

Responding YES causes the current vehicle depth to be set as the reference point.

Responding NO to the prompt erases the screen and the depth display mode remains unchanged.

Operating the HCU AUTO DEPTH key toggles the Auto Depth function and an "A" indicator is displayed in the depth block.

4.4.3 Camera Tilt Platform Position Indication

The camera tilt platform position is represented by a tilt icon, which indicates the position of the platform in the vertical plane.

4.4.4 CP Information

The optional CP probe can be used by operating the SU CP PROBE key that causes the cathodic potential detected by the probe to be displayed at the centre of the screen. The CP probe key has a toggle action, a subsequent operation of this key deselects the CP probe and the CP display is erased from the screen. The CP is in numeric form to three decimal places.

4.4.5 Display Mode

When in Flying Mode, operating the SU keypad DISP key (Fig. 4.1) causes the system to enter Display Mode. The page is displayed as white text on a black background and displays fixed text and editable text entered by the operator.

4.5 Error Messages

Error messages will be displayed if the following communications have failed:

- An error message **"SURFACE-SUBSEA DATA COMMUNICATION LOST"** indicates that communications have failed between the surface and the vehicle.
- An error message "**VIDEO DATA LINK LOST**" indicates that communications have failed between the surface control system and the video system.

4.6 Warning Messages

Warning messages may be displayed as detected by the Leak/Vac modules located in the Port and starboard vehicle pods. The sensors monitor the pods for both vacuum and watertight integrity. The warning messages are as follows:

- A warning message "**VEHICLE WATER ALARM**" indicates that the EPOD is taking in water.

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CHAPTER 5

SYSTEM FUNCTIONAL DESCRIPTION

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5. SYSTEM FUNCTIONAL DESCRIPTIONS

This chapter, with the aid of block diagrams, describes the various functions of the Tiger 880 system.

5.1 Introduction

The descriptions are divided into the following circuits:

- Power Distribution – AC and DC power supplies.
- Control systems – telemetry control of sub-sea units.
- Video system – video image functionality.

5.2 Power Distribution

5.2.1 AC Power System

Refer to Fig. 5.1. AC power is derived from the vessel main supply that is connected to the 9PSU-2. When the 9PSU-2 Main Isolator and AC CIRCUIT breakers are switched on, the 3-phase input to the 9PSU-2 is routed to a single-phase transformer, stepped down and split to provide three outputs.

- The first output, SURFACE AC is routed to the 10PDU-1 via a circuit breaker, relays and filter when the remote switch (located on the Surface Unit), AC SURFACE, is set to ON. This causes the SURFACE AC LED to illuminate indicating that the supply is available at the 10PDU-1. The SURFACE AC is split two ways, the first is routed to supply the three PSUs for the surface electronics (Video, TMS Electronics and ROV Electronics), the second supply is routed to the AC vehicle and AC TMS switching circuits to provide the control for the SUBSEA switching contactors.
- The second output (SUBSEA AC) from the single-phase transformer is routed to the 10PDU-1 when the START push button is operated to provide the subsea supplies. The supply is fed via a circuit breaker, relays and filter to the subsea switching contacts to route through 240 VAC for the vehicle and 240 VAC for the TMS. The vehicle AC is only routed through when the AC VEHICLE switch is set to ON, indicated by the illumination of the respective indicator. The TMS AC is only routed through when the AC TMS switch is set to ON, indicated by the illumination of the respective indicator.
- The third output of the single-phase transformer provides 110 VAC for the 9PSU-2 contactor and control circuits.

Vehicle AC is routed to the ROV via the winch, main lift cable, TMS and tether. TMS AC is routed to the TMS via the winch and main lift cable. The ROV AC supply is routed to the vehicle EPOD and fed to the transformer TF1. This provides 25 VAC outputs which are routed to the Power Supply PCB (6051AP) which supply 24 VDC to the internal PCBs, auxiliary bulkhead connectors and cameras.

5.2.2 Tooling Power Supplies

The Tiger System has the options for 440 VAC 3 phase or 250 VDC tooling supplies. The 3 phase PSU is routed via the cabin junction box A2,A3,A4 through the slipring assembly to the tether management system U4-1,U4-2,U4-3 with control from the 3-Phase Remote Control Switch #1 on the surface control unit. Output is via the 5601 umbilical U3. Telemetry is on the manipulator EPOD bulkhead connector Pins 4&5. The 250 VDC supply is routed directly from the EPOD Bulkhead U1 Manipulator connection with Pins 2 & 3 being DC- and DC+ and telemetry A and Bon pins 4&5.

5.2.3 DC Power System

Refer to Fig. 5.2. When the 9PSU-2 Main Isolator is switched on and the START button operated, the three-phase input is routed to the 3-Phase transformer via the MCCB to initialise the DC circuits. The AC is rectified by the Thyristor Rectifier to provide 250 VDC, which is applied to the DC relay and control circuits. The DC is only routed through to the 10PDU-1 when the 10PDU-1 remote switches, AC SURFACE and DC MASTER are operated.

The DC remote switching circuit produces vehicle DC1 and DC2, and TMS DC which are derived from the 250 VDC supply. Depending on the front panel DC switch positions, the relevant DC enable control signal energises its associated relay and applies DC to the SUBSEA units. The required DC1, DC2 and TMS switches must be pre-selected prior to switching on the DC MASTER switch, which once operated provides a hold on circuit to prevent further DC switching. Each DC supply has an indicator, which illuminates red when that supply is available for use.

The vehicle DC supplies the following:

- Starboard aft thruster (via the PCB 6056P).
- Port aft thruster (via the PCB 6056P).
- Starboard forward thruster (via the PCB 6056P).
- Port forward thruster (via the PCB 6056P).
- Vertical thruster (via the PCB 6056P).
- Vehicle Lights (via PCB 6050P).
- Manipulator bulkhead connector.

DC1 and DC2 are fed as DC+ and DC- via the umbilical on a number of conductors to the vehicle EPOD and routed to the Fuse and Filter PCB (6056P) and the Light FET Suppressor PCB (6050P).

For details of the TMS DC refer to the TMS technical manual.

5.2.4 Line Insulation Monitors

5.2.5 The Isolated Power Supplies, and Line Insulation Monitoring on Seaeye ROV systems.

All Seaeye ROV systems utilise isolated power supplies which may be AC, DC or both. A Power Distribution Unit (PDU) will provide these isolated power supplies; this may be an integral part of the surface equipment, or a separate unit. The isolated power is then distributed via the umbilical (or main-lift and tether) to the ROV, TMS and any additional tooling etc.

Providing an isolated supply removes the supplies' relationship to earth (vessel, structures, etc), and greatly reduces the risk of electrical shock. This method provides a safe system under normal conditions, as with a single fault no current will flow to earth.

If the supply becomes connected to earth, either directly or indirectly through a resistive path due to a fault or failure within the system, then the system becomes potentially unsafe if a second fault is introduced. Seaeye systems use Line Insulation Monitoring (LIM) devices to continuously monitor the resistance between the power conductors and earth, giving warning of potential faults. LIMs on Seaeye ROV systems typically provide both Off-line and On-line monitoring; this means that the systems continuously monitor the insulation resistance regardless of the ROV power being on or off. The LIM will disable the supply when the line insulation resistance falls below a set alarm level. This disable function may be directly operated from the LIM contacts or through the system's control software.

The use of ungrounded isolated power supplies and a LIM is in accordance with recommendations for acceptable practice in the IMCA Code of Practice for the Safe Use of Electricity Under Water AODC 035 (September 1985).

DANGER TO PERSONNEL AND EQUIPMENT. IT IS IMPORTANT TO NOTE THAT LIM'S DO NOT FUNCTION AS PERSONAL SAFETY PROTECTION DEVICES. A LIM MONITORS THE STATUS OF THE SYSTEM AND WARNS OF A POTENTIAL FAULT, THE LIM CAN CUT SUPPLY FEED TO HELP PROTECT PERSONAL AND EQUIPMENT, BUT THE REACTION TIME OF THE LIM IS GENERALLY TOO SLOW TO PREVENT ELECTRICAL SHOCK.

NOTE.The LIM does NOT negate the requirement to check the condition of all equipment before use and the carrying out of regular maintenance to ensure safe operation of the system.

Definition:

Line Insulation Monitoring (LIM) - also known as Ground Fault Monitor or Insulation Resistance Monitor. These devices monitor the condition of a system's power to earth insulation. The output may be in the form of a meter reading, an alarm, contactors or any combination of these. AC and DC Line Insulation Monitors (LIM) monitor the AC and DC power supply lines. If the insulation resistance of a power line to earth falls below the threshold set on the LIM, the supply is automatically cut off and either or both the AC and DC O/P Earth Fail lamps illuminate. If an insulation problem is detected by the AC LIM, an internal relay trips disabling BOTH AC and DC circuits. A fault detected on the DC power lines will ONLY disable the DC circuits.

5.3 Control Functions

Refer to Fig. 5.3. The ROV system uses a half duplex RS485 communication link. All control data is transmitted between the surface and subsea CPU PCB's over screen twisted pairs. Control data is transmitted by the surface CPU every 80 mS. The subsea CPU only transmits data on reception of a valid data string from the surface. Subsea data is monitored by the overlay PCB as it is retransmitted within the surface data string to the subsea CPU.

The two CPU PCB's, the surface CPU located in the surface unit and the subsea CPU located in the vehicle EPOD, control all functions. Data is multiplexed and transmitted and received by both CPU's via the RS485 telemetry link. The ROV system can be divided into the following control functions:

Vehicle telemetry, via telemetry A & B (U2 connector pins 7 & 8), interfaces to the following units:

- Vehicle Lights control.
- Thruster control.
- Vehicle Tilt control.
- Solid State Rate sensor (SSRS).
- Compass.
- Depth.
- Leak detection.
- CP type control.
- Camera selection control.

5.3.1 Lights Control

When the LIGHTS 1 potentiometer is rotated on the HCU, a voltage is produced proportional to the amount of rotation. The voltage is converted into a digital format by the 8-bit I/O PCB (6040P), processed by the 10PDU-1 CPU (6047P) and passed via the umbilical RS485 telemetry link to the vehicle CPU (6047P), which processes the data and passes it to the MFIO PCB (6059P). The MFIO converts the digital data into a pulse width modulated signal, which controls the 250 VDC supply to the vehicle lights via a FET and Light Suppressor PCB (6050P) to control the vehicle lighting intensity.

5.3.2 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 controls or 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 10PDU-1 Digital I/O PCB (6041P), processed by the CPU and transmitted over the RS485 telemetry link to the sub-sea CPU.

Two PCBs, 12-bit Analogue PCB (6081P) and 8-bit Analogue PCB (6040P) interface the joystick and trim controls.

The 12-bit Analogue PCB (6081P) interfaces the following controls:

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

The 8-bit Analogue PCB (6040P) interfaces the following controls:

- Turn set.

- Rate of turn.
- F/R set.
- Speed.
- Lateral set.

The rotation of the HCU potentiometers produce a voltage proportional to the amount of control required which is converted into a digital format by the 8-bit Analogue PCB and 12-bit Analogue PCBs, processed by the 10PDU-1 CPU (6047P) and sent as a digital signal via the RS485 telemetry link to the vehicle CPU (6047P). The digital data containing the speed and direction signals are passed to the Thruster Control PCBs (6034P). The speed signal is converted into a TTL pulse width modulated signal and applied to the required thruster to control its speed. The thrusters are controlled by a direction DC voltage signal, whose polarity dictates thruster shaft direction.

5.3.3 Vehicle Tilt Control

Rotation 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 8-bit Analogue PCB and processed by the 10PDU-1 CPU (6047P) and sent as a digital signal via the RS485 communicating link to the vehicle CPU (6047P) and then to the MFIO PCB (6059P). The data, proportional to tilt angle, is converted by the MFIO PCB into an analogue voltage and output to the Tilt motor assembly that turns the unit in the required direction. Mechanically connected to the tilt platform is a feedback unit that generates a feedback signal proportional to the angle amount of the tilt platform. The feedback signal is routed to the MFIO PCB to be compared with the required tilt angle. When the feedback voltage and demand angle voltages are equal (0 error difference), the Tilt is at is at the required tilt angle and stops. The feedback signal is also transmitted to the surface for display on the overlay.

However, when the required tilt angle is small, the demand signal is pulse width modulated (PWM) by the MFIO PCB (6059P), its duty cycle proportional to the difference between the demanded angle and the actual Tilt platform tilt angle. The PWM signal is routed through a Tilt Integration PCB (6058P) to reduce the noise generated by the PWM signal to the tilt motor.

5.3.4 Solid State Rate Sensor

The Solid State Rate Sensor (SSRS) located on the vehicle EPOD PSU (6051AP) provides azimuth stability by sensing the rate of change of the heading. This rate of change is input to the MFIO PCB (6059P) and subsequently read into the Sub-sea CPU (6047P). The SSRS data is used by the software to modify the demand to the horizontal thrusters.

5.3.5 Compass

The compass is located on the chassis. Heading data is passed from the compass (10CP/6) to the CPU (6047P) via the MFIO PCB (6059P) for transmission to the surface. The compass data is also used by the sub-sea CPU (6047P) for Auto Heading control.

When a compass calibration is initiated from the system configuration “YES” prompt a calibration request is transmitted via the surface CPU (6047P) and the RS485 telemetry link to the Sub-sea CPU (6047P). The data is input to the MFIO PCB (6059P) and output to the compass.

5.3.6 Depth Sensor

The depth sensor located on the vehicle chassis produces a RS232 digital signal, which is passed to the compass (COMPASS 4) and combined with the compass data for transmission to the surface CPU (6047P).

When Auto Depth is selected, depth sensor data is compared with the required depth by the sub-sea CPU (6047P) software to produce a signal for use by the Thruster Control PCBs (6034P). The PCB produces direction and speed signals to operate the vertical thrusters to keep the vehicle at the required depth.

5.3.7 Altimeter

The Altimeter, if fitted, is located on the vehicle chassis and sends its telemetry back to the surface via the CPU(6047) using RS485 and is powered by the same 24V supply as the depth sensor and protected by 250mA fuses F11 and F12.

5.3.8 Leak Detection

A water probe is connected to a Leak Detection PCB (6068P) in the electronics pod. If water is detected, or if the probe becomes disconnected, a leak signal is transmitted to the surface CPU. A warning code is then transmitted to the Video Overlay PCB, which displays the relevant message on the system monitor.

5.3.9 CP Probe

Two types of cathodic potential probes can be fitted, a proximity or contact and are described in the following paragraphs. CP type is selected during System configuration (Book 1, Chapter 4).

When a contact CP probe is fitted, a voltage generated by the probe (–2.5 to +2.5 VDC) is routed from the CP bulkhead connector pin 2 to the MFIO PCB (6059P) J2-1 B where the voltage is converted into a digital format and output to the system data bus when polled by the CPU. The probe 0 VDC reference is connected at the CP bulkhead connector pin 1 and is routed to the MFIO PCB J2-1 A via the CP Relay PCB (6082P). Relay operation is controlled by software during system configuration.

With a proximity probe fitted, only one signal line is connected from the probe to the MFIO PCB, the voltage range generated by the probe is the same as the contact probe. In this case, the 0 VDC reference is obtained by using a dedicated twisted pair in the umbilical via the CP switch. The CP voltage is processed in the same manner as a contact probe.

5.4 Video

5.4.1 Vehicle Video Path

Composite video from the camera CAM1(V1) and CAM2(V2) are routed through the MFIO card and on to the Balanced Line Video Driver PCB1, which converts the video into balanced video for transmission to the Surface Unit 10PDU-1 via VIDEO1.

Composite video from the camera CAM3 is routed directly to the Balanced Line Video Driver PCB2, which converts the video into balanced video for transmission to the Surface Unit 10PDU-1 via VIDEO2.

Depending on the VIDEO1/VIDEO2 switch position on the Surface Unit, one path is routed directly to a monitor via an isolation transformer, and the other to the Video Overlay PCB to be genlocked with overlay data.

5.4.2 Video Overlay

System data is extracted from the telemetry twisted pair and processed by the SBC68 Video CPU and input to the Video Overlay PCB for generation of the system data for subsequent display on the monitor. Keyboard data is also processed by the Video CPU.

The following data is processed and converted into displayed overlaid data:

- Digital compass readings in degrees.
- Digital vehicle depth in either metres or feet.
- Analogue compass rose of vehicle heading.
- Tilt.
- Auto heading and depth lock.
- Vehicle turns counter.
- Page annotation.
- Keypad and keyboard input data.

