SONAVISION LTD

SONAVISION 4000 SCANNING SONAR MAINTENANCE MANUAL

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PREFACE

This manual contains maintenance information for **the SONAVISION 4000** Scanning Sonar and is divided into three sections.

Section 1 Technical Description

Section 2 Maintenance Procedures

Section 3 Sub-assembly and Spares Data

Relevant figures are provided at the rear of each section.

The manual should be used with the **SONAVISION 4000** Scanning Sonar Operating and Installation Manual, part number SSV/ENG/SPEC/004. It is strongly recommended that the Operating and Installation Manual is read before reading this volume.

Should you have any comments about this manual, or the product, Sonavision are most interested in hearing from you as part of our product improvement scheme.

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SECTION 1 TECHNICAL DESCRIPTION

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1.1 INTRODUCTION

This section contains an overall mechanical and functional description of the **SONAVISION 4000** system, followed by more detailed functional descriptions of each sub-assembly and circuit board. Figure 1.1 shows the system units and the cable connections. Figure 1.2 is a system block diagram outlining the main sub-assemblies comprising the **SONAVISION 4000** The system can operate in either of two modes.

two wire mode with power supplied to the Subsea Unit directly from the Surface Control Unit and communications multiplexed on top of this.

or

with + 24V d.c. power supplied to the Subsea Unit from the host vehicle and communications via a direct RS422 link between the Surface Control Unit and the Subsea Unit (see Section 2.3.1 and 2.3.2 of the Operating and Installation Manual).

1.2 SURFACE CONTROL UNIT

1.2.1 Mechanical description

The Surface Control Unit sub-assembly locations are shown in Figure 1.3 The chassis is constructed of an aluminium 19 inch rack mounting unit, 3U high.

The mechanical assembly consists of a folded metal box, the front Panel assembly, the constant current supply and the VME rack.

The constant current supply is connected via its 25-way D-type plug to the mains input and the card rack. The front panel assembly consists of the panel and the two interface PCBs which contain the knobs, switches and processor electronics. The front panel is connected to the card rack assembly by a 15-way D-type connector.

The card rack itself contains the two main PCBs which are connected by VME backplanes. The J2 Interface Board busses all the rear panel signals to the rear panel (Figure 1.4).

1.2.2 Functional Description (Figure 1.4)

The Surface Control Unit contains three main sub-assemblies, the functionality of each of these will be discussed in turn. A complete overview can be found in the Surface Control Unit System Drawing (Figure 1.37).

1.2.2.1 Constant Current Power Supply

This performs a number of functions as listed below:

* Auto voltage select (eg. 110 or 220/240V a.c.).

* Cable integrity monitoring (line insulation, short circuit and open circuit fault detection and shutdown).

* Generation and control of the constant current power supply.

* Providing the 110V a.c. to the VME supply.

* Constant current shutdown signal to the processor to allow selection between FSK and R422 telemetry.

1.2.2.2 VME Rack

This rack contains a power supply and two printed circuit boards. The power supply receives power from the constant current supply and outputs +5V and ±12V d.c. to the two circuit boards and front panel. The power supply is located at the bottom of the VME rack, and immediately above it is the CPU/Graphics Board.

This board contains the main processor, which controls all of the sonar operations, communications with other processors, and graphics hardware for generating the RGB signals from the digital sonar data.

The board above the CPU/Graphics Board is the S-VHS Video/Telemetry Board. This board buffers the RGB signals produced by the CPU/Graphics Board and uses them to generate composite/SVHS video output. The other function of this board is to encode and decode the telemetry when the system is operating in FSK mode with the Subsea Unit powered from the Surface Control Unit.

1.2.2.3 Front Panel Assembly

This assembly consists of the front fascia, the Front Panel Interface Board, the Front Panel Processor Board and all associated controls (knobs, switches, etc.).

All of the front controls are mounted on the Front Panel Interface Board which in turn is mounted onto the front fascia. The jack socket is mounted directly onto the fascia.

The Front Panel Processor Board reads the status of the controls from the Front Panel Interface Board and transmits this to the main processor. In return the main processor sends audio data which is converted on the Front Panel Processor Board into audio tones.

1.2.3 Front Panel Interface Board (Figures 1.5 and 1.6)

This card performs two main functions. Firstly it mechanically mounts all the front panel controls and indicators, except the audio jack. Secondly, it provides the electrical connections form all switches, potentiometers, Leds and the loudspeaker to its daughter card, the Front Panel Processor Board.

Details of the control unit functions, controlled from this board, are discussed in Section 3.2. of the Operating and Installation Manual.