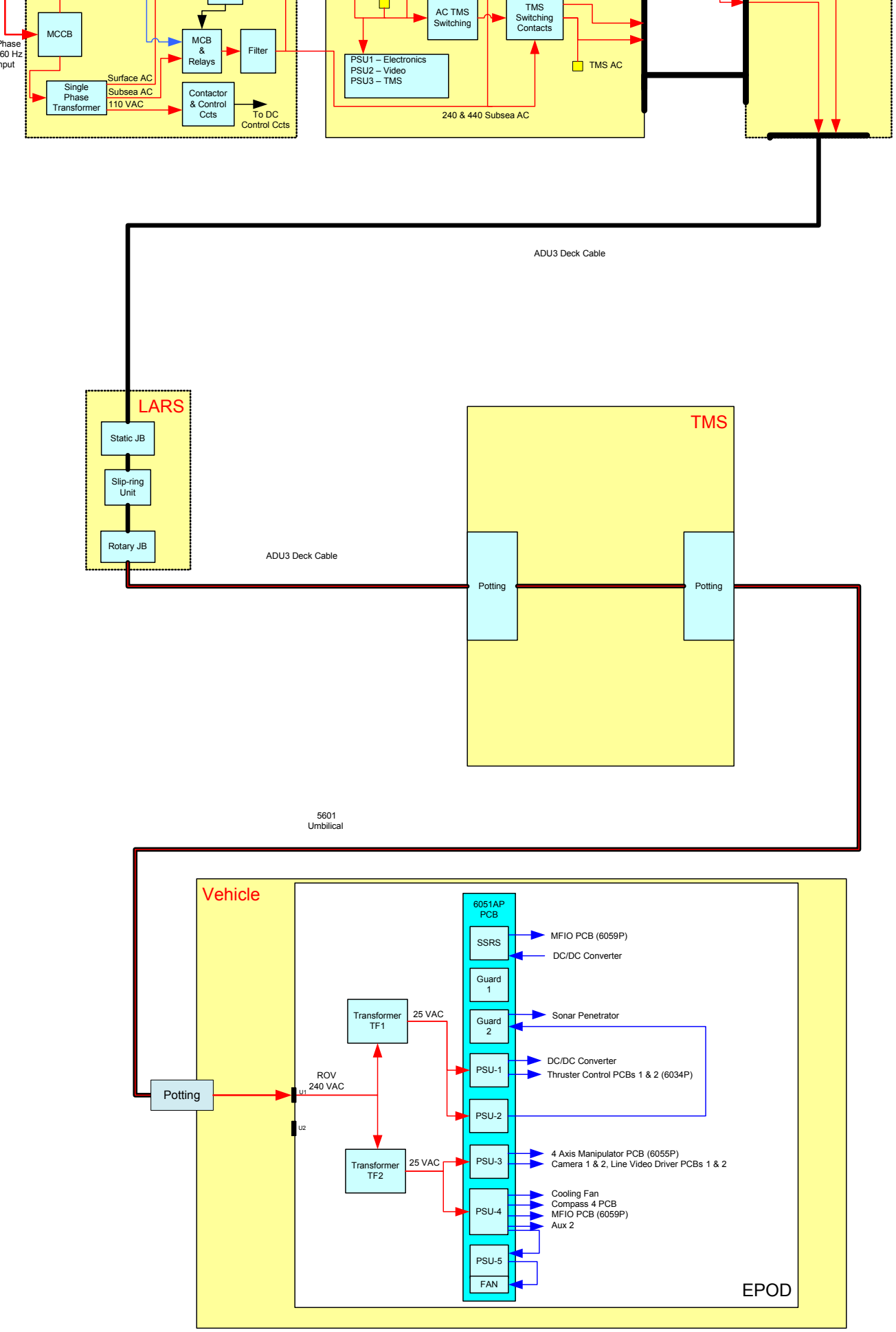

Figure. 5.1 AC Power Distribution

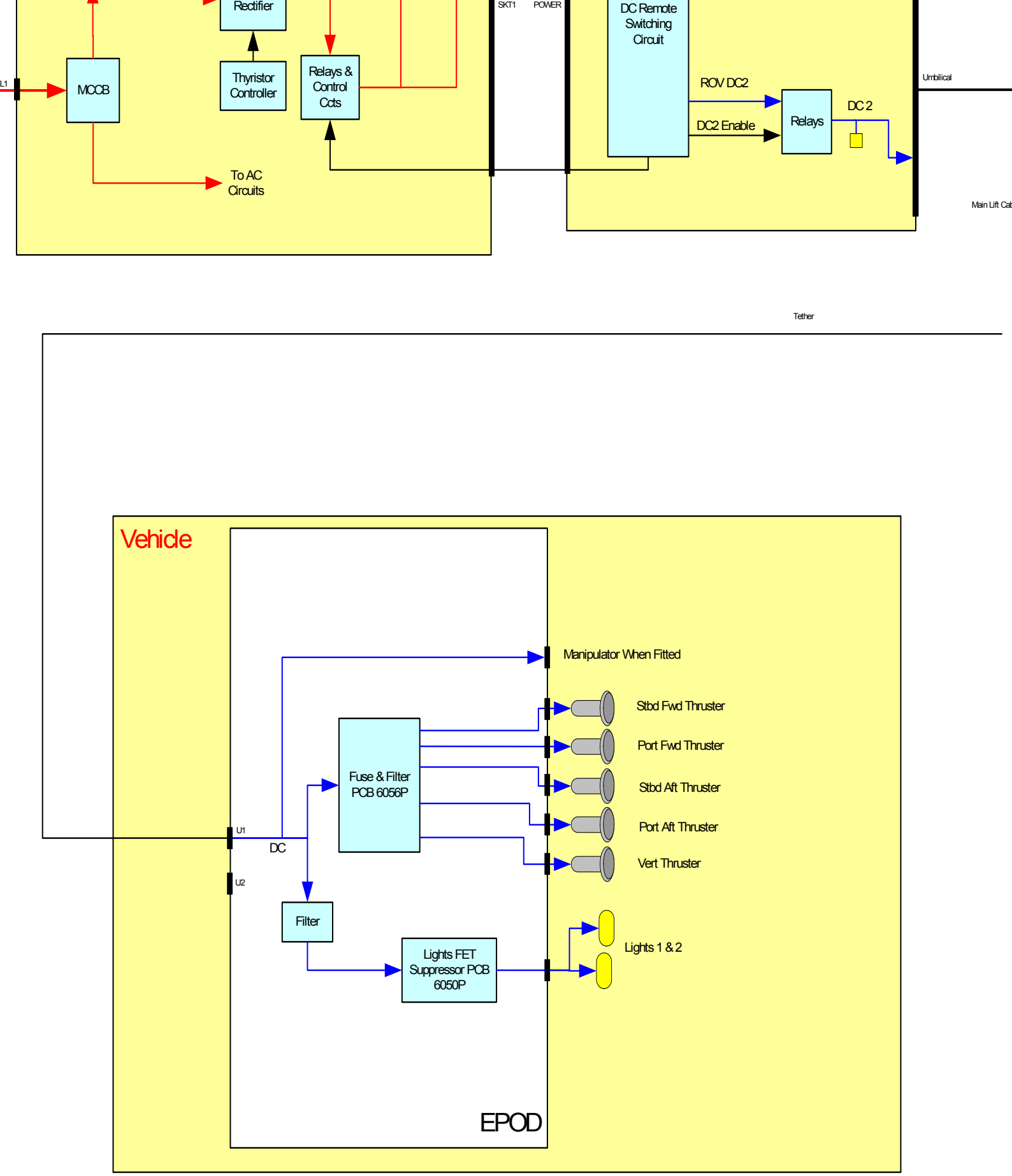

Figure. 5.2 DC Power Distribution

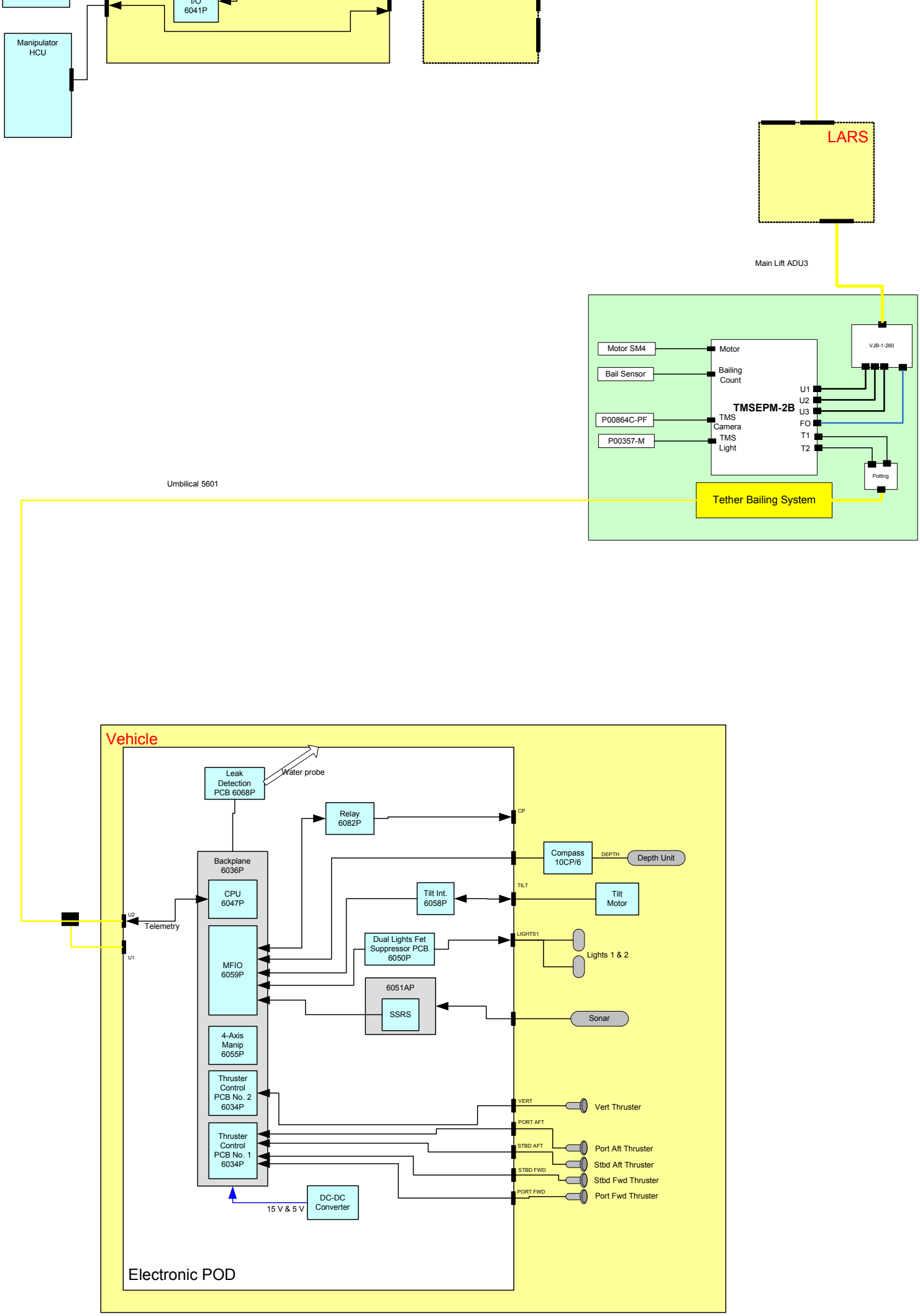

Figure. 5.3 Telemetry Control System

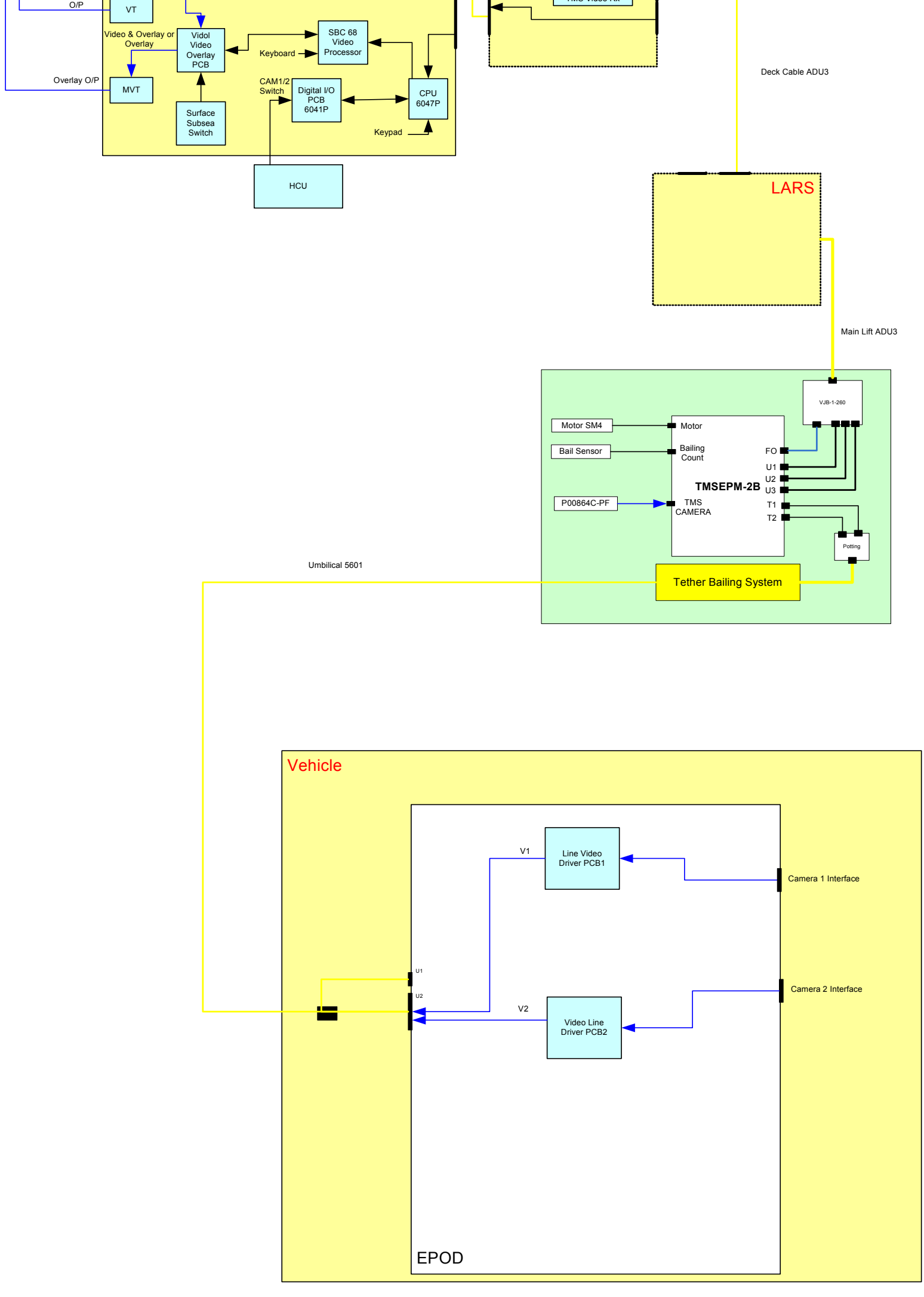

Figure. 5.4 Video System

CHAPTER 6

CORRECTIVE

MAINTENANCE

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6. CORRECTIVE MAINTENANCE

This Chapter contains the approved procedures for removal, dismantling, assembling and refitting of equipment necessary for the correct maintenance of the ROV system.

6.1 Introduction

Where access to equipment and lowest replaceable units is straightforward, it is considered unnecessary to give instructions on dismantling and assembling.

6.1.1 Safety Precautions

Lethal voltages are present in all of the units and can be present in cable connections between units and junction boxes. Maintenance can involve contact with substances harmful to health. Before any 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.

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.

POSSIBLE DANGER TO PERSONNEL AND DAMAGE TO EQUIPMENT. THE ELECTRONICS POD WEIGHS APPROXIMATELY 16 KG RESPECTIVELY, AND CARE SHOULD THEREFORE BE TAKEN WHEN LIFTING THE POD FOR SLINGING PURPOSES.

DANGER TO PERSONNEL AND EQUIPMENT. THE 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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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.

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

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

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.

6.1.2 Tools Required

The various maintenance procedures detailed in this handbook call for various standard and specialist tools. Not all tools are required for all procedures and the following list is not exhaustive, however it is strongly recommended that the special to type tools required for the more involved procedures be used. The following tools may be required:

- Flat bladed screwdrivers (common sizes).
- Open ended or ring spanners (common sizes).
- Socket set.
- Pliers, flat nosed.
- Wooden dowel.
- Propeller Puller tool (Part No P00268).
- Shaft Seal fitting tool kit (Part No Th111/1/2/3KIT).
- Hex keys (common sizes).
- 2 leg puller tool (150mm max. spread and reach).
- Torque wrench (to achieve 2.8 kg. m).

- Rubber mallet

6.1.3 Parts Required

It is recommended that a supply of spare parts is always available and ready for use, especially O-rings. The following parts may be required:

- Stainless steel plain M8 nut.
- M8 and M16 Nylok nuts.
- Loctite 222, 641 and 480.
- Silicone grease (Molycote MS111 or similar).
- Cleaning fluid (Amberklene or similar).
- Oil container suitable for collecting oil.
- Propeller puller tool (Part No P00268).
- Thruster Motor V-seals (Part No VSEAL0012).
- Thruster Motor Diaphragm (Part No TH066).
- Thruster Motor Shaft Seals Kit (Part No TH111).
- Thruster Motor Nose Cone O-ring (Part No 200-138).
- Thruster Motor Shaft Seal Platform (Part No TH112).
- Vehicle EPOD lid O-ring (Part No 200-370).
- Vent screw (Part No EP122).
- Vent screw O-ring (Part No 200-109).
- Nylon Jack Off screw, M5 x 20 mm (Part No 527-757).
- M2 Metal Shell connector O-rings (Part Nos 200-014)
- M3 Metal Shell connector O-rings (Part Nos 200-019).
- 8mm chain 25 and 30 link (Part No CHAINS8MM).
- 8mm chain link (Part No LINKS8MM).

6.2 Electrical Connectors and Seals

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 Amberklene 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.

6.3 Surface Unit

Figure. 6.1 Surface Unit Front Panel

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.

6.3.1 Dismantling

Proceed as follows:

1. Remove the two securing screws from the front panel (Fig. 6.1).
2. Carefully hinge down the front panel taking care not to damage any wires or ribbon cables.

6.3.2 Assembling

Proceed as follows:

1. Carefully raise the front panel ensuring none of the wires are trapped and secure with the two front panel securing screws.

6.4 Vehicle Electronics Pod

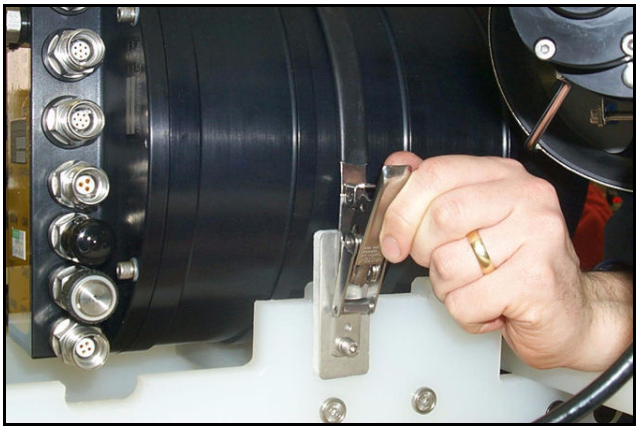

Figure. 6.2 Vehicle Epod

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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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

6.4.1 Removal

Proceed as follows:

1. Disconnect the electrical connectors from the electronics pod.
2. Unfasten the pod retaining strap latch and disengaged from the bracket and remove.
3. Carefully lift and rotate the electronics pod and manoeuvre though the rear of the vehicle and place on a dry and stable workbench.

6.4.2 Dismantling

Proceed as follows:

1. Identify and locate the housing vent screw and remove.

Figure. 6.3 Vent Screw Removal

2. Remove four screws securing the end-plate to the pod housing.
3. Using nylon M5 nylon jacking screws, jack off the endplate from the cylinder housing.

Figure. 6.4 Nylon Jack Off Screws

4. Pull away the housing from the end-plate and carefully withdraw the housing over the POD chassis. Remove the O-rings.

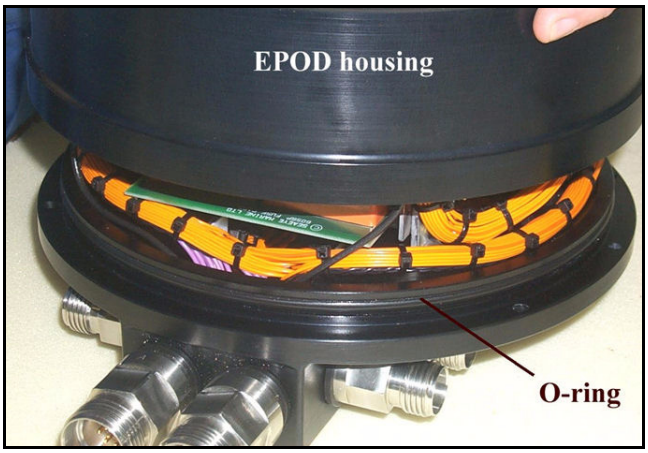

Figure. 6.5 Bulk Head Plate Removal

6.4.3 Assembling

Proceed as follows:

1. Clean the end-plate O-ring groove and mating surfaces.
2. Lubricate the new O-ring and groove with silicone grease and fit to the end-plate.
3. Visually inspect the pod housing for damage and clean as necessary.
4. Carefully locate the housing over the pod chassis and slowly slide into position. Ensure the O-ring is correctly in place and that no cables or wires are trapped.
5. Secure the end-plate to the housing with the four stainless steel screws ensuring the washers and screws are assembled in the following order, spring washer, plain washer, nylon washer.
6. Clean the vent screw O-ring groove and mating surfaces and inspect for damage.
7. Lubricate the new O-ring and grove with silicone grease and fit to vent screw.
8. Replace the vent screw.

9. Inspect the end-plate penetrators for damage, bent pins and corrosion. Clean each penetrator.
10. Check each penetrator torque loading to 30 Nm.

6.4.4 Refitting

Proceed as follows:

1. Clean and lubricate all electrical connector threadforms with silicone grease.
2. Carefully lift and rotate the electronics pod and manoeuvre into the rear of the vehicle.
3. Check, clean and lubricate all cable connector O-rings with silicone grease.
4. Reconnect all connectors to the EPOD and ensure that all connections are correctly mated and secure.
5. Replace the EPOD retaining strap over the pod engaging the latches into their brackets. Fasten the catches.

6.5 Thruster Motor

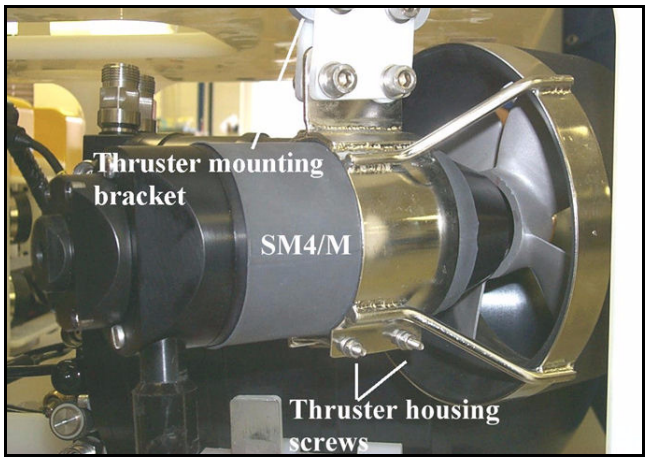

Figure. 6.6 Thruster Motor

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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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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

6.5.1 Removal

Proceed as follows:

1. Disconnect the thruster electrical connector from the EPOD end-plate.
2. Remove the cable ties from the thruster whip.
3. Supporting the thruster remove the two thruster mounting bracket screws and carefully withdraw the thruster from the vehicle.

6.5.2 Dismantling

Proceed as follows:

1. Using a wooden dowel wedge the propeller to prevent from turning.
2. Remove and discard the nylok nut from the propeller shaft.
3. Fully extend the legs of the puller tool and fit to the propeller with three in number M5 screws ensuring the jacking off bolt is located centrally on the propeller shaft.

4. Slowly tighten the Propeller Puller tool until the propeller “breaks” free.
5. Remove the Propeller Puller tool from the propeller.

NOTE.

Should difficulty be experienced when removing the propeller, removal can be facilitated by the careful application of heat to the propeller boss using a heat gun.

6. Loosen but do not remove the screws securing the nozzle to the thruster motor body and withdraw the motor rearwards from nozzle assembly.

NOTE.

To avoid damage to the end cap and whip, grip the thruster by the body and lever apart the nozzle if necessary.

6.5.3 Assembling

Proceed as follows:

1. Carefully insert the motor into the nozzle assembly and rotate the motor body to align the electrical whip in the required direction.
2. Tighten the screws to secure the motor body to the nozzle assembly.
3. Apply a liberal coating of Loctite 641 to the taper section of the thruster motor shaft.

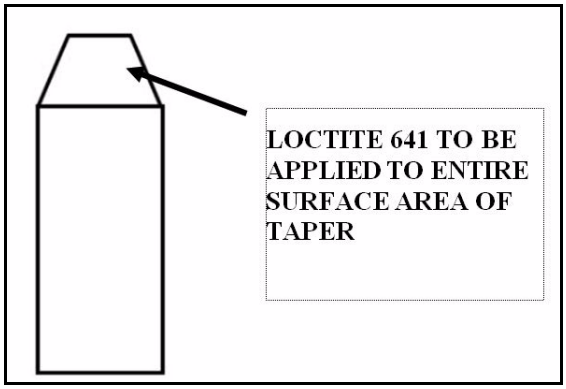

Figure. 6.7 Shaft showing area to apply

4. Refit propeller to the motor shaft.
5. Wedge propeller to prevent from turning.
6. Fit a plain M8 nut to the motor shaft and tighten until the propeller has located and locked onto the motor shaft.
7. Remove the nut and replace with a new nylok nut and torque to 2.8 kgm (20 lbf/ft).
8. Using a metal rule or other suitable flat surface align the nozzle assembly with the top of the M8 nut by loosening the nozzle assembly screws.

6.5.4 Refitting

Proceed as follows:

1. Locate the thruster and nozzle assembly in position on the vehicle chassis and secure with two in number hex screws.
2. Reconnect the motor electrical cable to the vehicle EPOD.

NOTE.

Dismantling the motor beyond the maintenance described within the handbooks will invalidate the warranty. If in any doubt, consult SAAB SEAEYE LTD. prior to any further dismantling of the Thruster Motor.

6.6 Thruster Motor V-Seal Replacement

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. THE THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE ROV 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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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

Proceed as follows:

1. Remove the motor from the ROV.
2. Dismantle the motor.
3. Support the thruster in a vertical attitude shaft uppermost.
4. Gently remove the V-Seal from the nose cone and discard.
5. Lubricate the motor shaft with silicone grease.
6. Fit a V-seal to motor shaft.

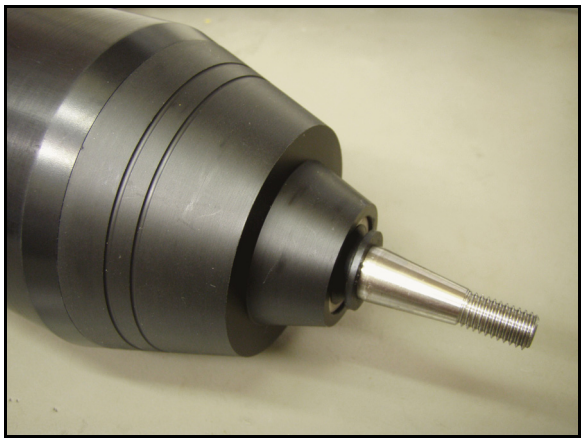

Figure. 6.8 V-Seal Fitment

7. Assemble the thruster motor.
8. Carry out an oil level check.
9. Refit the motor.

6.7 Thruster Motor Shaft Seal Replacement

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. THE THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE ROV 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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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

Proceed as follows:

1. Remove motor from the ROV.
2. Dismantle the motor.
3. Thoroughly clean motor exterior with Amberklene.
4. Position a container under the motor to collect the oil.
5. Remove and retain the fill and vent screws from the motor and drain the oil.
6. Gently remove the V-Seal from the nose cone and discard.
7. Unscrew the motor nose cone by hand. If removal proves difficult apply heat from a heat gun until the nose cone is hand hot and gently tap away the nose cone using a wooden dowel.
8. Remove and discard the nose cone O-ring.
9. Carefully remove the ceramic seal and discard.
10. Carefully remove the shaft seal assembly and discard.
11. Thoroughly clean the nose cone and shaft with Amberklene.
12. Lubricate the new ceramic seal with clean water with 50% washing-up liquid.
13. Using the seal insertion tool (Part No TH111-2) press the seal assembly onto the nose cone.

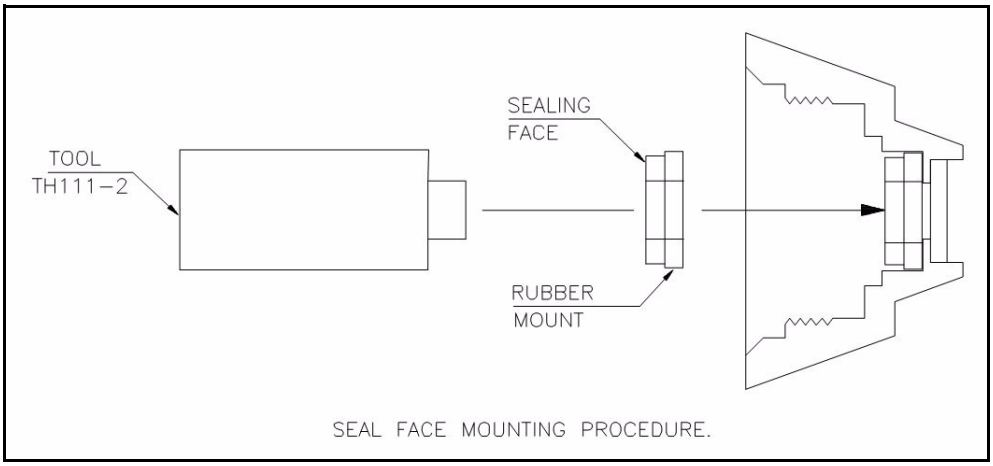

Figure. 6.9 Seal Face Mounting Procedure

Figure. 6.10 Ceramic Seal with Insertion Tools

14. Using the gauge tool (Part No TH111-3) rotate the nose cone looking for any high points. Firmly press down on the tool to remove high points and ensure the seal is fitted squarely onto the nose cone.

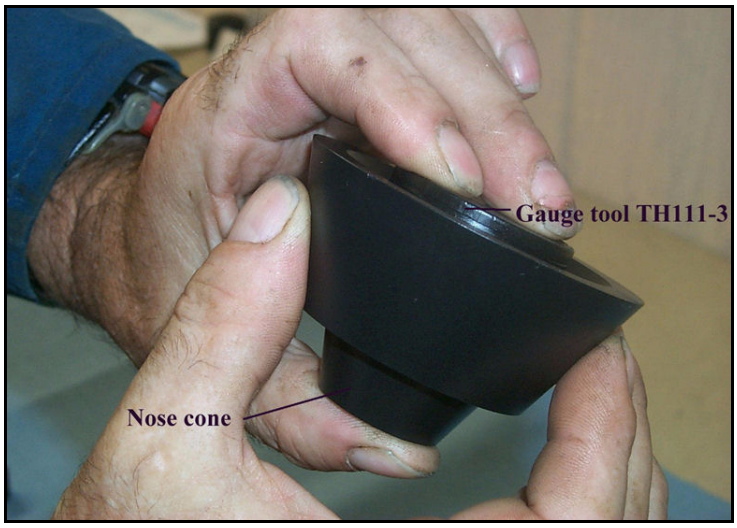

Figure. 6.11 Nose Cone Seal Fitting

15. Loosen the shaft seal M4 grubscrew and lightly coat the shaft seal M4 grubscrew with Loctite 641,
16. Lubricate the inside of the shaft seal with a mixture of water and 50% washing-up liquid. Fit the seal platform onto the thruster's shaft with the large diameter end of the seal platform facing the propeller end of the shaft.
17. Position the seal platform level with the top rim of the thruster's body using a fitting tool. Tighten the grubscrew sufficient to grip the shaft but allow the seal platform to slide with the application of slight pressure.

Figure. 6.12 Shaft Seal Fitting

18. Fit the 3mm shaft seal fitting tool (Part No TH111-1) onto the shaft and resting on the seal platform.

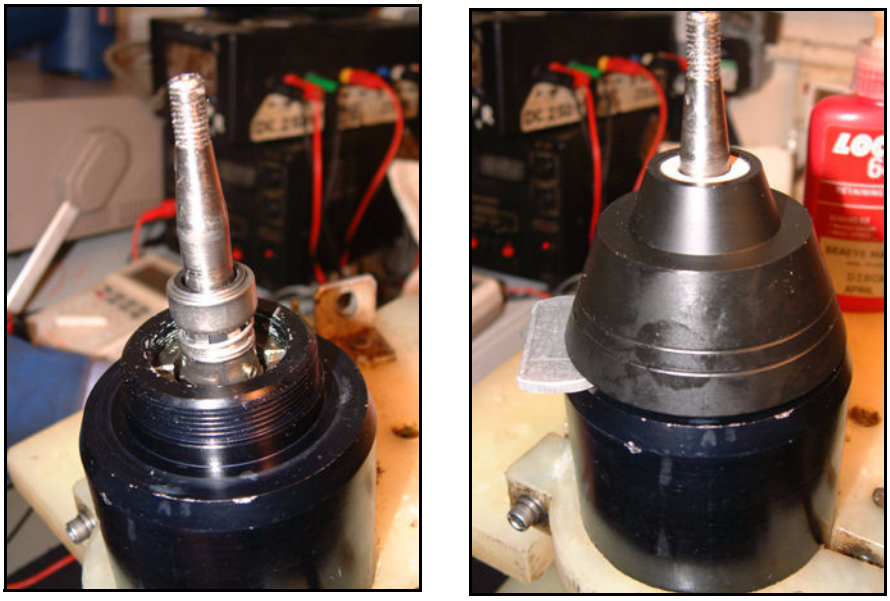

Figure. 6.13 Shaft Seal and 3mm Fitting tool

19. Fit the nose cone onto the shaft and screw down carefully to seat the seal platform at the correct position.
20. Carefully remove the nose cone.
21. Carefully remove the shaft seal-fitting tool without disturbing the seal platform.
22. Note the marking on the ceramic seal. This should be marked around ¾ of the seal face. If not, reposition the shaft seal until the marking is correct. Tighten the grubscrew fully.

Figure. 6.14 Detail Showing 'Clean' Ceramic Seal and 'Marked' Ceramic Seal

23. Clean and dry thoroughly the faces of the shaft seal and nose cone ceramic seals.

NOTE.

It is essential that all traces of oil and contaminates are removed from the shaft and ceramic seal faces and surfaces are perfectly dry.

24. Lubricate the nose cone O-ring with silicone grease.
25. Refit the nose cone.
26. Leave the thrusters undisturbed for a minimum of 30 minutes to permit the Loctite to cure.
27. Fit a new V-Seal.
28. Assemble the motor.
29. Carry out an oil level check.
30. Run the motor for 10 minutes to run in the surfaces of the shaft seal and ceramic seal faces.

CAUTION.

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

31. Refit the motor.

6.8 Thruster Motor Diaphragm Replacement

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. THE THRUSTER MOTORS MAY OPERATE WITHOUT WARNING WHEN THE SYSTEM DC SUPPLY IS ENERGISED. ENSURE THAT THE ROV 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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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

Proceed as follows:

1. Remove the motor from the ROV.
2. Thoroughly clean the motor exterior with Amberklene.
3. Position a container under the motor to collect the oil.
4. Remove the fill and vent screws from the motor and drain the oil.
5. Remove and retain the four hex screws securing the motor's top hat to the motor body.
6. Remove the top hat together with the diaphragm return spring.
7. Remove and discard the diaphragm.
8. Thoroughly clean the diaphragm housing.
9. Fit a new diaphragm ensuring the O-ring is correctly seated.
10. Fit the diaphragm return spring in position on the diaphragm.
11. Fit top hat and secure with the four hex screws using Loctite 222.
12. Carry out an oil fill check.
13. Refit the motor.

6.9 Thruster Insulation Testing

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.

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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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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

Damage may occur if the thruster insulation test is not carried out correctly.

Proceed as follows:

1. Connect the insulation tester.
2. The thruster can be insulation tested as follows.
   - Earth to DC.
   - Earth to Electronics.
   - Electronics to DC.
3. Reading is to be greater than 200 Mohms.

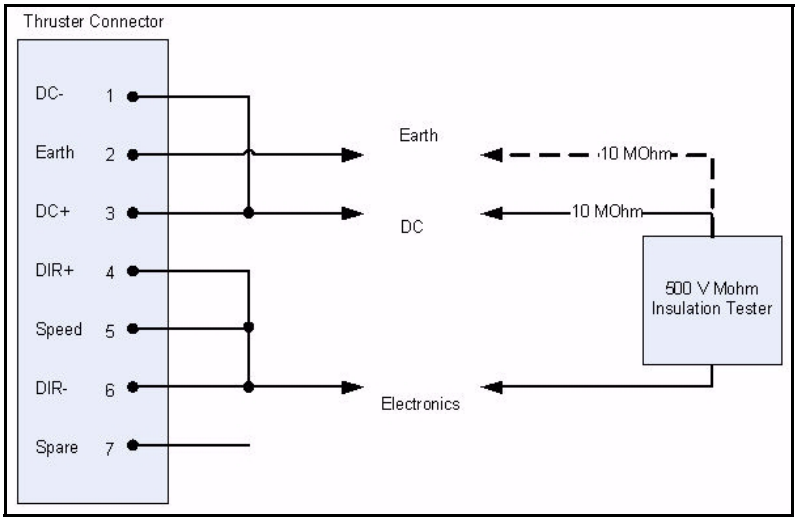

Figure. 6.15 Thruster Insulation Test Setup

NOTE.

Electronic lines must be kept bonded for insulation tests. Damage may occur to electronics if the lines are separated and tested individually.

6.10 Lamp Bulb Replacement

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.

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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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

Proceed as follows

1. Dry the lamp housing assembly.
2. Remove and retain lamp cover retaining bolts.
3. Carefully withdraw lamp cover and lamp glass from lamp assembly and dry any water accumulation immediately.
4. Remove lamp bulb by rotating anticlockwise and discard.
5. Remove and discard lamp O-ring.
6. Lubricate the O-ring using silicone grease and fit.
7. Carefully fit new lamp using a dry cloth taking care not to contaminate the glass envelope.
8. Thoroughly clean lamp glass with a lint free cloth and Amberklene and refit.
9. Refit lamp cover.
10. Apply Loctite 222 to the hex screw threads and secure in place taking care not to over tighten.

6.11 Metal Shell Connector O-Ring Replacement

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.

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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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

Proceed as follows:

1. Using a small screwdriver, open the spiralux washer and slide along the connector body towards the plug moulding.
2. Pull back the nut towards the plug moulding, remove and discard the O-rings.
3. Clean the O-ring grooves, connector body and nut with Amberklene.
4. Lightly lubricate two new O-rings and fit into the connector body O-ring grooves.
5. Slide the nut along the connector body past the spiralux groove.
6. Using a small screwdriver, slide the spiralux washer along the connector body until it locates into its groove.
7. Functionally check all systems.

6.12 Mechanical Re-termination of Armoured Cables

The following procedure describes the method for the recovery of a mechanical termination and re-termination of a cable fitted with the Scorpion Oceanics Ltd. termination.

6.12.1 Recovery of Mechanical Termination from Cable

Carry out the following procedure:

1. Unscrew the spring bend strain relief from the termination and slide the spring along the cable.
2. Bind or tape the cable armour adjacent to the termination.
3. Cut through the armoured cable with an angle grinder adjacent to the termination.
4. Cut through the inner cable tail at the universal coupling side of the termination.
5. Drill, chisel or burn out the potting materials and scrap the cable from the termination armour body.
6. Thoroughly clean out the bore of the armoured body.

6.12.2 Mechanical Re-termination of the Cable

Proceed as follows:

1. Mark the cable at a point allowing the required length of inner cable tail.
2. Slide the spring bend strain relief along the cable and beyond this termination point.
3. Slide the mechanical termination along the cable and beyond the termination point.
4. Tightly bind the cable with thin cord over approximately 20 mm length at the termination point.
5. Cut through the outer layer of the cable armour with an angle grinder at approximately 110 mm from the binding at the free cable tail side. (Take care to not generate excessive heat or the cable inner sheath may melt). Remove the loose armour wire strands.
6. Cut half way through the inner layer cable armour with an angle grinder at the same point on the cable. (Take care to not generate excessive heat or the cable inner sheath may melt). Snap off and remove the loose armour wire stands. Do not cut all the way through the inner layer of armour or damage may be caused to the cable inner sheath.
7. Slightly splay out (to a maximum of 10 degrees from the cable axis) and separate the 110 mm wire tails.
8. Thoroughly degrease the 110 mm wire tails with a brush and clean solvent.
9. Slide the termination armour body over the wire tails such that the wire ends are at the widest part of the conical bore of the termination and the binding in the narrow parallel part.
10. Apply mastic at the external interface of the armoured cable and termination.
11. Fit a ‘Jubilee’ clip on the cable at this interface to stop the termination from sliding along the cable.
12. Support the assembly vertically with the wide end of the conical bore uppermost and the cable exit central at each end.
13. Thoroughly mix a 250 cc Wirelock kit and pour into the conical bore of the termination to the widest point of the bore. Allow to cure. (Use Wirelock in accordance with the manufacturer’s instructions).
14. Thoroughly mix a small amount of polyurethane customer and fill the remaining bore with polyurethane. Allow to cure. (Use the polyurethane in accordance with the manufacturer’s instructions.
15. After the resins have cured, remove the supporting ‘Jubilee’ clip and mastic.
16. Screw the spring band strain relief back on to the termination.

NOTE.

Operators may find the recovery of the termination components and re-termination easier if the universal coupling is dis-assembled. If this method is adopted, then the following should be noted:

- Refit the screws using Loctite 242E retainer (or equivalent).
- Renew the internal circlips.
- Peen over the universal coupling pin bore outer ends.

Use appropriate safety equipment whilst using the tools and resins etc.

Proof loading of the assembly prior to use in service is recommended.

CHAPTER 7

MAINTENANCE TASKS

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7. MAINTENANCE TASKS

This Chapter contains the approved methods by which the maintenance tasks listed in Table 7.1 are carried out.

7.1 Introduction

For safety of personnel and protection of equipment the removal, dismantling, assembling and refitting of equipment must be performed in accordance with the corrective maintenance procedures as detailed in Chapter 6.

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. Maintenance tasks can involve contact with substances harmful to health. Before any 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.

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.

POSSIBLE DANGER TO PERSONNEL AND DAMAGE TO EQUIPMENT. THE ELECTRONICS POD WEIGHS APPROXIMATELY 16 KG AND CARE SHOULD THEREFORE BE TAKEN WHEN LIFTING THE POD FOR SLINGING PURPOSES.

DANGER TO PERSONNEL AND EQUIPMENT. THE 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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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.

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

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

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.

Task No	Task Description	When carried out
1	Pre-Operational Tests	Pre-flight
2	Post-Operational Tests	Post-flight
3	Thruster Motor Oil Level Check and Replenishment	Pre-flight Post-flight When motor has been drained of oil Every 4 months of operational use
4	Thruster Motor Shaft Rotation	Monthly
5	DC Power Supply Compensation	Change of umbilical or tether length Poor vehicle performance Post installation
6	Subsea AC Compensation	Post installation Under or over voltage
7	Video Overlay Adjustment	Unstable Overlay

Table. 7.1 Maintenance Tasks

Task No	Task Description	When carried out
8	Video Compensation Adjustment	Change of umbilical or tether length Change of umbilical Change of camera Change of Video PCB
9	Compass Calibration	Change of compass Loss of calibration indication Vehicle relocation
10	Finish Restoration	When necessary to carry out repairs
11	Vent Plug Removal	Prior to air transportation Exposure to direct sunlight Prolonged storage in high temperatures
12	Tilt Motor and Feedback Assembly Oil Level Check and Replenishment	Pre-flight Post-flight When units have been drained of oil
13	Tilt Feedback Potentiometer Synchronisation	Synchronisation Potentiometer replacement Potentiometer coupling slippage

Table. 7.1 Maintenance Tasks (Continued)

TASK 1
PRE-OPERATIONAL CHECKS

Frequency of Task

Pre-flight.

Introduction

These checks ensure that the equipment is fully functional, secure and in good working order prior to each operational use. It is recommended that a copy of the check list be used prior to each dive and signed and witnessed by a supervisor.

Tools Required

The following tools may be required:

- Torque wrench (to achieve 27 Nm/20ft.lbf/2.8kg.m).
- Hex key set.
- A non metallic wedge for wedging propellers.
- Diaphragm puller tool (Part No TH110).

Parts Required

No parts required.

Procedure

Proceed in accordance with Pre-Operational checklist.

TASK 1 - CHECK SHEET

PRE-OPERATIONAL CHECKS			
⚠ SWITCH OFF ALL SUPPLIES TO THE PSU AND CHECK ALL INDICATORS ARE EXTINGUISHED			
Vehicle checks			
Check Thruster propeller torque settings are 27 Nm (wedge props with dowel to prevent from turning)			
Check Thruster oil levels			
Check Tilt Motor and Feedback Unit oil levels			
Check Thrusters and Tilt Assembly are free from fouling			
Remove camera lens cap and clean lens with soapy water			
Confirm the following vent plugs are securely fitted:			
	Epod		
	Seaeye Camera/s (if fitted)		
Confirm ALL unused bulkhead connectors on the EPOD have dummy connectors 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 Thrusters, nozzles, crash bars and buoyancy foam are correctly fitted and secure			
Check ALL Camera/adaptors/ front ports are correctly fitted and secure			
System Vehicle Checks			
NOTE. If any major components have been replaced carry out Configuration procedure when prompted by the system monitor otherwise respond NO			
Carry out the following switch settings			
HCU	Lights Control	Set fully anti-clockwise	
	Vertical set, F/R Set, speed, Lat Set, Lat speed, Turn set, Turn rate, Tilt and Pan Controls	Set to central position	
	Thruster Enable Switch	Ensure OFF	
	Sonar switch	Ensure 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 unit			
⚠ WARNING. POSSIBLE DAMAGE TO LAMPS. VEHICLE LAMPS MUST NOT BE OPERATED FOR LONGER THAN 10 SECONDS IN AIR			
Operate lights and confirm lights illuminate			
⚠ WARNING. POSSIBLE DAMAGE TO MOTOR V SEAL. DO NOT OPERATE THRUSTERS FOR LONGER THAN ONE MINUTE IN AIR			
Calibrate the Thruster motors as follows			

Table. 7.2 Pre-Operational Checks

PRE-OPERATIONAL CHECKS			
HCU	Thruster Enable switch	Set to ON	
	F/R and Turn set controls	Adjust until horizontal thrusters are stationary	
	VERTICAL SET control	Adjust until vertical thrusters are stationary	
	LATERAL SET control	Adjust until horizontal thrusters are stationary	
	JOYSTICK control	Operate in all directions and confirm thrusters respond in all axes	
Confirm compass reading correct and follows vehicle movement (calibrate as required)			
Operate sonar systems and test (if fitted)			
Switch on the emergency strobe unit			
Vehicle ballast check			
If the weight of the vehicle has changed since the last operation carry out the following			
Immerse and adjust vehicle ballast for correct ballast and trim			

Table. 7.2 Pre-Operational Checks (Continued)

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

Authorised to dive? YES/NO

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

TASK 2
POST-OPERATIONAL CHECKS

Frequency of Task

Post-flight.

Introduction

These checks ensure that any damage that may have occurred during operational use can be repaired and any defects rectified before storage or subsequent operations.

Tools Required

The following tools may be required:

- Torque wrench (to achieve 27 Nm/20ft.lbf/2.8kg.m).
- Hex key set.
- A non metallic wedge for wedging propellers.
- Diaphragm puller tool (Part No TH110).

Parts Required

No parts required.

Procedure

Proceed in accordance with Post-Operational checklist.

TASK 2 - CHECK SHEET

POST-OPERATIONAL CHECKS			
⚠ SWITCH OFF ALL SUPPLIES TO THE PSU AND CHECK ALL INDICATORS ARE EXTINGUISHED			
Vehicle checks			
Clean vehicle with fresh water using a pressure hose			
Check Thruster propeller torque settings are 27 Nm (wedge props with dowel to prevent from turning)			
Check Thruster oil levels			
Check Tilt Motor and Feedback Unit oil levels			
Check Thrusters and Tilt Assembly are free from fouling			
Clean the camera lens with soapy water and fit the lens cover(s)			
Confirm the following vent plugs are securely fitted:			
	Epod		
	Seaeye Camera/s (if fitted)		
Remove any debris from structures			
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 Thrusters, nozzles, crash bars and buoyancy foam are secure and undamaged			
Check **ALL** Thrusters are free to move in both directions			
Check ALL Camera/adaptors/ front ports are secure and undamaged			
Switch off the emergency strobe unit			
Vehicle ballast check			
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			

Table. 7.3 Post-Operational Checks

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

Authorised to Stow? YES/NO

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

TASK 3
THRUSTER MOTOR OIL LEVEL CHECK AND REPLENISHMENT

Frequency of Task

Pre and Post-flight.

Replenishment every 4 months of operational use.

Introduction

The purpose of this check is to ensure that the thruster motor oil level is correct prior to operational use and details the procedure on how to replenish the oil if required. The thruster motor is a SM4/M and uses Mobilect39 oil, under **NO** circumstances are any other oils to be used.

Tools Required

The following tools may be required:

- Hex key set.
- A non metallic wedge for wedging propellers.
- Diaphragm puller tool (Part no TH110).
- Seaeye Fillkit (Part No P00514).

Parts Required

The following parts may be required:

- Mobilect39 oil.
- Clean container for collecting oil.

Oil Level Check Procedure

WARNING.

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. THE 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.

CAUTION.

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

Proceed as follows:

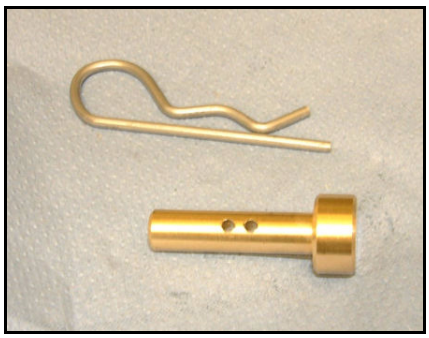


Figure. 7.1 Diaphragm Puller Tool

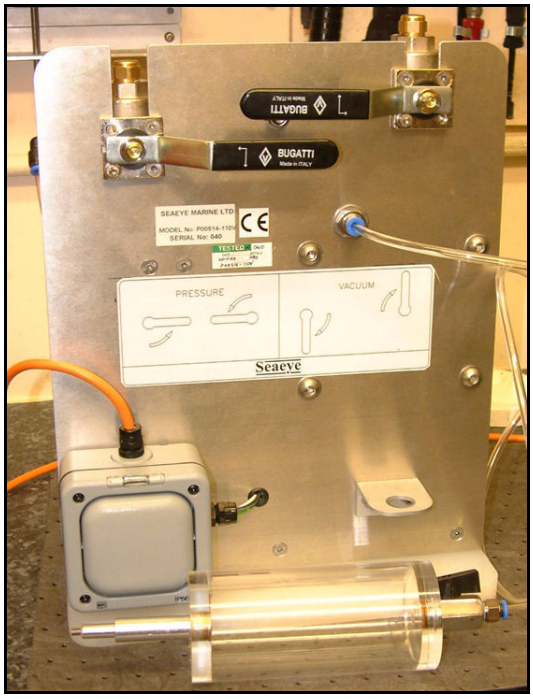


Figure. 7.2 Oil Fill Kit P00514

1. Visually examine the motor, motor cable gland and cable, and chassis vicinity for signs of oil leakage.
2. Using the Diaphragm Puller Tool, screw into the motor diaphragm and ensure that the top of the diaphragm cover is between the drilled holes on the tool.