1.2.4 Front Panel Processor Board (Figures 1.7 and 1.8)

This card contains the front panel processor (87C196KB) with 8K bytes of internal ROM. The processor's function is to communicate via an RS422 serial link with the main processor (MC68030) on the CPU/Graphics Board. The 87C196KB reads the switch position data and potentiometer positions and sends it to the main processor.

In return the main processor sends Led and audio information to the front panel processor.

1.2.4.1 Processor

The processor is configured to have no external memory. Data and address lines are port mapped and are toggled under software control. The data port is bidirectional and is wired to IC1 pins 26-33. Address lines and device selects are provided as follows:

Pin	Signal Name	Function
18	LED1 CLK	Latches Led data on IC14
19	LED2 CLK	Latches Led data on IC15
20	MATRIXSEL	Selects IC12 and 13 the keyboard coding devices
21-23	A0-A2	Selects Y strobe
24	FREQSEL	Enables parallel to serial conversion at IC16, 10.
25	VOLSEL	Latches audio volume onto multiplying DAC

1.2.4.2 Keyboard Encoder Logic

This logic enables the processor to detect which keys have been pressed.

There are sixteen press button switches, four joystick switches, volume On/Off and Auto/Manual gain.

These switches are arranged on a standard X/Y matrix. The columns (Y) on the matrix are pulled low by IC13. This open collector-driver pulls one of Y1-Y8 low as set by the address lines A0-A2. If a Y strobe is low for example, then any of the switches on that column being pressed causes the appropriate input row (X) to read low from IC 12.

The software handles two buttons pressed on the same column as an error and disregards the information.

1.2.4.3 Led Drivers

IC14 and IC15 are 8-bit latches which are written to by the processor. Their outputs directly drive the Leds on the front panel. The logic is configured so that a logic 1 on D1-D7 switches the appropriate Leds on.

1.2.4.4 IC8 provides a 5V reference for the processors internal analogue to digital converter An internal 1 from 8 multiplexer provides eight analogue inputs. Four of these are wired to the front panel controls (IC3 provides buffering).

The other four inputs are spare and are directly connected by PL1 for future use. IC4 provides the potentiometer voltage of 5 Volts.

1.2.4.5 Audio Circuitry

The processor has complete control of the audio output, controlling both volume and frequency. The processor uses the volume control setting and sonar amplitude data to generate the required audio amplitude value.

The simplest part of the audio logic is the amplitude control. The processor pulls VOLSEL/ low and outputs the required audio amplitude value on D0-D7. Bringing VOLSEL/ high latches the D0-D7 value into the analogue to digital converter. IC9 is a multiplying DAC, thus any output voltage is proportional to the voltage at VREF multiplied by the data value.

The frequency generation logic is more complex. The processor outputs an 8-bit value, representing the audio frequency, to IC16. IC16 is a parallel to serial converter controlled by IC10. The PLD IC10 is programmed to convert the 8-bit serial value to a 16-bit. This stream is fed to the frequency synthesiser, device IC5, which generates a signal in the range 0 to 2.9kHz. IC7 provides buffering into the A/D (IC9) and IC11 converts current to voltage, IC17 is the audio driver.

1.2.4.6 Serial Communications

IC2 provides a bidirectional RS422 serial link via the J2 Interface Board to the CPU/Graphics Board.

1.2.5 Video/Telemetry Board (Figures 1.9 a, b and 1.10 a, b)

Two versions of this card exist, S-VHS and VHS. This Section pertains to the former. For clients with VHS versions of **SONAVISION 4000** please refer to Appendix A.

This card produces composite video and S-VHS signals from the RGB signals, it also buffers the RGB and sync signals prior to routing to the rear panel connections.

The telemetry section is used for modulation and demodulation of the FSK telemetry signals.

1.2.5.1 Video

The incoming RGB signals are terminated by resistors R27, R32 and R37. From there they are buffered and scaled by the amplifiers of IC5 and IC6. The outputs of the amplifiers provide input to the composite encoder, IC9.

The components C7, R10, C8, T1, CV1 and C9 form the chrominance filter.

IC4 and its associated components provide buffering and amplification for the outgoing composite video signal (1.0V composite).

IC1 provides the buffers for the S-VHS video signals. The chrominance signal comes from the CHROMA FILTER and the luminance from the luminance delay circuitry consisting of TR1, TR2, DL1 and associated components.

IC29 generates the colour sub-carrier and locks the sync pulse generated by IC28 to provide the exact relationship between subcarrier and horizontal scan frequency. The pixel clock for the G300 on the CPU/Graphics Board is generated by IC10 and locked to the sync by IC23 with ancillary logic on IC24.

1.2.5.2 Telemetry

This circuitry generates and receives FSK telemetry when the Subsea Unit is powered from the Surface Control Unit.

The circuitry containing C52, D2-D5 and T2 filters off the FSK data. IC11 differentially amplifies the data and passes it to the bandpass circuit around IC12, 16. The signal is then demodulated by IC17 the Phase Lock Loop (PLL). This demodulated signal is differentially amplified by IC18 and filtered by IC19 and its logic. IC20 acts as a comparitor and outputs the decoded telemetry data.

IC15 generates the 4MHz reference frequency for FSK transmission (down link). IC14 uses the serial data stream to modulate in the two FSK down link frequencies 100kHz and 87kHz.

IC13 provides differentiated line drive via T2 onto the TEL+ and TEL-lines

1.2.6 <u>CPU/Graphics Board</u> (Figures 1.11 a,b and 1.12 a, b)

The CPU/Graphics Board is a high performance, VME bus compatible processor board based on the MC68030 micro-processor. The board provides a large selection of serial and parallel communication devices, and a real time clock with onboard battery back-up. Two Mbytes of dynamic RAM are provided (expandable to 5Mbytes).

1 Mbyte of memory is allocated to the onboard video memory subsystem which supplies multi-format video outputs.

1.2.6.1 <u>Card Features</u>

* MC68030 Micro-processor 20/25MHz

* DRAM 1 or 4 Mbyte dual ported memory

* VRAM
  1 Mbyte onboard video memory, fully dual ported between CPU, and video controller.

* MC68882 floating point co-processor (optional).

* G300 colour video controller.

* one boot EPROM up to 512K bytes.

* 8K x 8 non-volatile static RAM with real time clock.

* 6 serial I/O ports providing RS422 and RS232 interfaces.

* HPIB interface.

* 3 X 24-bit timer.

* full 32-bit VME bus master/slave interface, supporting the following data transfer types:

  - A32, A24, A16: D8, D16, D32 - master.
  - A32, A24, A16: D8, D16, D32 - slave.
  - full level VME arbiter.
  - onboard arbiter.
  - VME bus interrupter and handler IRQ1-7.
  - Bus time-out counters for local and VME bus access.

1.2.6.2 CPU

The MC68030 processor executes all the display and control code for the complete Surface Control Unit. The front panel and subsea processors act only as semi-intelligent peripherals.

The processor executes the industry standard OS9 operating system which is booted from the onboard EPROM. Software modules containing the sonar applications programs are copied into DRAM and executed.

The MC68030 is a 32-bit processor with a 4 Gbyte addressing range. Onboard caches for data and instructions, along with cache burst fill accesses improve overall system performance. The processor bus is connected to IC34 which is the floating point co-processor (not normally fitted).

1.2.6.3 Dynamic Memory Control

1 Mbyte DRAM (4Mbyte option) and 1 Mbyte VRAM are fitted as standard. These memories, IC44-45, 52- 62, 64-66, may be accessed as 8, 16, 24 and 32 bits wide, on any address boundary.

Control of both video and dynamic rams is provided by IC35 the dynamic memory controller (DMC). The DMC provides burst cycle access to the memories, generating the device Row/Column address strobes (RAS and CAS) and the multiplexed address lines.

The DMC also generates the memory refresh cycles.

1.2.6.4 Video Generation Circuitry

Onboard video signal generation is under the control of the G300 colour/video controller. This device contains the following features:

* 3 x 256 x 8-bit colour palettes.

* Video refresh and sync generation.

* Triple high speed 8-bit video DAC.

The G300 is memory mapped via a multiplexed address data bus generated by IC32, 33, 40-43. The MC68030 sees the G300 as a 24-bit wide device for its colour palette and registers. The G300 requests the memory bus from the MC68030 in advance for memory refresh cycles, and on gaining it accesses the video shift register on the video RAM, causing pixel data to be loaded into the shift registers. The pixel shift clock is also provided by the G300. The G300 reads four bytes of video data at once reducing required signal speeds. The G300 then sequences the four bytes to the 8-bit colour palette memory. The output of the colour palettes provide the RGB outputs .

1.2.6.5 Serial UARTS

Three double UARTS, IC46, 26 and 36 are provided onboard. This provides six bidirectional serial channels as follows:

IC36	Port 1 - Tracker ball	- RS232
	Port 2 - Printer	- RS232
IC46	Port 3 - Sonar A	- RS422
	Port 4 - Sonar B	- RS422
IC26	Port 5 - Front Panel	- RS422
	Port 6 - Remote Control	- RS422

XTAL X4 provides a Baud rate reference clock of 3.6864MHz for the UARTS. Device interrupts are fed to the VIC device (IC1) which in turn interrupts the processor.