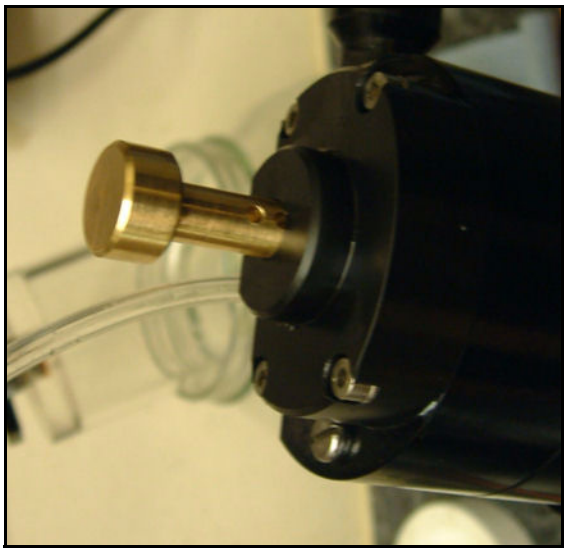


Figure. 7.3 Diaphragm Puller Tool Indication Hole

If the holes are not visible, carry out the oil replenishment procedure.

NOTE.

If frequent topping up is required, an investigation is required to ascertain the possibility of damage to the motor.

Oil replenishment procedure

NOTE.

It is recommended that the thruster oil is replenished every 4 months of operational use.

Proceed as follows:

1. Remove the required motor as detailed in Chapter 6.
2. Position the motor vertically using a mounting base.
3. Insert the Diaphragm puller tool into the motor end cap and screw onto diaphragm-threaded stud.

Figure. 7.4 Diaphragm Puller Tool

4. Holding the motor securely, pull upward on the puller tool until the locking pin hole is visible above the end cap and insert locking pin. If necessary, loosen the motor fill screw to release the pressure taking care that the oil pressure does not cause the oil to be released through the fill screw hole. Release the puller tool.

Figure. 7.5 Diaphragm Tool Pin Insertion

5. Carefully fully remove the motor fill screw and retain. Replace the O-ring.

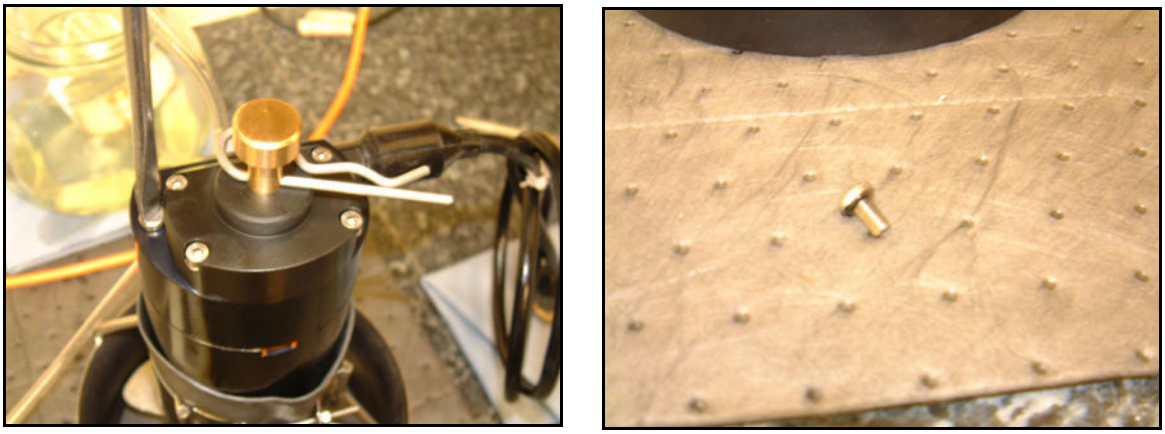
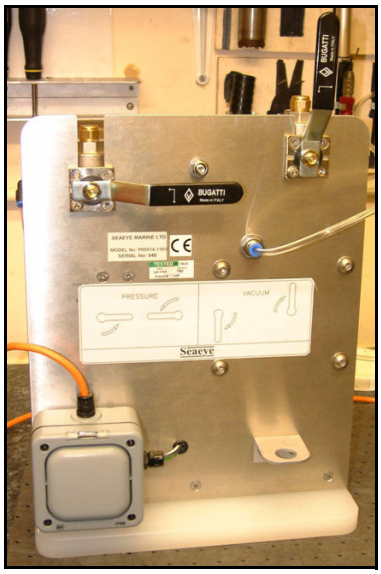


Figure. 7.6 Vent Screw

6. Ensure the Fillkit kit reservoir is clean and empty and the power switch is set to OFF.



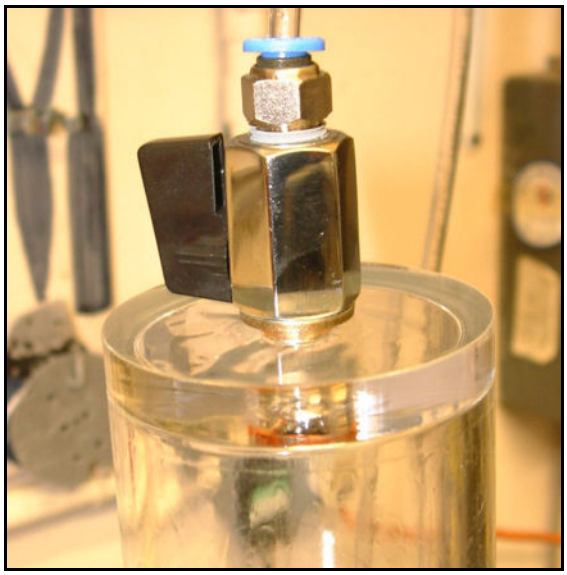


Figure. 7.7 Oil Fill Kit Valve Positions

7. Confirm the following:
   - Vacuum Valve – vertical position.
   - Pressure Valve – horizontal position.
   - Reservoir Valve – vertical position
8. Place the reservoir end in the container of the motor oil.
9. Switch on the Fillkit.
10. Slowly move the pressure valve towards the vertical position and confirm oil is being drawn from the reservoir.
11. When the reservoir is three quarters full, return the pressure valve to the horizontal position.
12. Move the reservoir valve to the horizontal position and switch off the Fillkit.
13. Connect the reservoir to the motor fill screw orifice. Position the motor so that it is approximately at a 45 degree angle with the motor fill screw orifice at the 'upper' position.
14. Move the reservoir valve to the vertical position.
15. Remove the diaphragm puller tool locking pin.
16. Switch on the Fillkit. Slowly move the vacuum valve and observe that the diaphragm puller tool rises as the oil is pumped into the motor. Ensure that the diaphragm puller tool does not reach the fully upper position while carrying out the 'oil fill' operation. When the diaphragm puller moves towards the upper position, close the vacuum valve and open the pressure valve to expel air from the motor. Ensure that the diaphragm puller tool does not reach the fully lower position while carrying out the 'cycling' operation.
17. Slowly continue to 'cycle' the vacuum and pressure valves up and down and observe that the diaphragm puller tool rises and falls. Ensure that the diaphragm puller tool does not reach the fully upper or lower position while carrying out the 'cycling' operation.

18. Observe that the air is expelled from the motor diaphragm through the oil reservoir.
19. When all air has been expelled, position the pressure and vacuum valves in the off position.
20. Fit the locking pin through the diaphragm lower locating pin hole.
21. Switch off the Fillkit.
22. Move the vacuum valve and reservoir valve to the vertical position.
23. The diaphragm puller tool will fall to the locking pin level.
24. Remove the Fillkit reservoir from the motor.
25. Refit the motor fill screw.
26. Clean the motor of any oil spillage.
27. Remove the locking pin and observe the puller tool pinholes and ensure that at least one of the holes remain visible. This indicates that the motor is completely filled with oil and purged of air. Should the tool “sink” into the motor end cap repeat the fill procedure.
28. Remove the diaphragm puller tool.
29. Visually examine the motor for signs of oil leaks.
30. Sparingly lubricate the motor connector threadforms with silicone grease.
31. Refit the motor to the ROV.

TASK 4
SM4/M THRUSTER MOTOR SHAFT ROTATION

Frequency of Task

Monthly.

Introduction

This task prevents the shaft seal and ceramic seal surfaces seizing when the motors are not being used for prolonged periods. This maintenance includes motors fitted and motors held in stores.

Tools Required

No tools are required.

Parts Required

No parts required.

Procedure

WARNING.

DANGER TO PERSONNEL AND EQUIPMENT. THE 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.

CAUTION.

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

Proceed as follows:

- Rotate all motor shafts through several revolutions.

TASK 5
DC POWER SUPPLY COMPENSATION ADJUSTMENTS

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.

Introduction

This Task adjusts the DC power supply to compensate for losses in the DC power lines between the surface unit and the vehicle. 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 vehicle to be operational.

Tools and Test Equipment Required

The following tool and test equipments may be required:

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

Parts Required

The following parts may be required:

- Shorting Pins.

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.

Round Trip Resistance Calculation Procedure

NOTE.

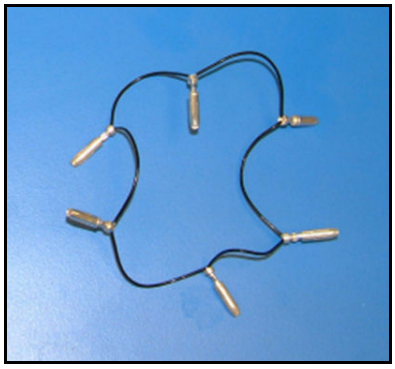
During this task refer to the umbilical drawings provided with the system.

Proceed as follows:

1. Ensure the ROV system electrically isolated.
2. Ensure that no person is performing maintenance work on the system or system cabling.
3. Disconnect the umbilical/deck cable from the Surface Unit UMBILICAL socket and the umbilical/tether from the vehicle.
4. Measure the round trip resistance between the Surface Unit end of the Umbilical/deck cable and the vehicle end of the umbilical/tether cable according to the system employed detailed below.
5. There are two ways to measure the round trip resistance:
   - Method 1: Measure the resistance of all the DC conductors in the umbilical, determine the average for one conductor and divide the resultant average by the number of conductors used for DC+ (the DC± conductors are in parallel) and multiply this value by 2 (total resistance (Rt) of DC+ and DC -).
   - Method 2: Connect the two surface shorting leads in the following manner:
     1st - Link all DC1 + and DC2 + lines together.
     2nd - Link all DC1- and DC2- lines together.
     Link all DC+ and DC- lines together at the umbilical ROV end.

NOTE.

All connections may not be present. Refer to the wiring diagrams and connect as appropriate.



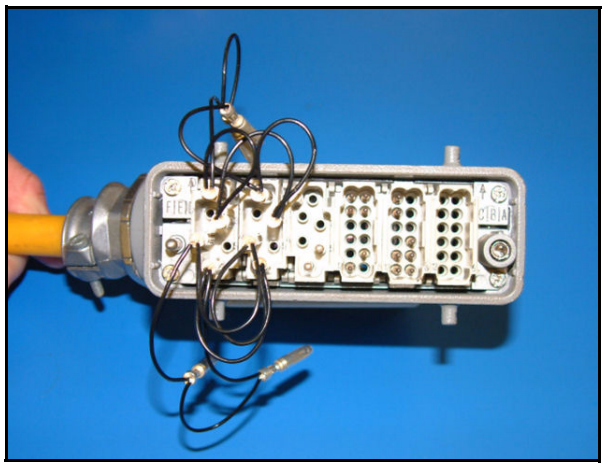
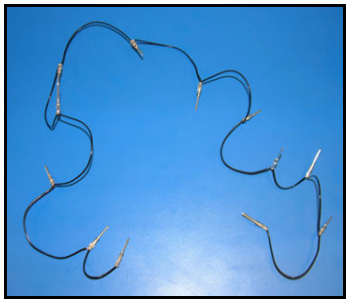


Figure. 7.8 Example Surface Shorting Lead



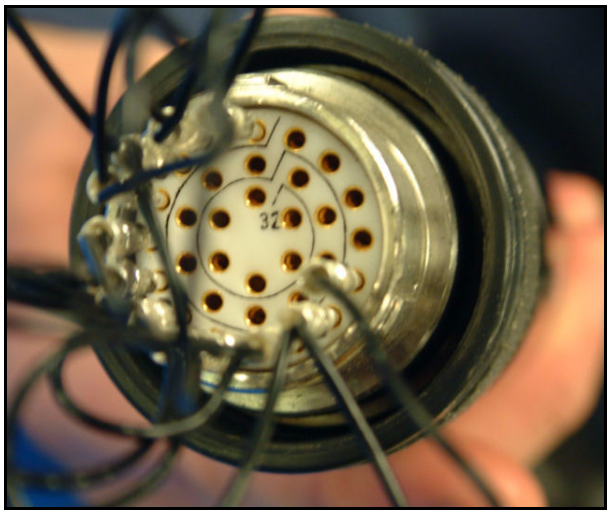


Figure. 7.9 Example ROV Shorting Lead

6. Measure the resistance of the cable between any DC+ and DC- on the surface unit end (between the 1st and 2nd links).
7. Make a note of the resistance, Rt.

DC Power Supply Compensation Adjustment Procedure

Proceed as follows:

1. Ensure the ROV system is switched off at all units.
2. Ensure that no person is performing maintenance work on the system or system cabling.
3. Disconnect the external power supply.
4. Gain access to the inside of the PSU and confirm the transformer is tapped to match the incoming mains supply.
5. Locate PSU potentiometers I comp and V Adj.

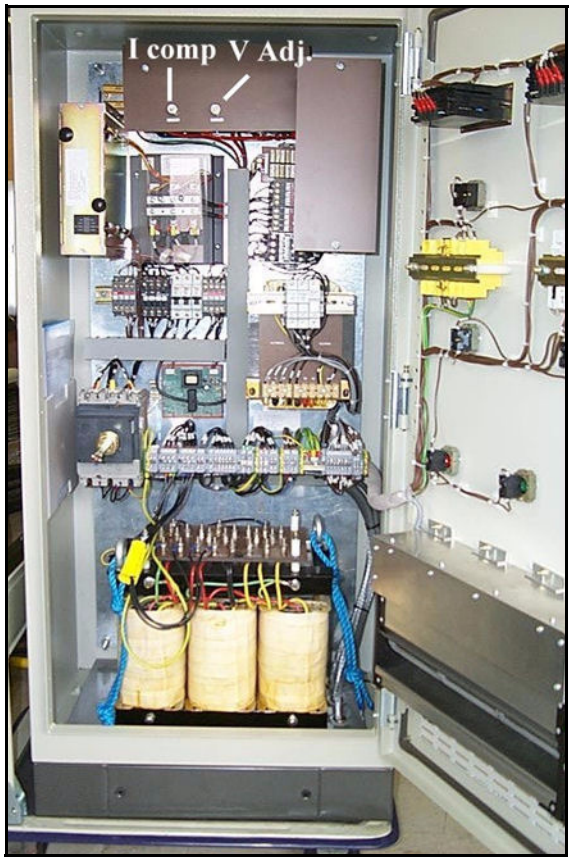


Figure. 7.10 PSU DC Compensation Potentiometers

6. Set I comp potentiometer fully anticlockwise (zero compensation).
7. Ensuring the external power supply is to off, connect the external power supply to the PSU.

WARNING.

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.

8. Switch on the external power supply.
9. Set the PSU switches to the following positions:
   - Mains isolator to ON.

NOTE.

As the PSU door is open, the Mains Isolator has to be operated manually by rotating clockwise for ON and anticlockwise for OFF.

- Ensure the AC circuit breaker to ON.
- Ensure that the Key-operated switch is set to I.

- Operate the START switch.

10. Set the SU switches to the following positions and ensure:
    - Set the AC SURFACE switch to ON.
    - Confirm the AC ON indicator is illuminated.
    - Set the AC TMS switch to ON.
    - Confirm the AC ON indicator is illuminated.
    - Set the AC VEHICLE switch to ON.
    - Confirm the AC ON indicator is illuminated.
    - Set the TMS DC switch to ON.
    - Set the VEHICLE DC switches to ON.
    - Set the MASTER DC switch to ON.
    - Confirm the DC indicators are illuminated.
11. Confirm the monitor prompts "**DO YOU WISH TO CONFIGURE THE SYSTEM**" and respond **NO**.
12. Whilst observing the PSU front panel Voltmeter, adjust potentiometer V Adj. until the voltmeter indicates 260 VDC.
13. Set the SU switches to the following positions and confirm:
    - Set the MASTER DC switch to OFF.
    - Confirm DC indicators are extinguished.
    - Set the AC VEHICLE switch to OFF.
    - Confirm the AC ON indicator is extinguished.
    - Set the AC SURFACE switch to OFF.
    - Confirm the AC ON indicator is extinguished.
14. Set the PSU switches to the following positions:
    - Set the Mains Isolator to OFF.
15. Electrically connect the system for operational use.
16. Carry out Pre-Operational checks as detailed in Task 1.
17. Launch the ROV.

NOTE.

The ROV when deployed will appear sluggish and underpowered until the DC compensation has been applied when the symptoms will disappear.

The following steps require the vehicle to draw a consistent current of at least 8 Amps from the DC supply whilst measurements and calculations are made. This can be achieved either by "pinning" the vehicle to the sea bed with vertical thrust, lights and some forward thrust applied, or by flying the vehicle at a constant speed in mid water.

18. Operate the vehicle to give a constant DC current draw of at least 8 Amps. Observe and note the PSU front panel ammeter reading.
19. Calculate the Surface voltage (Vs) as follows:
    Vs = 260 VDC + (DC current x Rt).

Example: 260 VDC + (10 Amps x 3.1 Ohms) = 291 VDC (Vs)

20. Whilst maintaining the current noted in Para. (18), adjust the PSU potentiometer I comp until the PSU voltmeter indicates Vs as calculated in Para. (19).

NOTE.

As the adjustment is made, the DC current will increase, therefore, either maintain the current measured initially by decreasing thrust, or repeat Paras. (18) and (19) until the correct adjustment is achieved.

It is recommended that the vehicle be run at full speed to check that sufficient makeup is possible. If sufficient makeup is not possible, the three-phase secondary tappings are to be adjusted to the next higher voltage if possible.

21. Switch off at all units power supplies.
22. Carry out Post-Operational checks as detailed in Task 2.

TASK 6
AC ADJUSTMENT PROCEDURE

Frequency of Task

AC Adjustment should be carried out in the following instances:

- System Relocation.
- New Installation.
- Change in Mains Supply.

Introduction

This task adjusts the system to enable operation on a variety of supply voltages.

Tools Required

The following tools may be required:

- 10 mm Spanner.
- Insulated screwdrivers (rated to 500 VDC minimum).

Parts Required

No parts required.

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.

CAUTION.

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.

Procedure

Proceed as follows:

1. Isolate and secure all vehicle electrical systems.
2. Ensure that no person is performing maintenance work on the system or system cabling.
3. Disconnect the external power supply.
4. With the input supply disconnected but available and taking precautions against electric shock measure, take note of the input supply voltage.

NOTE.

Unless otherwise stated the Transformer tappings are factory set to match a three-phase supply voltage of 440 VAC.

5. Gain access to the inside of the 9PSU and locate the Three-phase Transformer Primary Adjustment Links.
6. Adjust the links if necessary of the single phase transformer primary winding to correspond to the nearest voltage.
7. Adjust the links if necessary of the 3-phase transformer primary windings to correspond to the nearest voltage. To adjust the primary links of the 3-Phase transformer first remove four 10 mm nuts and remove the transformer cover.

NOTE.

The available voltages for the three-phase Transformers are marked accordingly on each terminal.

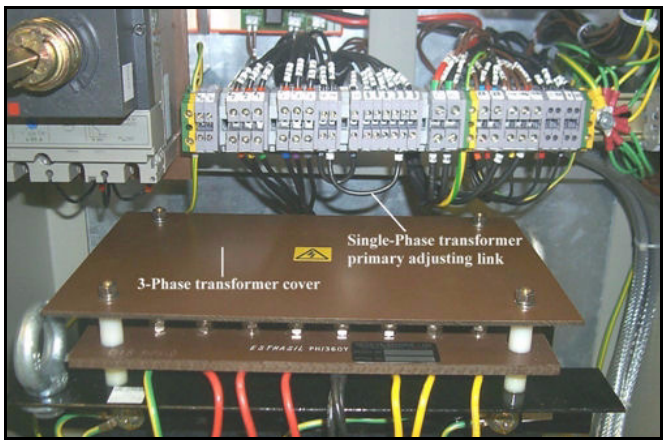


Figure. 7.11 Single-Phase Transformer Selector Link

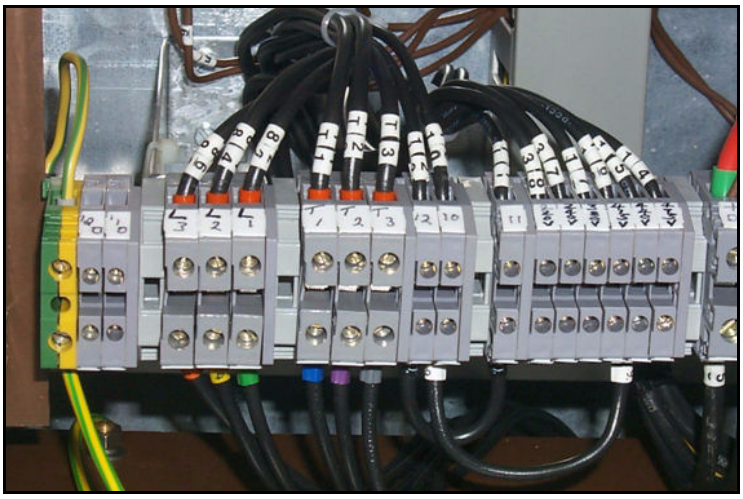


Figure. 7.12 9PSU Single Phase Terminal Block Link

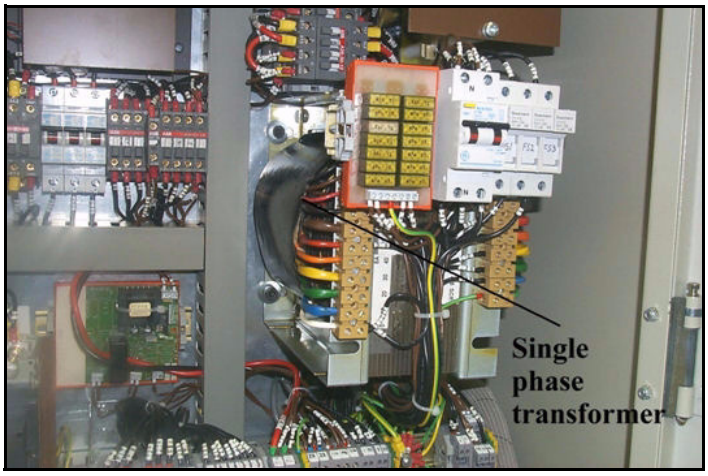


Figure. 7.13 Single-Phase Transformer

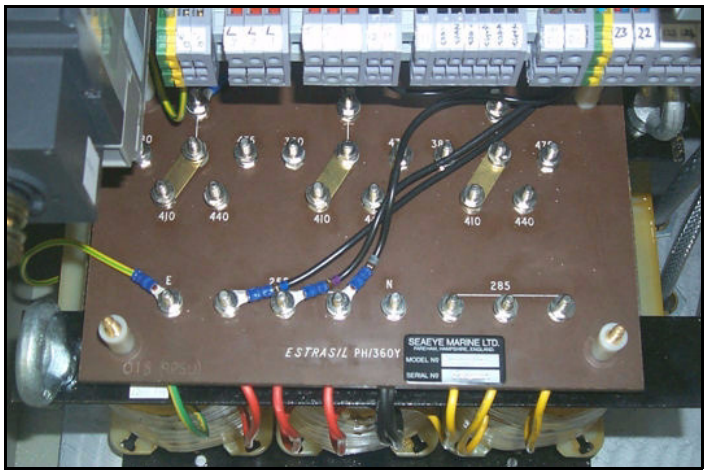


Figure. 7.14 Three-Phase Transformer Selector Links

8. Replace the transformer cover and secure with the four 10 mm nuts.

9. Power up the AC system and measure the Subsea AC output on the DIN rail. The voltage is to be between 230 and 240 VAC.
10. If the voltage is outside the specified limits, the selector links on the primary and secondary windings of the single phase transformer require re-adjusting.