1.2.6.6 VME Interface

The VME controller is the VIC068 (IC1) device. The reader is referred to the device user manual for full details. The main functions of the device are:

* VME Bus arbiter.
* VME Interrupt controller.
* VME control logic generator.

IC3, 10, 11, 15, 17, 18 and 29 are the data buffers and IC4, 9 and 16 the address buffers.

1.2.6.7 HPIB Interface

The memory mapped device IC20 controls the HPIB interface, IC5 and 6 are HPIB bus drivers.

1.2.6.8 Factory Set Default Jumpers

a) JP1 2-JP1 7 - select base address for VME inter-processor communications channel on VIC chip.

b) JP6-JP11 - select VME base address for graphics card.

c) Switch SW3.
S1-S6 - various Power UP options:

S1	S2	
OFF	OFF	500kHz head (spare)
OFF	ON	1 MHz head
ON	OFF	500kHz head*
ON	ON	200kHz head

S3	ON	high resolution graphics
	OFF	low resolution graphics*
S4	OFF	PAL timing*
	ON	NTSC timing
S5	OFF	run mode*
	ON	test mode
S6	OFF	video clock onboard (non S-VHS version)
	ON	video clock off board (S-VHS version)

d) JP2-JP5 - EPROM Selection Jumpers

e) JP1-DMC Clock Select

1 - 2 - Selects CLK/2
2 - 3 - Selects CLK

* default

1.2.7 J2 Interface Board (Figures 1.13 and 1.14)

The surface unit system drawing Figures 1.3 shows the position of the J2 Interface Board. The card's main function is to provide signal routing from the CPU/Graphics Board to the rear panel connectors. The card also routes fault data and FSK telemetry signals on the constant current PSU to the CPU/Graphics and Video Telemetry Boards respectively.

1.2.7.1 Directly Routed Connections

The following I/O connections are directly tracked across this Board:

* HPIB.

* Trackerball.

* Printer.

* Front Panel.

1.2.7.2 Remote Control Interface

The remote control interface is transmitted on port6 and is routed to the rear panel on SKT6. The serial link arrives on the J2 Interface Board as RS422 levels and dependent on SW1 can be routed directly to SKT6 or first converted to RS232 levels. For RS232 operation IC3 converts bidirectional RS422 to TTL, which is then converted to RS232 by IC4.

1.2.7.3 Sonar Telemetry

Two sonar communications techniques are supported by the control unit:

* FSK Telemetry.

* RS422 Telemetry.

The constant current supply status line CC PSU SHUTDOWN is utilised to select which telemetry technique is active. If CC PSU SHUTDOWN is asserted RS422 telemetry mode is selected. If the FSK telemetry system is selected, IC2 routes RX3, TX3 and T/L3 to serial data uplink, serial data downlink and T/L.

IC1 converts the RS422 sonar stream to TTL for IC2.

When RS422 is selected for Subsea Unit control IC2 routes the serial communications TTL signals and talk/listen to a pair of opto isolators. IC5 isolates the uplink and IC7 the down link and talk/listen.

PSU 1 provides the isolated supply for the Subsea Unit side of the link, IC6 converts the bidirectional TTL signal to half duplex RS422, with talk/listen controlling the link direction.

F1 and F2 are electronically resetable fuses which require the unit to be powered off for thirty seconds to reset.

1.2.7.4 Auxiliary Sonar

A second RS422 channel (Channel B) is supplied on the rear panel subsea connector. Channel B is for future expansion to other subsea sensors as a second system for dual profiling.

Channel B is derived from port 4 on the CPU/Graphics Board. IC1 converts the RS422 to TTL which is buffered by IC4, and sent to the opto coupler IC9 for the uplink, and IC10 for the downlink. IC11 converts the isolated TTL signals to RS422, controlled by an isolated derivative of T/L4. F3 and F4 are electronically resetable fuses for protection. PSU 2 provides the isolated 5 Volt supply for the subsea reference side of the link.

1.2.8 Constant Current Power Supply Unit (Figures 1.15 and 1.16)

The primary function of this unit is to supply d.c. power and FSK telemetry to the underwater unit via two wires in the umbilical cable. However, other auxiliary functions have been introduced to enhance the system operation.

Physically the unit comprises three boards namely; the Input Control Board, the Transformer Board and the Output Regulator Board. These are mounted on a modular chassis which houses the main transformer and inductor assemblies.
Removal and replacement of the unit is described in Section 2.4 of this manual.

NOTE: This Power Supply Unit is live at all times, unless the external a.c. supply is removed.

1.2.8.1 Input Control Board

This board interfaces with the rest of the Surface Control Unit. The a.c. supply is not used directly but is routed to the Transformer Board where two unregulated d.c. supplies are generated. IC1 regulates the first to 9.5V to provide power for the board. A set of "window" voltages is derived from this proportional to the a.c. supply ranges. IC2 compares these voltages with the second d.c. supply VCOMP (which is proportional to the a.c. supply).

If the a.c. supply is in the correct range 104-122V, 207-254V then IC2 pins 13, 14 or Pins 1, 2 will be high respectively. If IC2 pins 13, 14 are high then RL2.1 is activated (via TR1) and the a.c. supply is corrected to the 11 5V tap on the main transformer, if not, the input supply is connected to the 240V tap.

RL2.2 is used to confirm the change over in supply and will activate a timer formed by R20 and C14. If this condition persists a start signal is sent to TR2 activating RL1 correcting the a.c. supply to the main transformer.

NOTE: The potentiometers RV1, 2 and 3 are factory set and are not to be adjusted except by trained personnel.

1.2.8.2 Transformer Board

A.C. LIVE and NEUTRAL are taken from the Input Control Board via PL1 to power both T1 and T2 continuously, even when the Front Panel Power switch is in the OFF position.

T1, via BR2, C2, R1 and R2, provides a d.c. voltage which is proportional to the a.c. supply voltage, and this is used on the Input Control Board to decide whether the Surface Control Unit is connected to the supply.

T2 via BR3 provides enough voltage (unregulated) over the input range to power the monitoring circuits on the Input Control Board.

The main (200VA) transformer on the chassis is connected to the rest of the system via TB1 on the rear of the transformer board and provides isolated 1 50V a.c. and isolated 1 2V a.c..

A rectified voltage HT (174-243V a.c. depending on the voltage) is generated from the 150V a.c. and passed to the Output Regulator Board

The transformer board also routes signal lines between the Output Regulator and Input Control Boards.

Output Regulator Board

HT is passed to the switching unit composed of TR1, TR2, D4, C2, C3 and the transformer/inductor mounted on the side chassis plate. The switching action is produced by monitoring the return current in R7 and R8, amplifying the voltage produced and comparing this to a variable reference at IC1 pin 3. TR5 generates a constant current of 1mA to give a set voltage for this purpose (varied by RV1 on the Input Control Board). As IC1 pin 1 switches, a defined feedback current is injected into R35 to produce hysteresis, and clean switching. This output is then inverted to drive TR3 which is used to activate the switcher. Note that a short circuit at the output of the unit would cause TP6 to rise to full rail voltage momentarily and so the monitoring of TP6 is done via a R22 to limit any fault current into IC2 pin 5 to approximately 1 mA.

The current flowing in R7 also contains the ripple components filtered out by C2 and C3, this aids the switching process.

The amplified monitored voltage is also fed to voltage comparator IC3 which detects output currents less than 230mA (approximately) and greater that 1.5 Amps (approximately). The thresholds for these being derived from a stable 5V reference (IC5), however, to allow normal power up the Open Circuit detection threshold has to be allowed to rise gradually since it may be 5-10mS before the output current is fully established. Similarly, the first time TR1 conducts, C2 and C3 will be uncharged and will take a large current which is not a Short Circuit fault condition, for this reason C11 raises the Short Circuit detection threshold for a time sufficient to allow C2 and C3 to charge. To maintain isolation these signals are opto isolated back to the Input Control Board.

1.3 SUBSEA UNIT (Figure 1.17)

1.3.1 Mechanical Description

The Subsea Unit of the **SONAVISION 4000** is a single pressure housing, manufactured from titanium. This housing contains all the necessary electronics, a stepper motor/gearbox drive electronics, sliprings (providing electrical interface to the rotating transducer assembly) and a compensated seal mechanism.

Power to the unit may be either 24 Volts from the host vehicle or a constant current supply from the Surface Control Unit, facilitating two wire operation.

1.3.2 Functional Description (Figure 1.18)

The main elements of the Subsea Unit are the power supply electronics, control/processing electronics, drive electronics, preamplifier and the transducer array. A complete overview can be found in the Subsea Unit System Drawing (Figure 1.38).

The power supply electronics consist of three boards:

* +5V Motor PSU Board, generating +5V d.c. and the motor voltage.