TASK 7
VIDEO COMPENSATION ADJUSTMENTS

Frequency of Task

Video adjustments are be carried out in the following instances:

- Significant changes to the umbilical or tether length.
- Change of umbilical or tether.
- Change of camera.
- Change of video driver.

Introduction

The purpose of this Task is to pre-emphasise the video signal to compensate for signal loss due to the length of the umbilical and tether. The video system installed can be Fibre Optic, co-axial or a twisted pair depending on customer requirements. Fibre Optic systems require no compensation. With the co-axial video system the Video Amp PCB (6032P), fitted to Seaeye cameras, is adjusted for video compensation, however, with a twisted pair video system the 6032P PCB is factory set for zero compensation and the Line Video PCB adjusted for cable length. The PCB's are factory set to match the length of cable supplied, however, in the event of significant changes to the umbilical/tether length video compensation adjustment is necessary. The adjustments are made by setting up the sync pulse and by selecting DIL switches mounted on the PCB's proportional to the length of cable. The PCB's can accommodate umbilical lengths of 0 to 800 meters in 200 metre increments.

NOTE.

This procedure is for fitted Seaeye cameras. For other cameras such as the Kongsberg cameras fitted to some ROVs, the video compensation procedure may be different. Contact Saab Seaeye Ltd for video compensation instructions.

Tools and Test Equipment Required

The following tools and test equipment may be required:

- Tuning tool.
- Oscilloscope.

Parts Required

The following parts may be required:

- BNC T-piece.
- Test Lead Kit (Part No.P01835).

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.

CAUTION.

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.

Twisted Pair Video Compensation Procedure

Proceed as follows:

1. Ensure the ROV system is switched off at all units i.e. SU and the external power supply.
2. Ensure that no person is performing maintenance work on the system or cabling.
3. Disconnect the external power supply to the PSU.
4. Remove the camera unit from the ROV.
5. Remove the vent plug from the camera enclosure.
6. Remove the nylon lockwire from between the camera body and end-cap and carefully withdraw the end-plate.
7. Ensure the Video camera VIDEO/AMP PCB (6032P) DIL switches are to off for zero compensation.
8. Connect the oscilloscope to the output of the camera
9. Connect the PSU external power supply and switch on.
10. Set the following unit switch positions:
    - Set the PSU Mains Isolator to ON.
    - Set the PSU AC circuit breaker to ON.
    - Set the SU AC SURFACE switch to ON.
11. Adjust RV1 on the 6032P PCB to give a 300mv sync pulse.

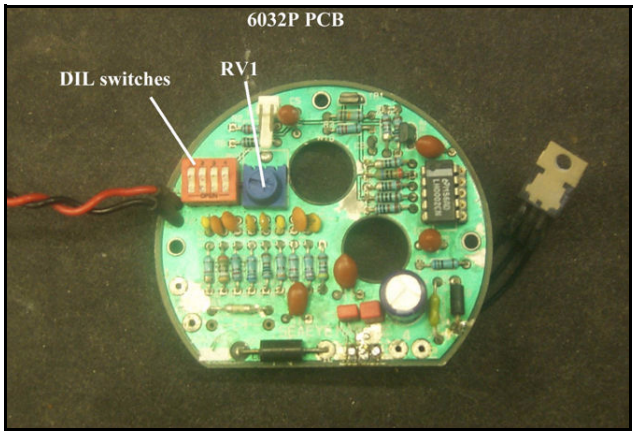


Figure. 7.15 6032 PCB

12. Set the oscilloscope and connect to the Balanced line video receiver PCB (located in the SU) as follows:
    - Dual Trace.
    - V/cm 200 mV.
    - Timebase 10 ìS.
    - TV line triggering.
    - Channel 1 to video A.
    - Channel 2 to video B (inverted).
    - Common grounds to GND.

NOTE.

If a monitor is not connected a 75-ohm load resistor must be wired to the video output.

13. Adjust RV1, line Driver PCB (located in the EPOD), for maximum signal.

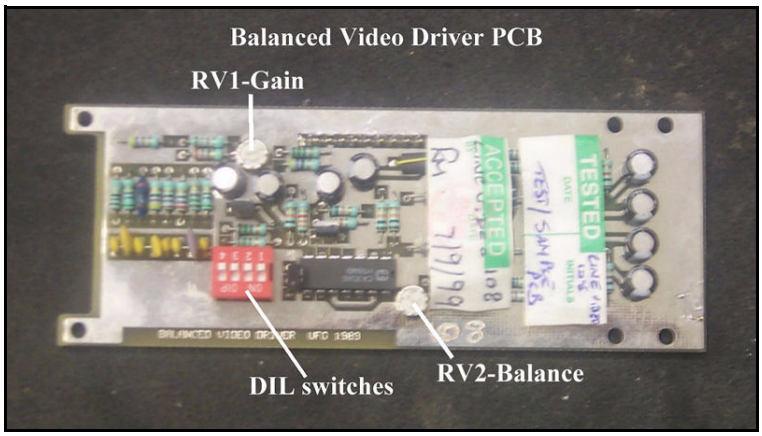


Figure. 7.16 EPOD Balanced Line Driver PCB

14. Set the oscilloscope to ADD ensuring channel 2 is inverted.
15. Adjust the Balance RV2 for minimum signal.
16. Set the oscilloscope to single trace and observe the video output from the surface unit.

17. Locate the four DIL switches on the Line Driver PCB and make only one at a time until the sync pulse is clearly defined with square edges. The DIL switches represent the following approximate lengths:
    - DIL 1 = 200m.
    - DIL 2 = 400m.
    - DIL 3 = 600m.
    - DIL 4 = 800m.

NOTE.

Only one DIL switch should be made at any one time.

18. The Video Receiver Amp in the surface unit can be adjusted to add further high frequency gain as follows.
19. Gain access to the Balanced Line video receiver PCB located in the Surface Unit.
20. Connect the oscilloscope to DIRECT VIDEO on the surface unit front panel.

NOTE.

The SURFACE/SUBSEA switch must be set to SUBSEA and the VIDEO1/VIDEO2 switch set o the correct position.

21. Ensure all DIL switches are in the OFF position.

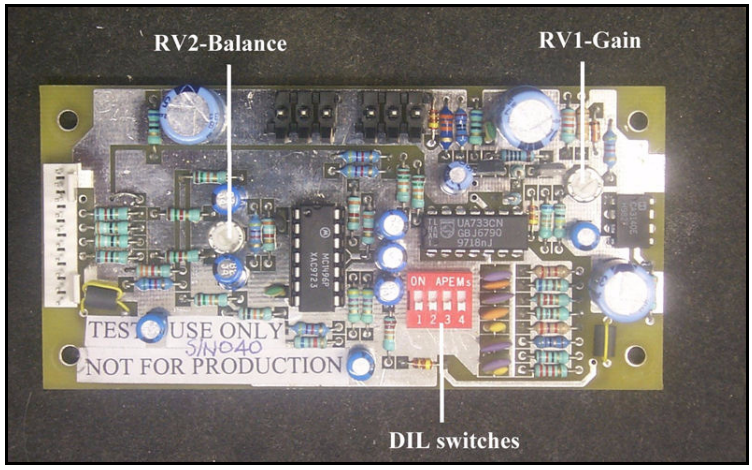


Figure. 7.17 Surface Unit Balanced Line Receiver

22. Adjust the BALANCE potentiometerRV1 to its mid position (on the centre line of the PCB).
23. Adjust the GAIN potentiometer, VR2 to produce a video signal amplitude of 1 V peak to peak (from the bottom of the sync pulse to peak white).
24. Set the following unit switch positions.
    - Set the SU AC SURFACE switch to OFF.
    - Set the AC circuit breaker to OFF.
    - Set the Mains Isolator to OFF.
25. Disconnect test leads and equipment.
26. Reassemble the surface unit and camera unit and refit to the vehicle.

TASK 8
VIDEO OVERLAY ADJUSTMENTS

Frequency of Task

Video overlay adjustments are to be carried out in the following instances:

- Video overlay instability with stable video picture.

Introduction

Video overlay adjustments can be carried out in one of two ways. The first procedure requires test equipment, however, if the required test equipment is not available the video overlay can be adjusted by eye as detailed in the second procedure.

Tools and Test Equipment Required

The following tools may be required:

- Frequency counter.
- Oscilloscope (35Mhz minimum bandwidth) and probes.
- Trimming tool.
- Colour bar generator or camera.
- Colour monitor.

Parts Required

The following parts may be required:

- Test Lead Kit (Part No P01835).

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.

CAUTION.

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.

Video Overlay Procedure (Using Test Equipment)

Proceed as follows:

1. Ensure the ROV system is switched off at all units i.e. SU.
2. Ensure that no person is performing maintenance work on the system or system cabling.
3. Disconnect the external power supply to the PSU.
4. Open the SU and using the extender card and extender leads gain access to the video Vidol PCB.

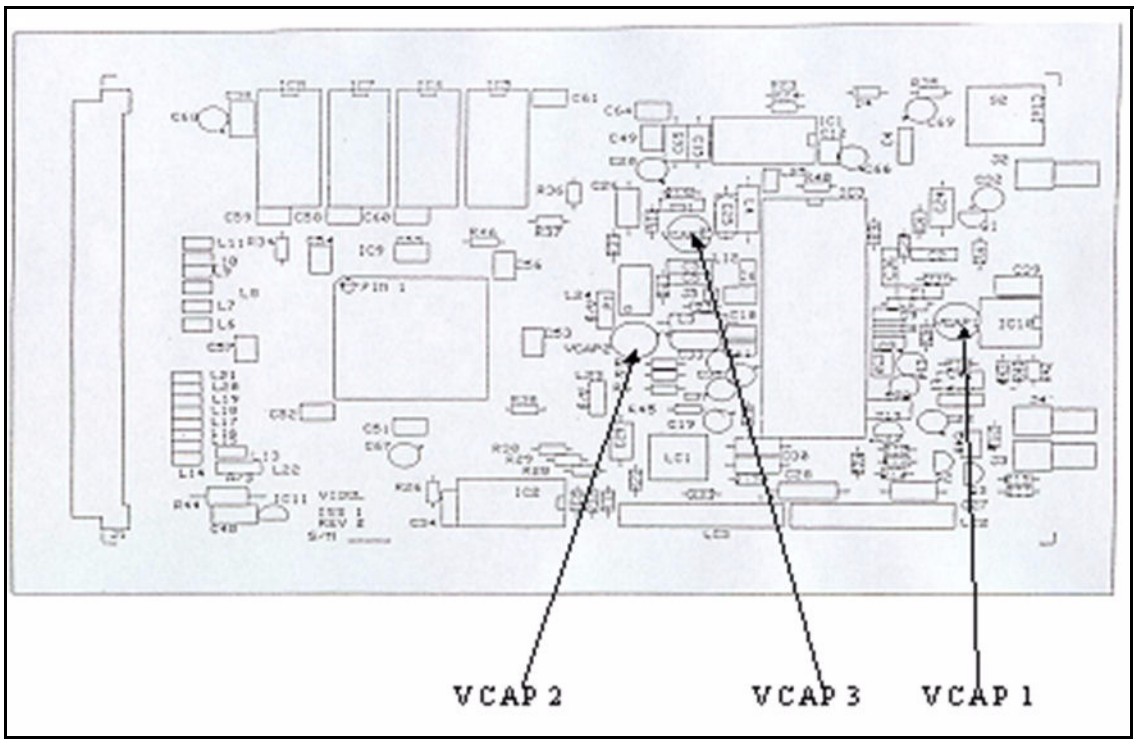


Figure. 7.18 Video Vidol PCB Identifying VCAP 1, 2 and 3

5. Connect the test lead as follows:
   - Connect common probe to the case of one of the video plugs.
   - Connect positive probe to video overlay PCB IC3 pin 35 or IC1 pin 4.
   - Connect to the input of the frequency counter.
6. Connect the PSU external power supply and switch on.
7. Set the following unit switch positions:
   - Set the PSU Mains Isolator to ON.

- Set the PSU AC circuit breaker to ON.
- Set the SU AC SURFACE switch to ON.

8. Using the trimming tool adjust VCAP1 to obtain a clock frequency of 30 Mhz ± 100Hz on the frequency counter.
9. Disconnect the test lead from the frequency counter and connect to the oscilloscope.
10. Set up the Oscilloscope as follows:
    - V/cm to 2 volts.
    - Timebase to 10ìS.
11. Remove probe from IC3 and connect to IC3 pin 5.
12. Using the trimming tool adjust VCAP 3 to obtain a 64ìS sync line signal on the oscilloscope.
13. Disconnect the probes and switch off the oscilloscope.

NOTE.

To set up the burst frequency accurately requires that the unit be returned-to works, however, the following procedure may be utilised when operational time constraints dictate to provide an approximate adjustment.

14. Connect the video source to the video overlay input.
15. Connect the SU DIRECT VIDEO output connector to the monitor.
16. Switch the video select switch to SURFACE, ensuring the video overlay is in the default mode (when first switched on).
17. Adjust VCAP 2 to obtain a green background in the compass rose box.
18. Switch off the monitor, video source and disconnect.
19. Set the following unit switch positions:
    - Set the SU AC SURFACE switch to OFF.
    - Set the AC circuit breaker to OFF.
    - Set the Mains Isolator to OFF.
20. Remove the extender PCB, leads and secure the system.

Video Overlay Procedure (Using Eye Method)

Proceed as follows:

1. Ensure the ROV system is switched off at all units i.e. SU.
2. Ensure that no person is performing maintenance work on the system or system cabling.
3. Disconnect the external power supply to the PSU.
4. Open the SU and using the extender card and extender leads gain access to the video overlay PCB.
5. Connect the PSU external power supply and switch on.
6. Set the following unit switch positions:
    - Set the PSU Mains Isolator to ON.
    - Set the PSU AC circuit breaker to ON.
    - Set the SU AC SURFACE switch to ON.

7. Switch the video select to SURFACE.
8. Adjust VCAP 1 to obtain a stable, centralised sharp overlay.
9. Switch the video select to SUBSEA.
10. Adjust VCAP 3 and adjust to obtain a stable overlay.
11. Repeat Paras. (7) to (10) to achieve a stable overlay on both SURFACE and SUBSEA positions.
12. Switch the video select to SURFACE.
13. Adjust VCAP 2 to obtain a green background in the compass rose box.
14. Set the following unit switch positions:
    - Set the SU AC SURFACE switch to OFF.
    - Set the AC circuit breaker to OFF.
    - Set the Mains Isolator to OFF.
15. Remove the extender PCB, leads and secure the system.

TASK 9
COMPASS CALIBRATION

Frequency of Task

The following procedure is to be carried out in the following circumstances:

- Loss of compass calibration (indicated by an “O” displayed on the system monitor overlay.
- When additional metal equipment has been fitted to the vehicle.
- Change of compass.
- System relocation.

Introduction

This task details the procedure for compass calibration. Calibration can be conducted either on land or in water but in either case away from metallic structures. When calibrating on land, it is recommended that the vehicle be calibrated whilst suspended from a hoist.

Tools Required

The following tools may be required:

- Hand held compass.
- Hoist.

Parts Required

No parts required.

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.

CAUTION.

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.

Procedure

Proceed as follows:

1. Set the system up for operational use, but if calibrating the compass on land do not energise the 260 VDC supplies.
2. Rotate the vehicle to a magnetic heading of between 271 and 359 degrees as indicated by the hand held compass.
3. Set the PDU switches to the following positions:
   - AC VEHICLE switch to OFF.
   - AC SURFACE switch to OFF.
   - MASTER DC switch to OFF.
   - After a delay of at least 10 seconds switch the AC SURFACE switch to ON.
   - Set the MASTER DC and VEHICLE DC switches to ON **if calibrating in water**.
4. When prompted by the system monitor message **"DO YOU WISH TO CONFIGURE THE SYSTEM?"** respond YES.
5. Respond NO to subsequent prompts until asked; "**DO YOU WISH TO INITIALISE THE COMPASS?"** is displayed and respond YES.
6. Start to rotate the vehicle (starting in the NW quadrant) slowly and evenly clockwise through 360 degrees at a rate of one revolution per minute.
7. Respond NO to all subsequent prompts until **"DO YOU WISH TO CONFIGURE THE SYSTEM?"** is displayed and respond NO.
8. Confirm the system has entered Flight mode.
9. At the system monitor confirm that "I" is displayed to confirm the vehicle compass is initialised for calibration and the vehicle heading displayed at the start is between 271 and 359 degrees.

NOTE.

At no time is the vehicle to be allowed to turn anticlockwise once Initialisation has started.

10. Rotate the vehicle s evenly clockwise through 360º.
11. At the monitor observe as the vehicle rotates the "I" has been replaced by "R".
12. When the vehicle has passed through 360º for the third time, confirm that the monitor does no longer display "R" and no other error codes are displayed.
13. If "R" remains displayed repeat the calibration procedure.
14. On completion of calibration carry out a functional test on the auto heading mode.

TASK 10
FINISH RESTORATION

Frequency of Task

When it is necessary to carry out minor body repairs.

Introduction

This task details the procedures on how to carry out minor damage repairs to anodised enclosures. In the event of major damage contact SAAB SEAEYE LTD. for advice.

Tools Required

The following tools may be required:

- P1000 wet and dry.
- Black Humbrol paint.
- Amberklene.
- Lint free cloth.

Anodised Enclosure Repair Procedure

WARNING.

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.

Proceed as follows:

1. Remove the damaged anodised enclosure.
2. Clean the damaged area with lint free cloth soaked in Amberklene.
3. Dress the damaged area using the P1000 wet and dry.
4. Apply black Humbrol paint to the damaged area; allow to dry and apply a second coat if required.
5. Refit the anodised enclosure.

TASK 11
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 electronics pod 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.

TASK 12
TILT MOTOR AND FEEDBACK ASSEMBLY OIL LEVEL CHECK AND REPLENISHMENT

Frequency of Task

Pre and Post-flight.

Introduction

The purpose of this check is to ensure that the tilt motor and feedback assembly oil levels are correct prior to operational use and details the procedure on how to replenish the oil if required. The procedure for filling both the tilt motor and the feedback assembly are similar. The units use Mobilect39 oil, under **NO** circumstances are any other oils to be used.

Tools Required

The following tools may be required:

- Hex key set.
- Diaphragm puller tool (Part no TH110).
- Seaeye Fillkit (Part No P00514).

Parts Required

The following parts may be required:

- Mobilect39 oil.
- Clean container for collecting oil.

Oil Level Check Procedure

WARNING.

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.

Proceed as follows:

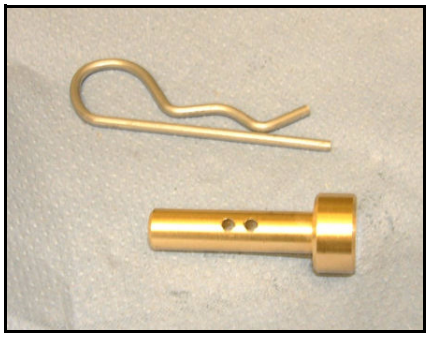


Figure. 7.19 Diaphragm Puller Tool

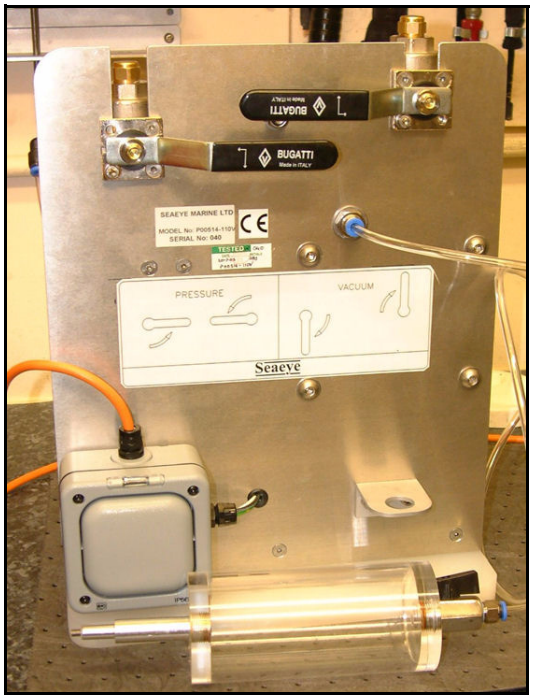


Figure. 7.20 Oil Fill Kit P00514

1. Visually examine the motor and feedback unit, cable glands and cables, and chassis vicinity for signs of oil leakage.
2. Using the Diaphragm Puller Tool, screw into the motor/feedback diaphragm and ensure that the top of the diaphragm cover is between the drilled holes on the tool.

If the holes are not visible, carry out the oil replenishment procedure.

NOTE.

If frequent topping up is required, an investigation is required to ascertain the possibility of damage to the motor.

Oil replenishment procedure

Proceed as follows:

1. Remove the required motor/feedback assembly.
2. Position the unit vertically using a mounting base.

3. Insert the Diaphragm puller tool into the unit end cap and screw onto diaphragm-threaded stud.
4. Holding the unit securely, pull upward on the puller tool until the locking pin hole is visible above the end cap and insert locking pin. If necessary, loosen the unit fill screw to release the pressure taking care that the oil pressure does not cause the oil to be released through the fill screw hole. Release the puller tool.

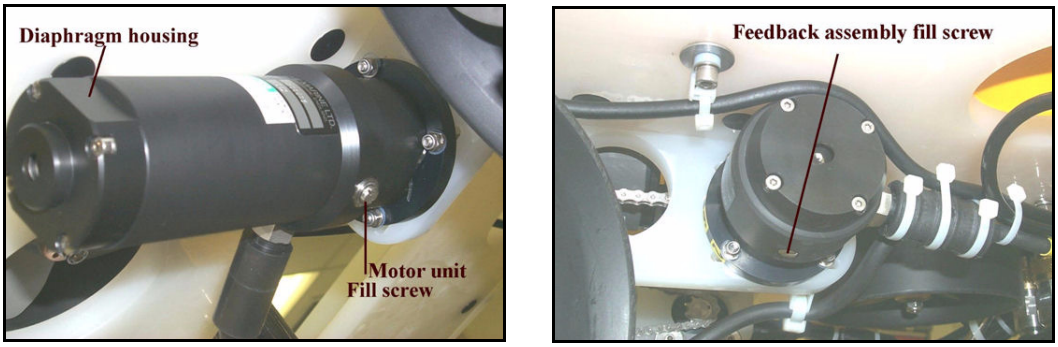


Figure. 7.21 Vent Screws

5. Carefully fully remove the unit fill screw and retain. Replace the O-ring.

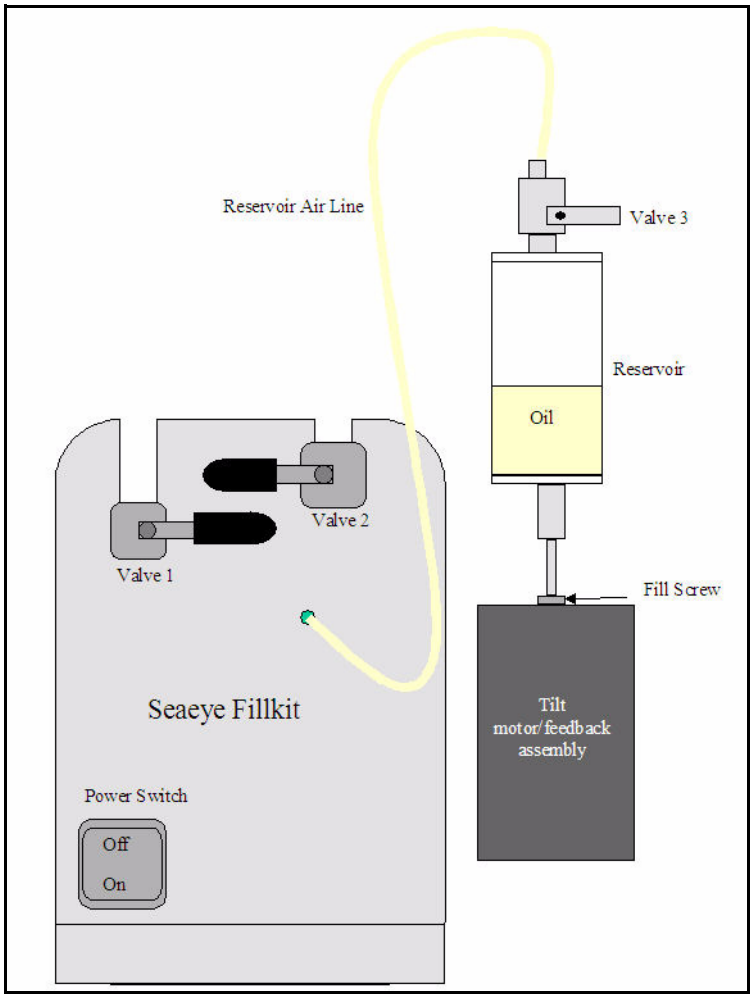
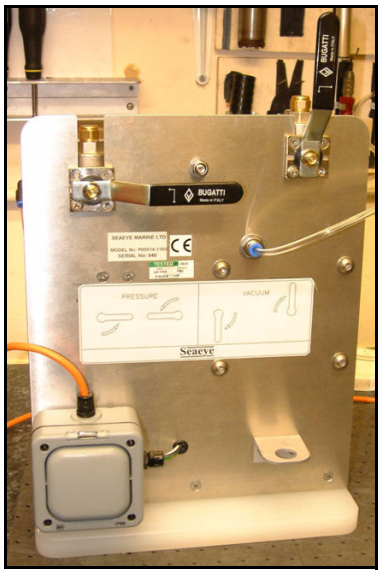


Figure. 7.22 Oil Replenishment Setup

6. Ensure the Fillkit kit reservoir is clean and empty and the power switch is set to OFF.



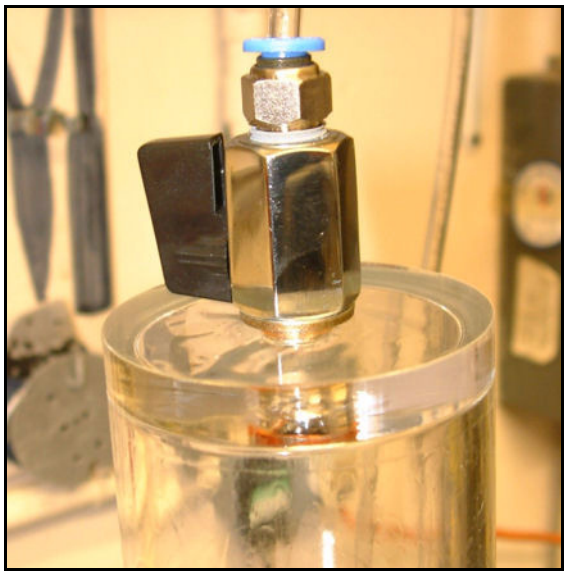


Figure. 7.23 Oil Fill Kit Valve Positions

7. Confirm the following:
   - Vacuum Valve – vertical position.
   - Pressure Valve – horizontal position.
   - Reservoir Valve – vertical position
8. Place the reservoir end in the container of the replenishment oil.
9. Switch on the Fillkit.
10. Slowly move the pressure valve towards the vertical position and confirm oil is being drawn from the reservoir.
11. When the reservoir is three quarters full, return the pressure valve to the horizontal position.
12. Move the reservoir valve to the horizontal position and switch off the Fillkit.
13. Connect the reservoir to the unit fill screw orifice. Position the unit so that it is approximately at a 45 degree angle with the unit fill screw orifice at the 'upper' position.
14. Move the reservoir valve to the vertical position.
15. Remove the diaphragm puller tool locking pin.
16. Switch on the Fillkit. Slowly move the vacuum valve and observe that the diaphragm puller tool rises as the oil is pumped into the unit. Ensure that the diaphragm puller tool does not reach the fully upper position while carrying out the 'oil fill' operation. When the diaphragm puller moves towards the upper position, close the vacuum valve and open the pressure valve to expel air from the unit. Ensure that the diaphragm puller tool does not reach the fully lower position while carrying out the 'cycling' operation.
17. Slowly continue to 'cycle' the vacuum and pressure valves up and down and observe that the diaphragm puller tool rises and falls. Ensure that the diaphragm puller tool does not reach the fully upper or lower position while carrying out the 'cycling' operation.

18. Observe that the air is expelled from the unit diaphragm through the oil reservoir.
19. When all air has been expelled, position the pressure and vacuum valves in the off position.
20. Fit the locking pin through the diaphragm lower locating pin hole.
21. Switch off the Fillkit.
22. Move the vacuum valve and reservoir valve to the vertical position.
23. The diaphragm puller tool will fall to the locking pin level.
24. Remove the Fillkit reservoir from the unit.
25. Refit the unit fill screw.
26. Clean the unit of any oil spillage.
27. Remove the locking pin and observe the puller tool pinholes and ensure that at least one of the holes remain visible. This indicates that the unit is completely filled with oil and purged of air. Should the tool “sink” into the unit end cap repeat the fill procedure.
28. Remove the diaphragm puller tool.
29. Visually examine the unit for signs of oil leaks.
30. Sparingly lubricate the unit connector threadforms with silicone grease.
31. Refit the unit to the ROV.

TASK 13
TILT FEEDBACK POTENTIOMETER SYNCHRONISATION

Frequency of Task

The following procedure is to be carried out in the following circumstances:

- Tilt feedback potentiometer synchronisation.
- Tilt feedback potentiometer replacement.
- Wear on potentiometer coupling.

Introduction

The purpose of this task is to synchronise the feedback potentiometer and the overly tilt icon data.

Tools Required

The following tools may be required:

- 2 mm hex key.

Parts Required

No parts are 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.

Proceed as follows:

1. Ensure the ROV system is switched off at all units.
2. Ensure that no person is performing maintenance work on the system or cabling.
3. Disconnect the tilt motor connector from the electronics pod.
4. Power up the vehicle **AC supply ONLY**.

5. On the prompt "**DO YOU WISH TO CONFIGURE THE SYSTEM?**" respond NO.
6. Confirm normal flying mode overlay is displayed together with images from the vehicle video camera.
7. Locate and ensure the two grubscrews on the potentiometer drive chain sprocket are fully tightened.

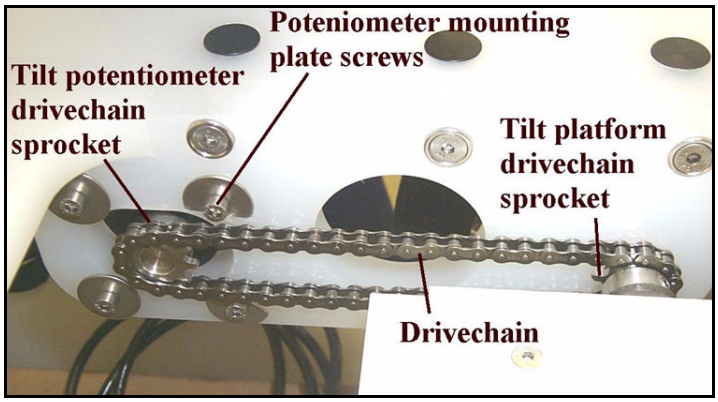


Figure. 7.24 Tilt Platform Drive Chain and Sprockets

8. Adjust the tilt platform by hand to the central (horizontal position) and hold.
9. Locate the two grubscrews on the tilt platform drivechain sprocket and loosen.

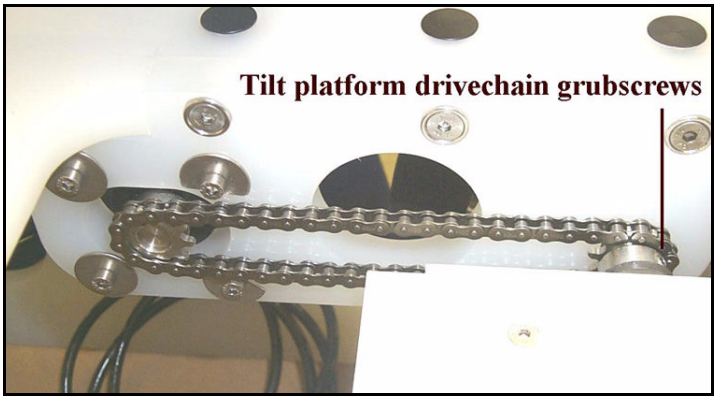


Figure. 7.25 Tilt Platform Drive Chain Sprocket Grub Screws

10. Insert the 2 mm hex key into one of the grubscrews and using it as a lever rotate the sprocket until the tilt icon on the overlay indicates that the tilt platform is horizontal. Fully tighten the grubscrews to lock the sprocket to the tilt platform stub shaft.
11. Move the tilt platform and confirm the tilt icon is now synchronised with the tilt platform position. Repeat the above steps as necessary.
12. Power down the vehicle AC system.
13. Reconnect the tilt motor connector to the electronics pod.

CHAPTER 8

DIAGNOSTIC

MAINTENANCE

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8. DIAGNOSTIC MAINTENANCE

This Chapter provides diagnostic flow charts to help the maintainer arrive at the possible defective area.

8.1 Introduction

The main fault detection tool for Seaeye systems is the SML Telemetry Monitor unit (TMU) which provides a comprehensive aid to fault diagnosis by monitoring system telemetry.

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. As stated earlier, the TMU unit is the primary method for fault finding as the charts provided 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.

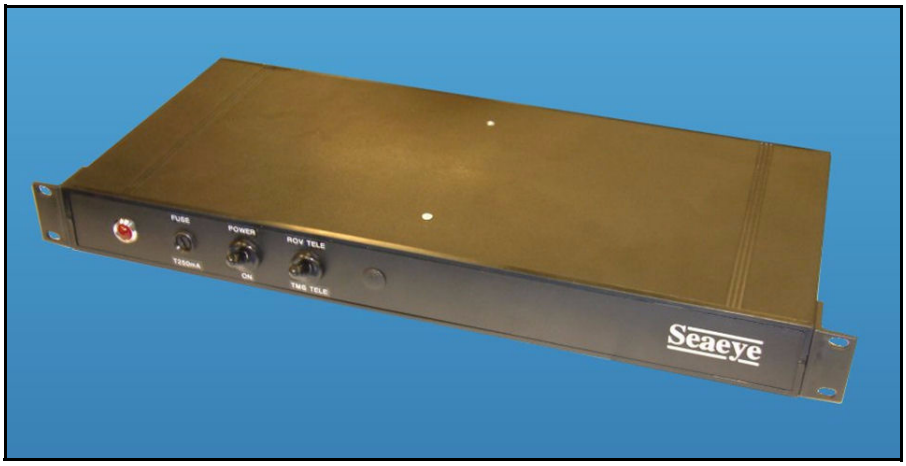

Figure. 8.1 SML Telemetry Monitor Unit

8.1.1 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.

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.

POSSIBLE DANGER TO PERSONNEL AND DAMAGE TO EQUIPMENT. THE ELECTRONICS POD WEIGHS APPROXIMATELY 16 KG RESPECTIVELY AND CARE SHOULD THEREFORE BE TAKEN WHEN LIFTING THE POD FOR SLINGING PURPOSES.

DANGER TO PERSONNEL AND EQUIPMENT. THE 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 equipment. When using an insulation meter, ensure that the cable under test is disconnected at both ends.

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.

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

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

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.

8.2 SML Unit Telemetry System

The Telemetry Monitor Unit and associated software is dual purpose; designed to monitor system telemetry as an aid to fault diagnosis and to transmit environmental data to external navigational/survey equipment. Extracted data from the telemetry is converted by the Data Converter from RS485 into RS232 format and received by an IBM compatible PC (not supplied) for subsequent display using the software provided. Environmental data from the PC can be transmitted via PC COM port 2 to external equipment for processing.

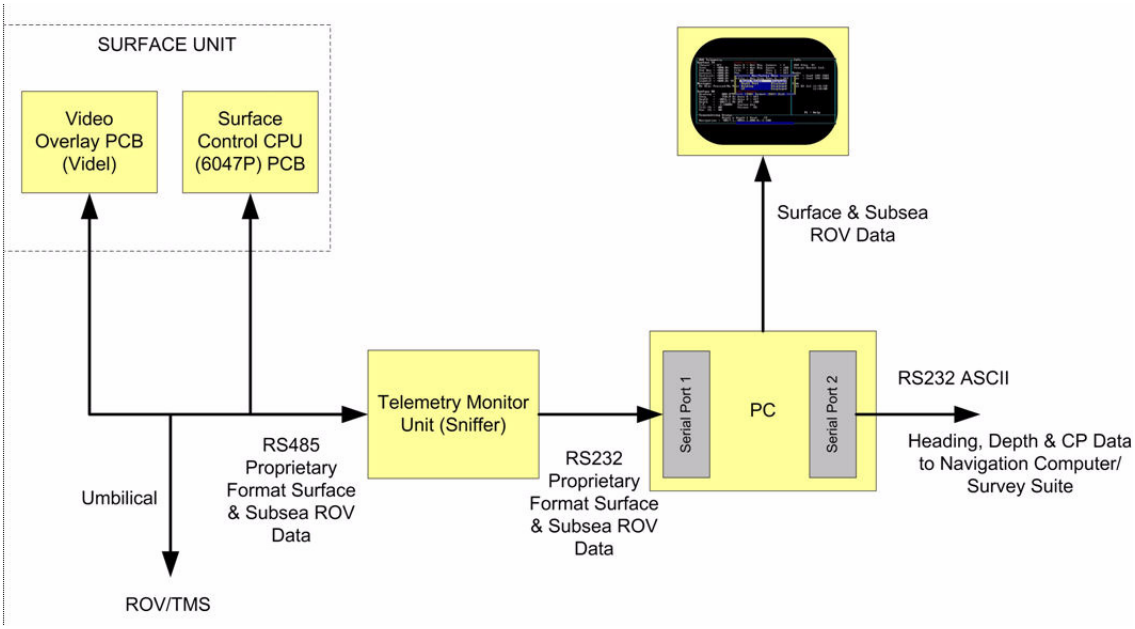

Figure. 8.2 Functional Block Diagram of Data Export Diagnostic System

8.2.1 General Description

The Data Converter is a self contained, impact- resistant plastic unit that requires either a 120 or 240 VAC external power supply or a 9 VDC battery fitted within a battery compartment at the rear of the unit. The front and rear panels contain the following:

- PC connector socket
- BAT/AC selection switch

- COMMS input socket
- Red power indicator
- Mains input socket
- ON/OFF switch
- ROV/TMS telemetry switch
- Battery compartment

8.2.2 Hardware Installation

Connect the system as follows:

1. Ensure the supply is disconnected from the rear of the Data Converter.

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.

2. Ensure the voltage setting in the unit corresponds to the Sniffer unit input supply as detailed in Fig. 8.3.

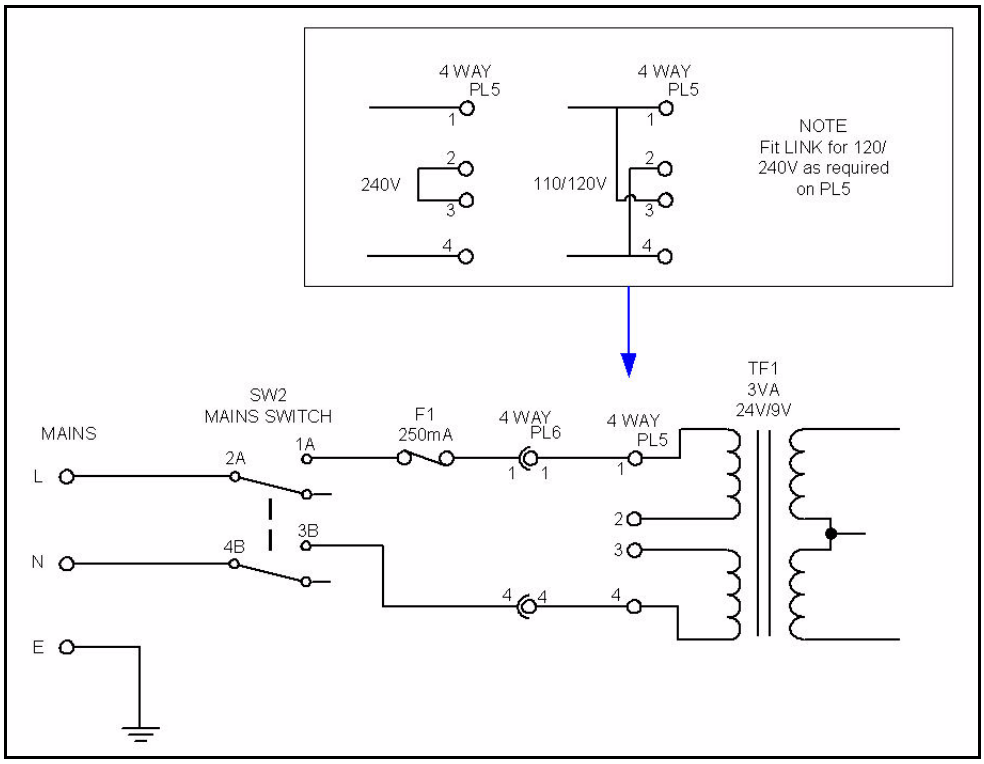

Figure. 8.3 SML Unit Input Power Supply Link Setting

3. Connect the lead from the Data Converter PC connector to COM port 1 of the PC.
4. The orange and yellow twisted pair lead can be connected in one of two ways depending on the ROV system as follows:
   - **New Systems** - Connect the orange and yellow twisted pair lead from the Data Converter COM connector to the 15 way D connector on the rear of the Surface unit.
   - **Older Systems** - Disconnect the telemetry lead from the CPU PCB (6047P) and connect the supplied 3 way Molex "T" adaptor. Connect the telemetry lead and orange and yellow twisted pair lead to the "T" adaptor.
5. Connect the external power supply.
6. Set the rear switch to I (ON) position and confirm the front panel led illuminates.

8.3 Digital Protocol Analyser (DPA)

The DPA was written specifically for Saab Seaeye ROVs as both a diagnostics tool and a pilot aid. It is used to analyse the telemetry between the surface and subsea and to present this data in a human readable format (as opposed to the raw binary data being passed between surface controller and ROV).

8.3.1 Configuration

ROV Telemetry

Standard Seaeye ROV protocol: RS485 Half Duplex (Many Talkers & Listeners) twisted pair, multidrop.

- 1 Start bit, 9600 Baud, 8 Data bits, No Parity, 1 Stop bit.

Nav/Survey Telemetry

RS232 twisted pair, complying to NMEA 0183 version 1.5.

- 1 Start bit, 4800 Baud, 8 Data bits, No Parity, 1 Stop bit. Update rate once a second(1Hz)

ASCII transmission data format

With ‘multiple strings’ selected, the following strings can be enabled by clicking the corresponding button on the main screen:

- Depth Below Surface feet
  - $DBS,XXXX.X,f<CR>(carriage return)<LF>(line feed)
- Depth Below Surface metres
  - $DBS,XXXX.X,M<CR>(carriage return)<LF>(line feed)
- Compass Heading (magnetic)
  - $HCC,XXX,<CR>(carriage return)<LF>(line feed)
- CP (mV)
  - $PCP,XXXX<CR>(carriage return)<LF>(line feed)

NOTE.

Negative sign "-" is shown as first character in a field if the value is negative. The sign is omitted if the value is positive.