* $\pm$ 12V PSU Board, generating + 12 and -12 Volts d.c.

* The Constant Current Receiver Board which provides filtering, dumps excess current and generates a signal indicating the presence (or not) of a constant current supply used in selecting the telemetry mode.

The control and processing electronics also consists of three boards:

* The Switchband Receiver Board, providing gain and a superheterodyne receiver.

* The Transmitter Telemetry Board which generates the pulse for transmission and encodes and decodes all telemetry.

* The Subsea Processor Board which controls the operation of all other elements in the Subsea Unit, processing the received sonar data and communicating with the Surface Control Unit.

1.3.3 Motherboard (Figures 1.19 and 1.20)

The subsea motherboard interfaces all of the subsea electronics. It is divided into two basic areas; the first is the PSU area, the second the main electronics cards. The PSU cards (three off) are mounted across the motherboard whereas the telemetry, receive and processor cards are mounted length wise. All cards are mounted via indirect connectors and are easily accessed for replacement and test.

The main function of this card is to provide the electrical interconnections between boards without resorting to hardwiring and ribbon connections.

1.3.3.1 Circuit Description

The motherboard has a number of active components mounted onto it. These circuits provide three functions:

* Profiler threshold detection.

* Motor drive generator.

* PSU power up logic.

The profiler logic is based around IC2. This simple comparator takes its reference input from a voltage generated on the Subsea Processor Board under software control. A pre-filtered version of the demodulated sonar is fed to the other input via a fast attack/slow decay circuit. The first strong return generates a positive going interrupt pulse to the processor to indicate "bottom" signal. This logic is only used with the Sonavision 1 MHz profiler array.

IC1 contains the bipolar bridge driver for the stepper motor converting the TTL phases from the processor to the A and B phases for the motor windings. D1 to D8 provide inductive clamping.

The auto start circuit provides a means of supplying the inrush current required by the d.c.-d.c. converters. The inrush current must be supplied from C1, C2 and so the converters are prevented from switching on until sufficient charge has accumulated in C1 and C2.

Capacitors C1 and C2 also provide a.c. decoupling and act as a current reservoir.

1.3.4 Constant Current Receiver Board (Figures 1.21 and 1.22)

This card provides the following functions:

* Provides a 24 Volt supply from the constant current line (if selected) .

* Detects if the constant current supply is active and signals the Transmitter Telemetry Board to select the appropriate communications mode.

* Automatically routes external 24V supply.

* Filters off FSK communications data.

1.3.4.1 Circuit Description

This card operates from either the surface unit constant current supply or a nominal vehicle supply of 18-30 Volts (external 24V).

Considering vehicle derived power firstly, F1 is an electronically resetable fuse with a thirty second reset time. If F1 goes open circuit, power must be removed from the unit in order to reset it.

C1 and C2 on the motherboard provide smoothing, with T1 acting as a current balanced choke attenuating supply line noise and also prevents switcher noise from the d.c.-d.c. converters getting back out to the vehicle's supply.

Should the constant current from the Surface Control Unit be connected, then this is used as the power source for the subsea 24 Volt supply. L1, L2 allow the d.c. component to pass but not the a.c. L1, L2, C1 and C2 filter out the frequency shift keyed signal from the constant current and divert it to the Transmitter Telemetry Board.

Diodes D1, D2, D3 and D4 provide a rectifier bridge circuit so that CC + and CC- may be interchanged without operational problems.

IC1 and its associated circuitry provide an over voltage detection circuit whose purpose is to control TR1. On detecting over voltage in the filtered 24V output this circuit switches TR1, thus draining excess current from the system. This current is discharged in R1 which is mounted on the chassis end plate. TR1 will be switched off when the line voltage has dropped to approximately 23.2V.

On detection of a constant current derived 24 Volts the current source CC1 supplies 1mA. This current is converted to a voltage on the Transmitter Telemetry Board.

1.3.4.2 Connections

Signal	Pin	Function
Ext 24V	PL1-5	18-30V Vehicle Supply*
CC+	PL1-4	Surface Control Unit Supplied + Ve Power/ Telemetry
CC-	PL1-3	Surface Control Unit Supplied -Ve Power/Telemetry
Ext 0V	PL1 -1	0V Vehicle Reference *
FSK+	PL1-9	Frequency Shift Keyed +Ve Signal
FSK-	PL1-8	Frequency Shift Keyed -Ve Signal
I-DUMP	PL1-2	From Constant Current Supply
CC-DET	PL1-10	1mA Current Output Used To Select FSK Or RS422 Telemetry
24V	PL1-7	Filtered 24V supply.
0V	PL1-6	Sonar 0V Reference (must **not** be connected to Ext 0V).