With ‘single string’ selected, a single string is transmitted as follows,

- With pitch and roll included:
  - $PCI,S(sign)XXXX.X(depth mtrs data),S(sign)XXXX.X(depth ft data),XXX.X(heading data),S(sign)X.XXX(CP data),S(sign)XX.XX(Pitch), S(sign)XX.XX(Roll)<CR>(carriage return)<LF>(line feed)
- Without pitch and roll included:
  - $PCI,S(sign)XXXX.X(depth mtrs data),S(sign)XXXX.X(depth ft data),XXX.X(heading data),S(sign)X.XXX(CP data)<CR>(carriage return)<LF>(line feed)

NOTE.

Pitch and roll are only available if the appropriate sensor is fitted and the ROV software updated to use it.

8.3.2 Hardware Configuration

The application opens up with the configuration panel, which allows the serial ports to be set for ROV telemetry and the navigation export (the export can be set to ‘unused’ if not required). Any selection of heading, depth in metres, depth in feet and CP voltage can be exported by clicking the respective buttons on the configuration panel. The configuration panel can be hidden, if desired, by pressing Ctrl+O or by clicking ‘Configuration’ on the ‘View’ menu. All these settings are stored in the DPAsettings.ini file in the installation folder.

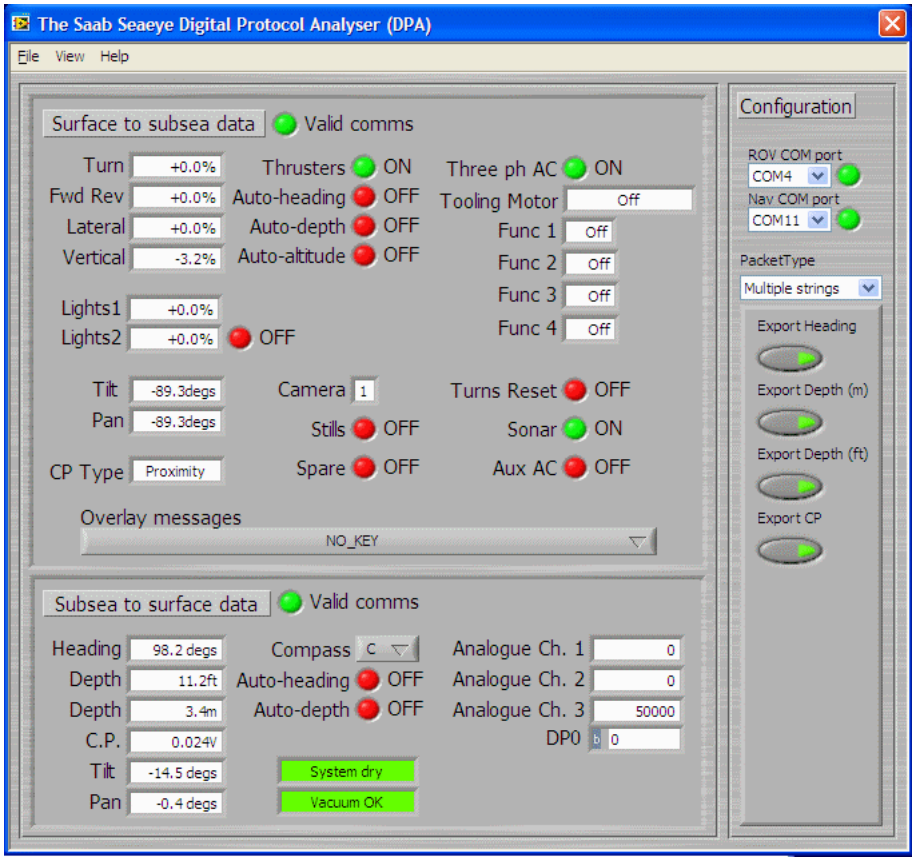

Figure. 8.4 Vehicle Windows Viewer Panel

8.3.3 Diagnostics

In the event of the application repeatedly crashing or failing to open a serial port, a diagnostics message panel can be opened by pressing Ctrl+m or by clicking 'Messages' on the 'View' menu. Copy the text from this box and send it to rovs@seaeye.com for assistance in finding the problem.

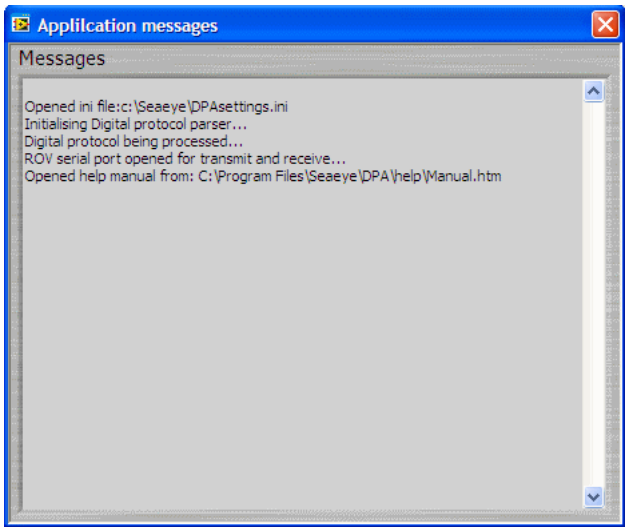

Figure. 8.5 DPA Message Panel

8.4 DOS Software Installation

Software supplied on the disk includes vehicle and TMS programs and can be run on virtually any IBM compatible PC. Vehicle software can be run through either a DOS window or from DOS. The Vehicle software also includes a windows based software program that can be installed onto a PC to provide a windows interface for vehicle telemetry information.

The TMS program can only be run from DOS.

NOTE.

The software does not have to be installed and can be run from A drive.

8.4.1 Vehicle Software Installation

The system has been designed for default settings of the PC COM ports as follows:

- Com port 1 IRQ4 ROV telemetry.
- Com port 2 IRQ3 data export.

If the ports require exchanging the command line parameter “rovview3 –C2” requires passing. This will set the default settings as:

- Com port 1 IRQ4 data export.
- Com port 2 IRQ3 ROV telemetry.

NOTE.

It is not possible to run the software using different COM ports other than COM ports 1 and 2. If other COM ports are required contact Seaeye Marine for advice.

The software can be run from windows by double clicking the “Rovview3.exe” file or from DOS by entering “A\rovview3.exe” at the DOS prompt. Instructions can be found on the readme file on the disk.

NOTE.

The media used to store the software must be writable.

To quit the program press the <ESC> key.

8.4.2 Software Configuration

A configuration file is read at the start of the program and contains the following variables:

- nav id – this determines which data is sent in the Nav/survey string.
- depth offset – maintains the depth offset value when the PC is switched off.
- config id – determines whether Lights 2 is variable or switched depending on the ROV system.

The configuration file is overwritten when the program is exited using the <Esc> key.

NOTE.

If the configuration file is deleted or corrupt the system defaults to set values and a depth zero will be required to display the correct depth value. It is recommended that a zero depth is carried out on the surface prior to each vehicle operational task and when the unit is connected during operation when there will be a discrepancy between overlay and Sniffer unit depth indication.

8.4.3 Operation

The Viewer displays three areas:

- ROV Telemetry – Displays data transmitted (Surface TX) and received (Surface RX) from the ROV.
- Info – Displays the ports in use and their associated IRQ value. Current time is displayed with date and time the program was started. Pressing the return key resets program start time.
- Transmitting status – Displays the data exported from the Nav/Survey port to the Survey Suite.

Figure. 8.6 Vehicle Viewer Display

During operation the following keys can be used:

- F1 Help menu
- F2 Config menu
- F4 Nav/Survey menu
- P Pause
- Ret Reset time
- Esc Exit program

The config and Nav/Survey menus when selected from the function keys allow an item to be highlighted by scrolling up or down using the arrow keys. When the required item has been highlighted pressing the <TAB> key changes the current value (Fig. 8.5). Pressing the return key exits the menu.

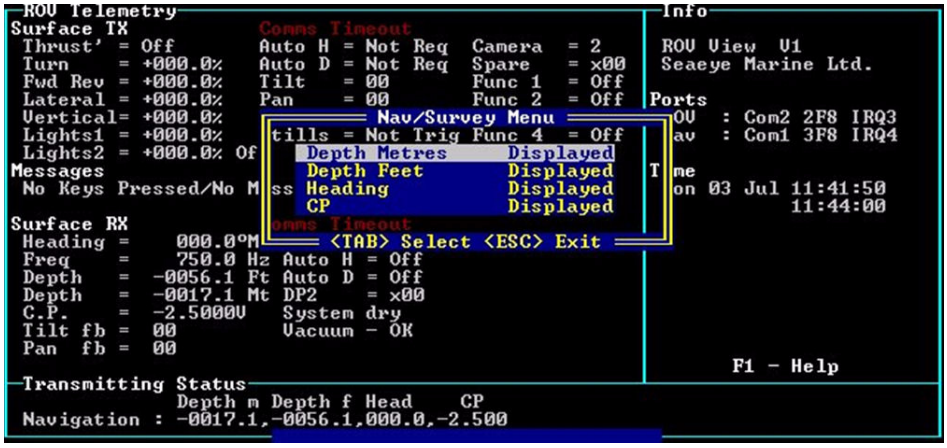

Figure. 8.7 Nav/Survey Menu

8.4.4 Output Data Format

The output data format complies with the NMEA 0183 standard of 1 start bit, 4800 baud, 8 data bits, no parity, 1 stop bit at an update rate of 1 per second. The data string format consists of the following:

$PC1,Sxxxx.x,Syyy.y,Sz.zzz<CR><LF>

where:

$ = sign character (+/-)

x = depth in metres

y = heading in degrees

z = CP in volts

<CR> = carriage return character

<LF> = line feed character

8.4.5 TMS Software Installation

The program can be run by entering “A:\TMSVIEW1\TMSVIEW1.exe” from DOS at the DOS prompt. Instructions can be found on the readme file on the disk.

The viewer display has two panels. The upper panel displays data flowing from Surface to Subsea and the lower panel displays data flowing from Subsea to Surface.

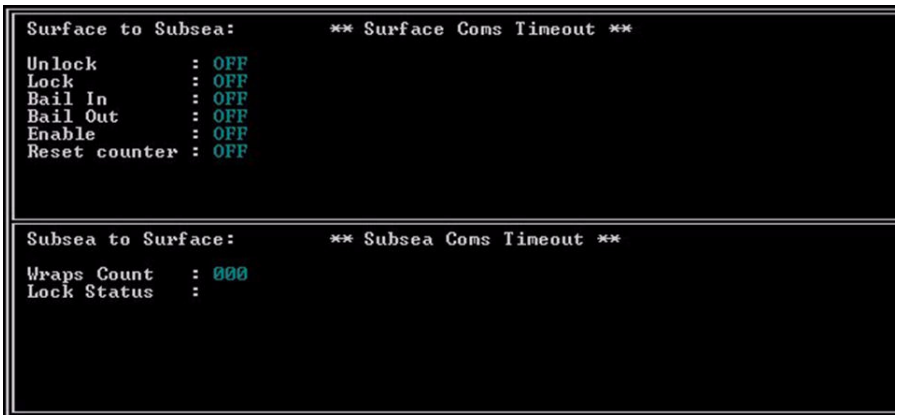

Figure. 8.8 TMS Viewer Display

8.4.6 Viewer Error Messages

The following table is a list of possible error messages that can be displayed on the viewer.

Error Message	Meaning
Surface Comms Timeout	Displayed in the upper panel. Indicates that the viewer is not receiving communications from the surface CPU
Subsea Comms Timeout	Displayed in the lower panel. Indicates that the viewer is not receiving communications from the Subsea CPU. This message also occurs during a system configuration procedure
Heading=Error I	Indicates that the subsea system is not receiving data from the compass
Heading=Error A	Indicates that the subsea system is receiving from the compass but the messages received are not recognised as being valid
Freq=Error and Depth=Error	If either of these messages are displayed then the output of the depth sensor is either not being received by the subsea system or is out of range

Table. 8.1 Viewer Error Messages

8.4.7 Parts Supplied

Table 8.2 lists the parts supplied with the Data Converter.

PART	Quantity
SML232/RS485 Data Converter	1
25 way to 9 way RS232 lead	1
13 way Molex “T” adaptor lead	1
Telemetry patch leads	2

Table. 8.2 Parts Supplied

PART	Quantity
3.5” floppy disk	1
Power lead	1

Table. 8.2 Parts Supplied

8.5 Tiger Fault Diagnosis

FAULT SYMPTOM	PROBABLE CAUSE	REPAIR ACTION
Lamps do not respond to HCU demand	No DC supply.	Test DC supply and umbilical connection.
	Defective lamp	Replace
	Fuse blown	Check lamp holder fuses, Dual Light FET Suppressor PCB fuses and fuse F3, located on the EPOD side-plate
	Defective PCBs: 6062P 6059P 6040P	Replace
	Lights control not configured	Configure (Chapter 4)
	Defective HCU cable or lights control potentiometer	Replace
Thrusters do not respond to HCU demands	No DC supply	Test DC supply and umbilical/tether connections
	Thruster enable switch to off	Set to on
	Thruster controls not configured	Configure (Chapter 4)
	Communications failed surface/ subsea	Restore
	Propellers fouled	Clear fouling
	Fuses blown	Check fuses on: 6056P 6034P

Table. 8.3 Tiger Fault Diagnosis Information

FAULT SYMPTOM	PROBABLE CAUSE	REPAIR ACTION
Thrusters do not respond to HCU demands	Defective HCU cable	Replace
	Defective HCU or potentiometers	Replace
	Defective PCBs: 6056P 6034P 6041P 6040P 6081P	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
	Fuse blown	Check fuses on: 6056P 6034P
	Defective PCBs: 6056P 6034P	Replace
Tilt does not respond to HCU demand	HCU TILT control not configured	Configure (Chapter 4)
	Tilt unit fouled	Clear platform
	Defective PCBs: 6040P 6059P 6058P	Replace
	Defective Tilt feedback potentiometer 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 SU Video PCBs	Replace
	Monitor set up, leads	Check control settings and leads

Table. 8.3 Tiger Fault Diagnosis Information (Continued)

FAULT SYMPTOM	PROBABLE CAUSE	REPAIR ACTION
No Video image from cameras	No AC supply	Test AC supply and umbilical connections
	No camera supplies	Investigate
	Defective PCBs: 6032P Vidol	Replace
	Defective camera	Replace
	Video Line Driver fuses blown	Replace
Poor Video image	Poor connection	Check/clean
	Monitor setting	Check
	Incorrect video comp	Check (Chapter 7)
	Defective video PCBs	Replace
Unstable overlay with stable video image from cameras	Incorrect video overlay adjustment	Adjust (Chapter 7)
No overlay data with camera video images present	No overlay selected	Operate SU keypad COL key
	Defective Video PCBs	Replace
Control system does not respond to SU keypad	Defective keypad ribbon	Repair/replace
Control system does not respond to SU keypad	Defective 6041	Replace
	System crashed	Reset
System will not enter flying mode at NO response to start up prompt	System not previously configured	Configure (Chapter 4)
	Configuration data lost or invalid	Re-configure (Chapter 4)
Vehicle drifts or wanders during or after rotate demand	Defective SSRS	Replace 6051AP
Vehicle unstable in autopilot auto-depth mode	Incorrect trim	Check trim (Chapter 3)
	Defective depth sensor	Replace
	Defective 6059P	Replace

Table. 8.3 Tiger Fault Diagnosis Information (Continued)

FAULT SYMPTOM	PROBABLE CAUSE	REPAIR ACTION
Vehicle unstable in autopilot auto-heading	Defective compass	Replace
	Compass block displaying status byte	Refer to error codes (Chapter 4)
	Compass not calibrated	Calibrate compass (Chapter 7 Task 9)
	Compass affected by surrounding equipment	Relocate equipment and reinitialise compass (Chapter 7)
	Defective SSRS	Replace
	Defective 6059P	Replace
Compass block displays status byte symbols	Compass unit detects error conditions	Refer to error codes (Chapter 4)
Depth reading does not change	Vehicle in auto-depth mode	Operate HCU AUTO DEPTH switch
	Defective depth sensor	Replace
	Defective 6059P	Replace

Table. 8.3 Tiger Fault Diagnosis Information (Continued)