* only used if working from vehicle supply.

1.3.5 +5V Motor PSU Board (Figures 1.23 and 1.24)

The input d.c. voltage (18-32V) is applied to PSU1 via noise rejection filters and the isolated + 5V d.c. thus obtained is passed to the rest of the system via similar filters.

The input d.c. voltage is also fed to the motor power supply comprising main elements IC1, TR6 and TR7 which form the basis of an open loop 1 2V regulator with compensation for input voltage variations only. This supply will generate higher voltages if a light load is applied and this will compensate for the inductive reactance term in the stepper motor as it varies with motor speed and hence attempt to keep constant motor torque available.

1.3.5.1 5V PSU

The isolated d.c.-d.c. converter PSU1 will deliver 0.5A @ 5V over the input range 18-32V d.c. However, switch mode PSUs generate noise in the form of spikes and ramp waveforms and in an effort to reduce both input and output noise decoupling is provided by C9,C11 (High Frequency) and C10,C12 (Low Frequency). T1 and T2 are current balanced transformers, they effectively a.c. short circuit the Input and Output lines respectively. Only the "clean" sides of the filter 0V points are commoned.

1.3.5.2 Motor PSU

CC1 generates approximately 1mA via D1 and R1 to charge C1 in a linear fashion, and when the voltage on C1 reaches the voltage set by ZD1, IC1 pin 1 switches on TR1 to discharge C1 rapidly. R2 and C2 provide sufficient delay to allow discharge to be completed while D2 and R5 compensate for the variation in gate drive that would occur with variable supply voltage. D1 is used to partially compensate for TR2's base emitter thermal coefficient, and R1 is used to give the ramp a d.c. offset. R6 and R7 scale both ramp and offset for comparison with a portion of the supply voltage provided by R8, R9 and ZD2. IC1 pin 7 generates the active signal for the switcher.

R12 and C5 shape the drive pulses to minimise interference caused by excessive switching speeds storing energy in stray inductances. R15 and C13 decouple the control circuits from the power circuits while C7, L2 and C14 reduce the switching noise getting back to the main supply. TR4 and TR5 form a complimentary emitter follower boot strapped by D4, R13 and C6 to ensure good turn off of the main switching MOSFETS TR6 and TR7. D5 maintains current flow in L1 when TR6 and TR7 are off, recovering the stored energy in L1, C8 provides output smoothing.

A soft start is provided by C4, R10 and D3 to hold IC1 off during power up. TR3 and R11 serve to shut the motor supply down should the input supply suddenly drop by several Volts - a condition which could indicate a motor short circuit (and hence L1 saturating), although direct short circuit protection is not included.

1.3.6 + 12V PSU Board (Figures 1.25 and 1.26)

This board takes as its input 24V from the filtered vehicle supply. Using d.c.-d.c. converters it produces a + 12V output.

1.3.6.1 Circuit Description

C1, T1 and C2 provide HF and LF filtering of the incoming 24V and 0V lines.

C3, T2 and C4 provide HF and LF filtering of the generated + 12V.

The -12V circuit functions in an identical manner.

1.3.7 Subsea Processor Board (Figures 1.27 and 1.28)

Based on the Intel 196KB device the subsea processor performs the following functions:

* Digital telemetry encoding and decoding.

* Sonar sampling .

* Base gain control.

* Time varying gain (TVG) control of the sonar Switchband Receiver Board.

* Selection of receiver reference frequency.

* Selection of transmitter frequency.

* Digital selection of profiler trigger threshold.

* Generation of stepper motor phases.

* Control of Tx pulse duration and power level.

* Detection of sonar head reference strobe.

1.3.7.1 Processor

The 87C196KB processor runs from a 12MHz crystal and contains 8K internal ROM, timers, I/O ports, full duplex serial port and 256 bytes RAM.

1.3.7.2 Control Logic

This section consists of the control PLD (IC7) and the address latches (IC4/5).

The Control PLD provides the address decoding for the onboard RAM (IC8) and EPROM (IC6) as well as the selects for the dual digital to analogue converter (IC9). The PLD also controls the wait state logic required for the slow access to the DAC (IC9).

IC 4/5 latch the address information from the processor (IC3) for RAM, EPROM and the address decoder logic PLD.

1.3.7.3 Memory Mapped Peripherals

Three devices are memory mapped:

* 8K x 8-bit static RAM.

* 8K x 8-bit EPROM.

* A dual 12-bit digital to analogue converter.