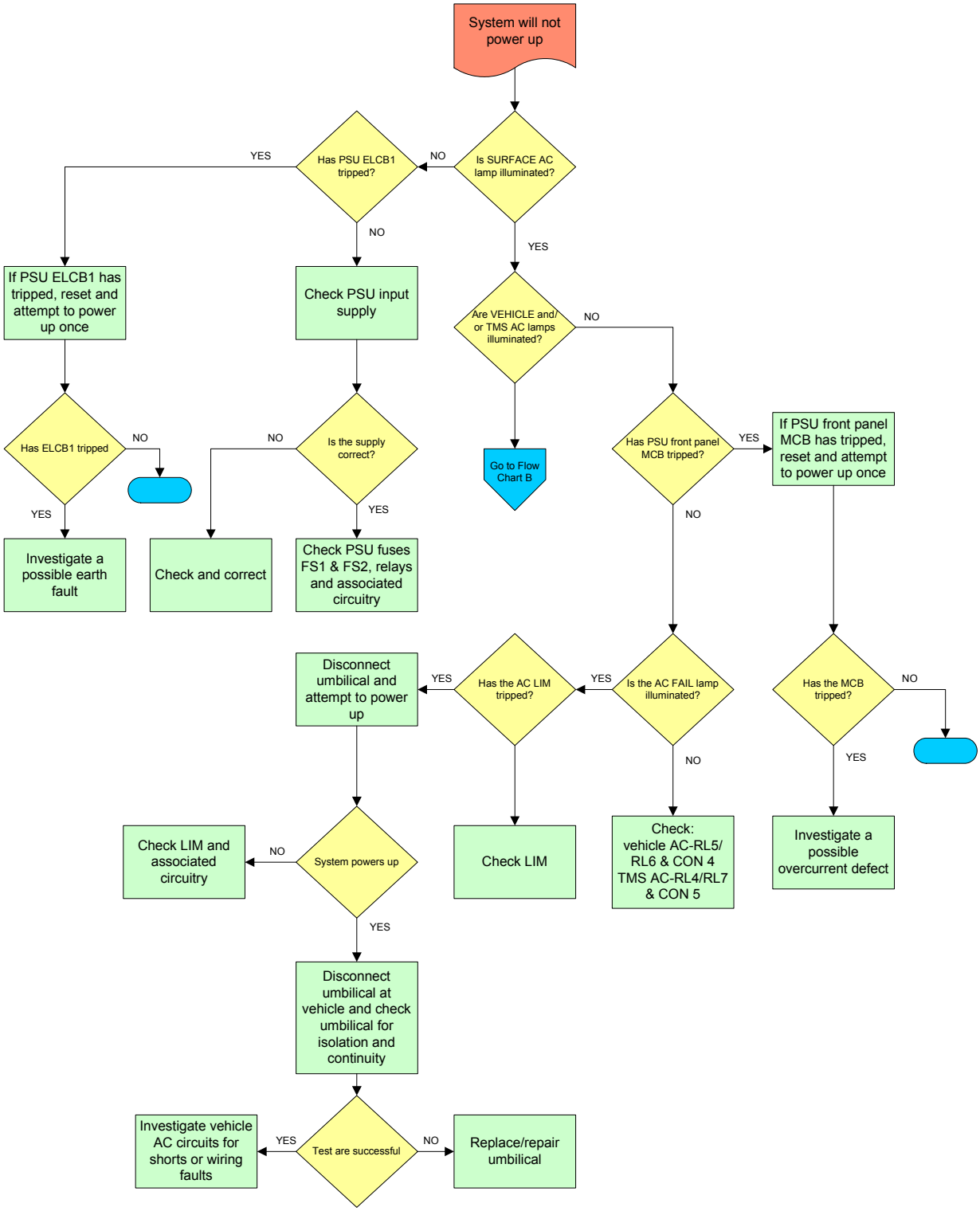

Figure. 8.9 Power Up Fault Diagnosis Chart A

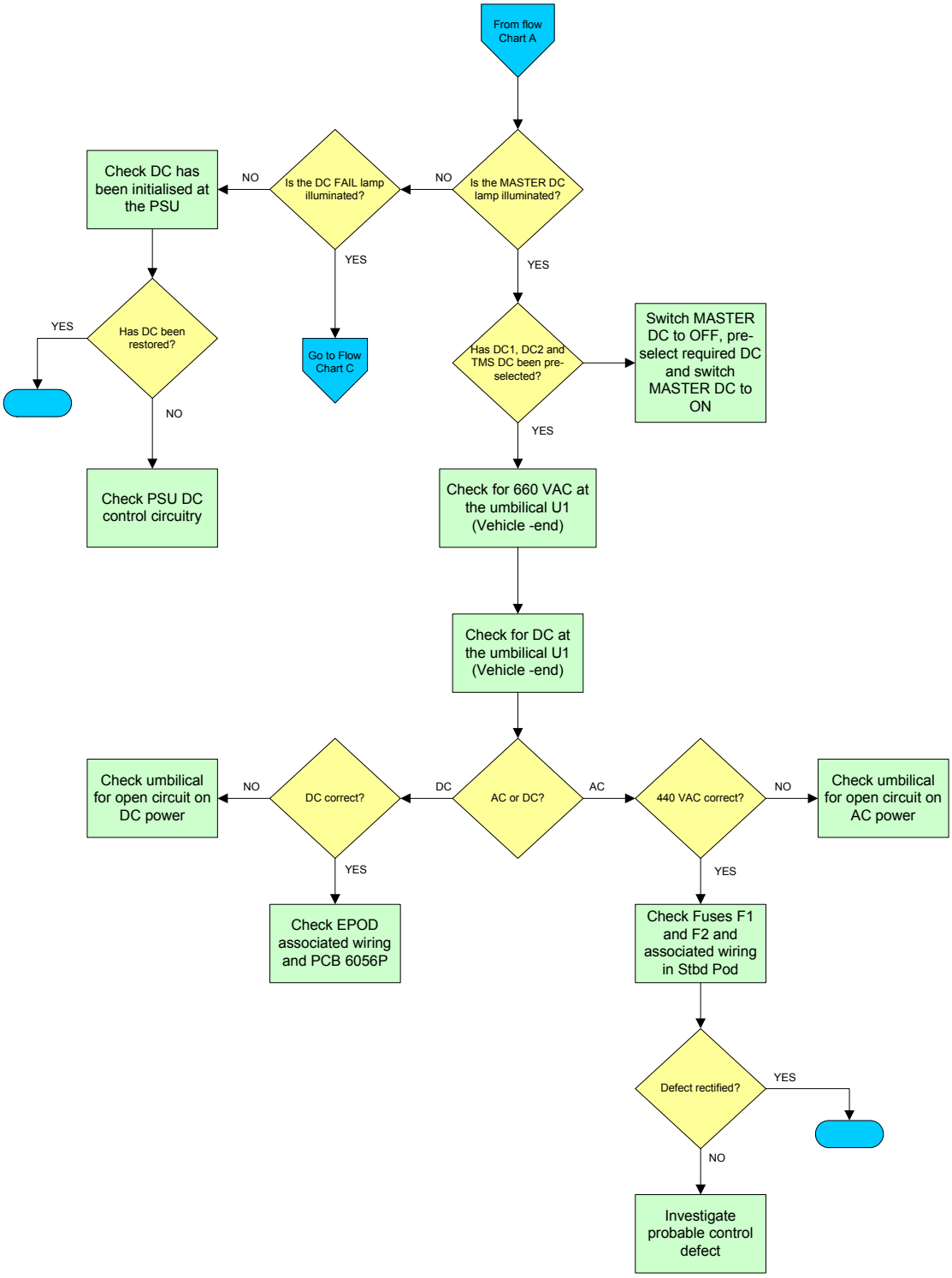

Figure. 8.10 Power Up Fault Diagnosis Chart B

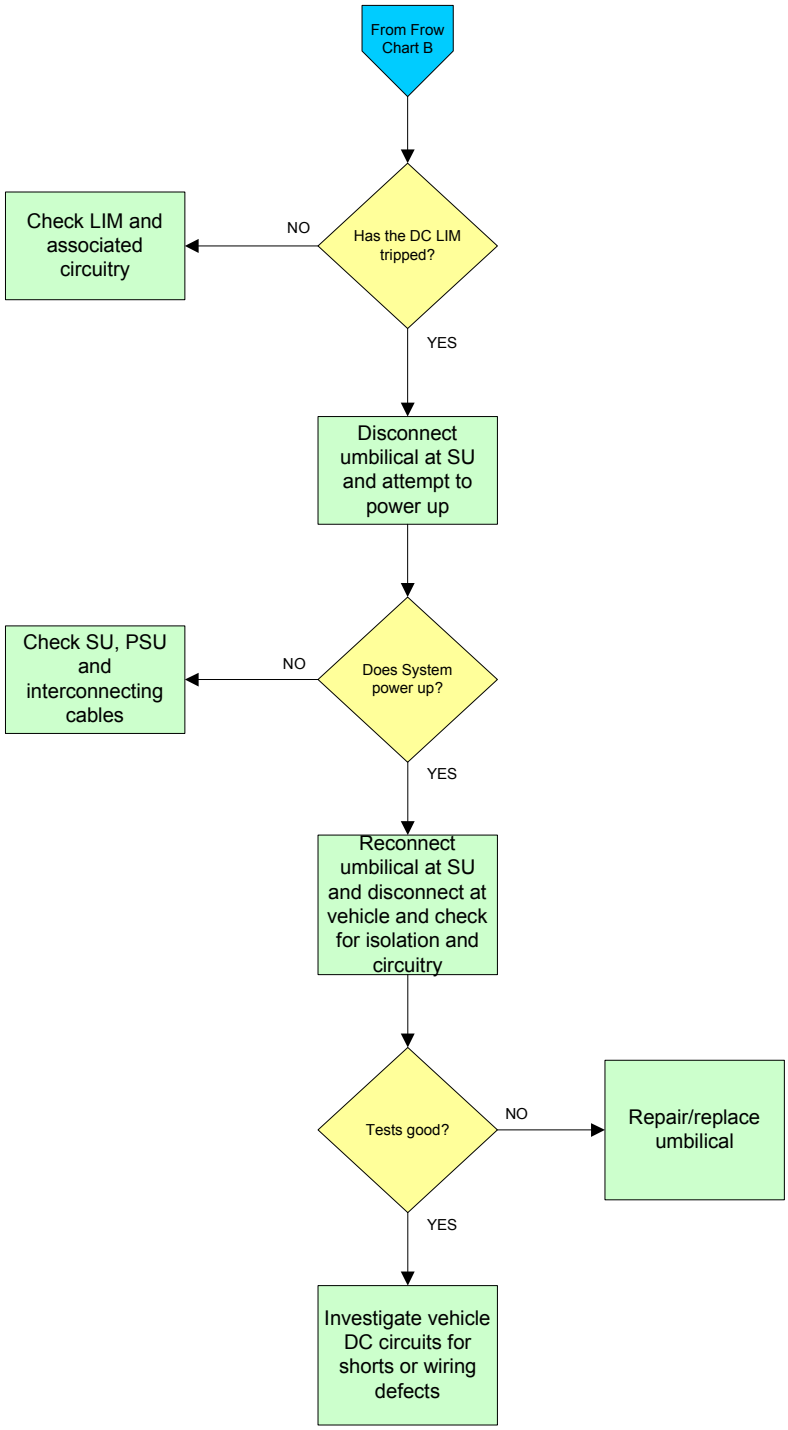

Figure. 8.11 Power Up Fault Diagnosis Chart C

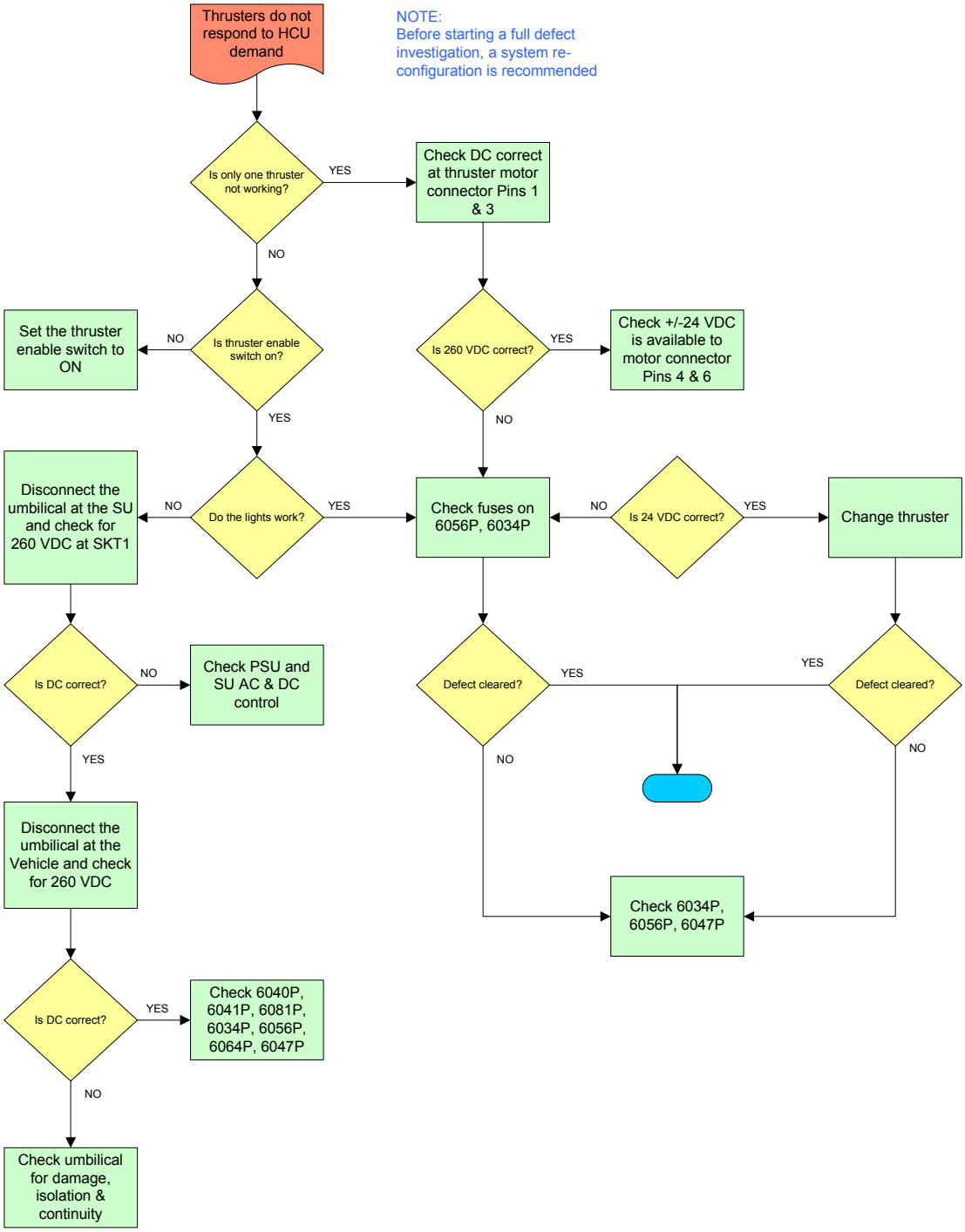

Figure. 8.12 Thruster Fault Diagnosis Chart

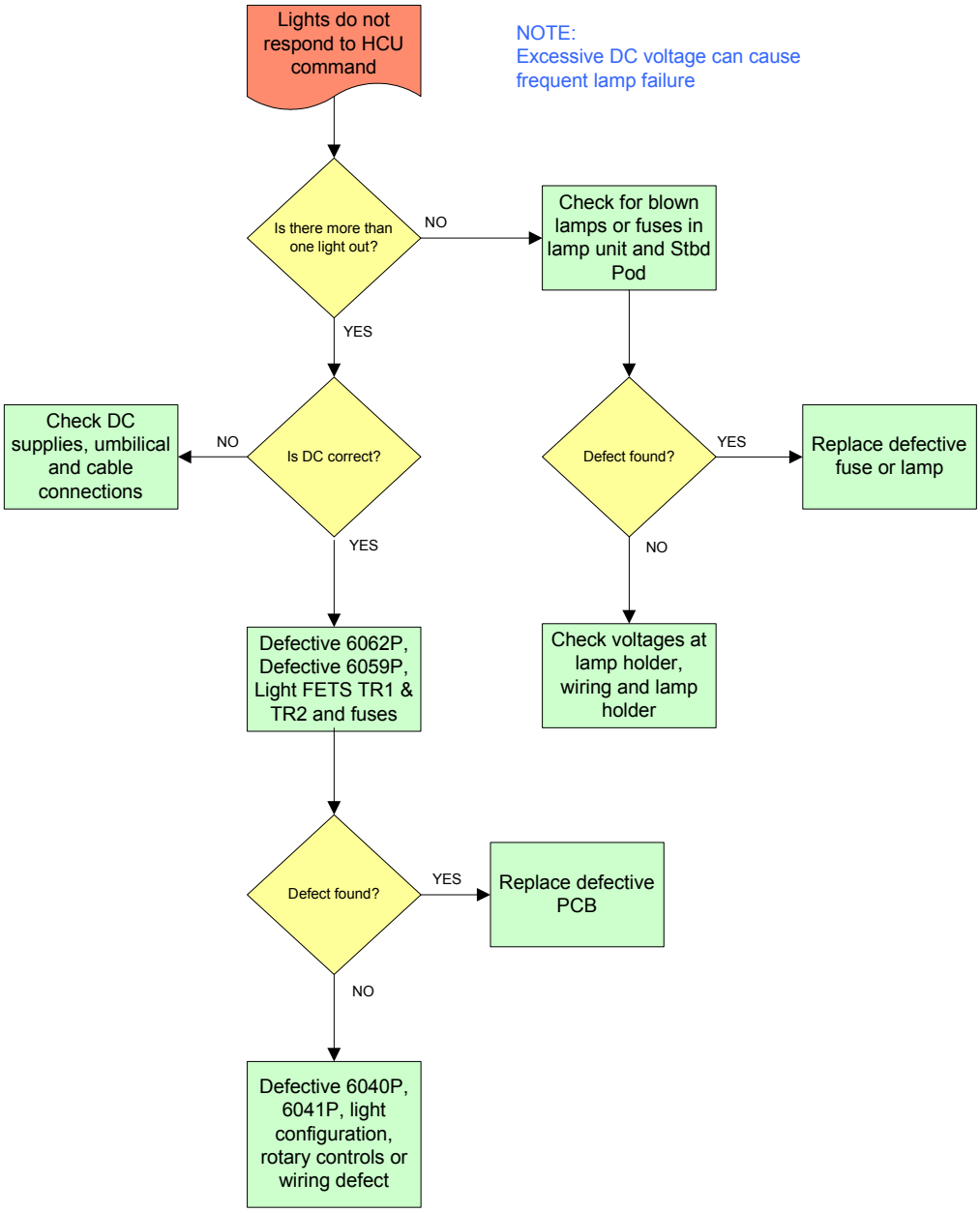

Figure. 8.13 Lights Fault Diagnosis Chart

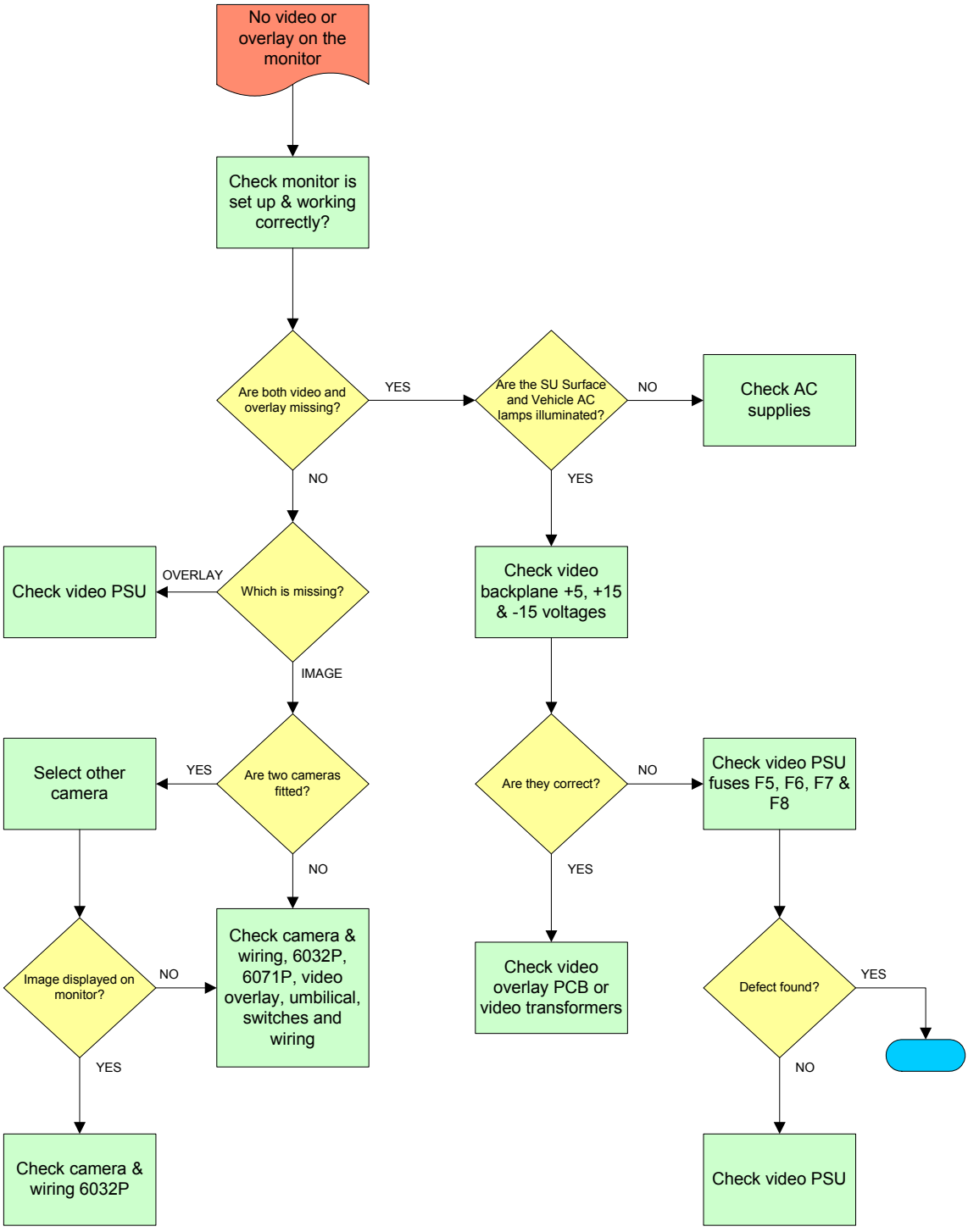

Figure. 8.14 Video Fault Diagnosis Chart

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CHAPTER 9

PARTS

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9. PARTS

This chapter details the Tiger 880 system parts.

9.1 Chassis General Arrangement Parts

Refer to Drawings S03757 Sheets 1 to 6.

Item No.	Part No.	Description	Qty.
1	02-655	Catchplate	2
2	580-077	Cable Mounting Cradle M6 Hole	16
3	237M5	Tappex Threaded Insert M5	2
4	237M8	Tappex Threaded Insert M8	6
5	CH069	Chassis Acetal Fixing Button	38
6	CH072	Csk. Chassis Washer	43
7	EP114	Epod Fixing Strap - Tiger	1
8	P00180	Seaeye Tiger Starboard Side Rail	1
9	P00186	Seaeye Tiger Port Side Rail	1
10	P00191	Seaeye Tiger Chassis Skid	2
11	P00198	Seaeye Tiger Aft Lower Cross Rail	1
12	P00210	Seaeye Tiger Chassis Skid Brace	1
13	P00246	Seaeye Tiger Forward Lower Cross Rail	1
14	P00247	Seaeye Tiger TMS Retainer Bar	2
15	P00250	Tiger Tilt Assembly	1
16	P00826	Seaeye Tiger 1000 Buoyancy Foam	1
17	P00831	Seaeye Tiger 1000 Top Platform	1
18	P00853	Seaeye Tiger 1000 Lift Frame	1
19	P00855	Seaeye Tiger 1000 Tie Bar Top Mounting Bracket	2
20	P00858	Seaeye Tiger 1000 Tie Bar Bottom Mounting Bracket	2
21	P00862	Seaeye Tiger 1000 Tie Bar	2
22	P00902	Umbilical Shackle Point	1
23	P01471	Catchplate Spacer (Plastic)	2
24	P01472	Catchplate Spacer (stainless)	2
25	P01652	Thruster Mount Bracket	4

Table. 9.1 Tiger Chassis Parts

Item No.	Part No.	Description	Qty.
26	P01885	Depth Module Mounting Saddle	1
27	P02032	Equipment Guard - Polypropylene	2
28	P02194	SV2000 Sonar Mounting Bracket – Tiger 1000	1
29	P02195	Seaeye Tiger 1000 Chassis Support Bar	2
30	P02225	Seaeye Tiger Thruster Drop Plate	4
31	P02886	M6 Coachscrew Foam Insert	4
32	P03758	Tiger 1000 Rubbing Strake Inlay	1
33	P03759	Tiger 1000 Vinyl Rubbing Strake	1
34	POLY4031E	Rubbing Strake Endcap	2
35	STF006	M5 Nylok Nut Stainless A4	2
36	STF007	M6 Nylok Nut Stainless A4	24
37	STF008	M8 Nylok Nut Stainless A4	19
38	STF011	M5 Plain Washer Stainless A4	4
39	STF012	M6 Plain Washer Stainless A4	32
40	STF013	M8 Plain Washer Stainless A4	32
41	STF020	M5 Penny Washer Stainless A4	2
42	STF021	M6 Penny Washer Stainless A4	14
43	STF025	M6 Spring Washer Stainless A4	10
44	STF026	M8 Spring Washer Stainless A4	3
45	STF043	M5 x 40 Socket Screw Stainless A4	2
46	STF048	M6 x 40 Socket Screw Stainless A4	6
47	STF051	M8 x 20 Socket Screw Stainless A4	1
48	STF057	M5 x 40mm Countersunk Head Screw Stainless A4	16
49	STF059	M6 x 50mm Countersunk Head Screw Stainless A4	40
50	STF124	M8 x 20 Skt. Button Screw	2
51	STF128	M6 x 12 Socket Screw Stainless A4	4
52	STF143	M8 x 35 Countersunk Screw A4	9
53	STF145	M6 x 35 Button Screw Stainless A4	8
54	STF162	M6 x 20 Countersunk Screw Stainless A4	4
55	STF163	M8 Half Nut	2

Table. 9.1 Tiger Chassis Parts (Continued)

Item No.	Part No.	Description	Qty.
56	STF172	M6 x 35 Button Screw Stainless A4	2
57	STF217	M8 x 35 Socket Screw Stainless A4	8
58	STF250	M6 x 25 Countersunk Head Screw Stainless A4	3

Table. 9.1 Tiger Chassis Parts (Continued)

9.2 Tiger Tilt Assembly

Refer to Drawings S00250 Sheets 1 and 2.

Item No.	Part	Description	Qty
1	525-751	WASHER NYLON FLAT M5	8
2	237M5	TAPPEX M5 BRASS INSERT	8
3	BW-15	BELVILLE WASHER	4
4	CB140	CAMERA SUPPORT TRAY	2
6	P00098	FEED BACK STUB SHAFT	1
7	P00099	CLUTCH STUB SHAFT	1
8	P00100	MOUNTING PLATE TIGER CLUTCH STUB SHAFT	1
9	P00101	PH BRONZE FEEDBACK TILT END	1
10	P00102	STAINLESS SPACER	1
11	P00103	PH BRONZE TILT MOTOR CLUTCH END	1
12	P02022	TILT MECHANISM FRICTION DISC	1
13	P00109	SPACER	1
14	P00120	SPACER	1
15	P00195	TIGER PORT TILT MOUNT PLATE	1
16	P00196	TIGER STBD TILT MOUNT PLATE	1
17	P00206	CAMERA PLATE	1
18	P00357-M	SINGLE LAM WITH METAL SHELLED CONNECTOR	2
19	P00625	TILT MOTOR	1
20	P02026	SPROCKET TILT MECHANISM 30 TEETH	1
21	P02027	TILT MECHANISM SPROCKET BUSH	1
22	P02172	TIGER TILT DRIVE CHAIN (ASSEMBLY)	1
23	P02173	TIGER TILT F\B CHAIN (ASSEMBLY)	1

Table. 9.2 Tiger Tilt Assembly Parts

Item No.	Part	Description	Qty
24	SPROCKET 01	10 TOOTH 8MM PITCH SS SPROCKET	2
25	STF006	NUT NYLOK M5 A4	14
26	STF011	WASHER PLAIN M5 A4	14
27	STF013	WASHER PLAIN M8 A4	2
28	STF017	WASHER PLAIN M12 A4	1
29	STF020	WASHER PENNY M5 A4	4
30	STF021	WASHER PENNY M6	1
31	STF025	WASHER COIL SQUARE SECTION M6 A4	1
32	STF026	WASHER COIL SQUARE SECTION M8 A4	2
33	STF027	SCREW GRUB M5 X 6 A4	4
34	STF043	SCREW SKT CAP M5 X 40 A4	8
35	STF058	SCREW SKT CSK M5 X 30 A4	12
36	STF064	SCREW SKT CSK M5 X 12 A4	2
37	STF084	SCREW SKT CAP M6 X 16 A4	1
38	STF105	NUT HALF 1/2" UNF S/S A4	2
39	STF116	SCREW SKT CAP M8 X 40 S/S A4	2

Table. 9.2 Tiger Tilt Assembly Parts (Continued)