The additional EPROM is not required therefore IC6 is not loaded.

Normally only channel A is accessed on the DAC, during sonar reception this device is accessed every 1 ms, providing a gain voltage on PL2 -15. Increasing the front panel gain control potentiometer causes this voltage to fall and vice versa.

1.3.7.4 Port Mapped Peripherals

The motor phases are provided on PL1 pins 3, 4, 5 and 6. As the motor is continually stepped during reception of the sonar signal there should always be pulsed wave outputs on all four lines, the frequency of these depends on motor speed.

Four frequency data lines F_D0-F_D3 provide data to the two offboard digital Phased Locked Loops, ie. the transmitter and receiver control frequencies. The address lines for these devices are F_A0-F_A2. The selection of each device is uniquely controlled by F_S1 and F_S2. These devices are only accessed shortly after power UP.

Signal	Pin	Function
OSC_IN	SK1-1	Ref. Freq (3MHz) For Synth.
F_S2	SK1-23	Tx-Digital PLL Select
F_S1	SK1-11	Rx-Digital PLL Select
F_D0 to F_D3	SK1-4 to 7	Digital PLL Data Line
F_A0 to F_A2	SK1 -8 to 10	Digital PLL Address Line
SONAR IN	SK1-3	Demod Sonar From Rx Card
M0-M3	PL2-3 to 6	Motor Phases (TTL)
INT	PL1-1	Profile Threshold Detected

Signal	Pin	Function
VREF	SK1-2	Voltage Ref For A To D
REF	PL1-2	Profiler Ref Out
GAIN +	PL2-4	Gain Voltage Out
DATA UPLINK	PL2-8	Serial Data Out To Surface
DATA DOWNLINK	PL2- 1 2	Serial Data In From Surface
T/L	PL2-7	Surface Comms Direction
H_Ref 1	PL2-1	360° Head Strobe
H_Ref 2	PL2-2	10° Head Strobe
TX_Gate	PL2-21	Extended Tx Gate
TXx Gate	PL2-13	Tx Pulse (TTL)

1.3.8 Frequency Synthesiser Board (Figures 1.29 and 1.30)

The card generates two reference frequencies for the transmitter and receiver cards.

It also provides signal conditioning of the received sonar signal and a voltage reference for the processor card.

1.3.8.1 Circuit Description

The logic around IC5, inverts and buffers the modulated sonar for the A to D on the Subsea Processor Board.

1.3.8.2 The frequency synthesiser card is mounted directly onto the Subsea Processor Board and contains surface mount devices.

NOTE: On NO account should repairs be undertaken without the unit being returned to Sonavision.

1.3.8.2 Connections

Signal	Pin	Function
f_Rx		Receive Freq. Ref. OUT
f_Rx (0V)		f-rx 0V Return
f_Tx		Transmitter 2 x Freq

f_Tx (0V)	f-tx 0V Return
V ref	87C196 A to D Ref
Rx+	Demod Sonar +Ve In
Rx -	Demod Sonar-Ve In
OSC IN	3MHz TTL Clock
FS1	Rx Digital PLL Select
FS2	Tx Digital PLL Select
FA0-FA2	Digital PLL Address Bus
FD0-FD3	Digital PLL Data Bus
Sonar IN	Single Ended Demodulated Sonar Out

1.3.9 Transmitter Telemetry Board (Figures 1.31 and 1.32)

This provides the following functions:

* Transmitter drive pulse for 500kHz, 200kHz and 1 MHz arrays.

* RS422 telemetry circuits.

* FSK receiver/transmit logic.

1.3.9.1 Transmitter

The transmitter contains three functional units:

* Burst control logic.

* Power amplifier.

* Power control logic.

1.3.9.2 Burst Control Logic

Two low going pulses are provided by the Subsea Processor Board, TX-Gate and X-Gate. The gate pulse is the length of transmission (100,uS nominal) and repeats at the pulse repetition of the sonar. The appropriate delay between pulses would be:

13-20mS	10 metres
0mS	20 metres
67mS	50 metres
133mS	100 metres

The TX-Gate pulse is 100/1S longer than gate and is provided to ensure that the transmitter is excited during decay of the transmission envelope.

The transmission clock reference is provided at twice the transmit frequency ((2_CLk)Tx), ie. 1 MHz for 500kHz transmission. This open collector signal is terminated by R2. IC2 provides the push-pull differential drive to TR2 and TR8. IC1 together with TR13 and IC2 pins 1 and 5 gate the Tx clock off during reception periods, IC2 pin 2 ensures that the transmitter is also disabled during this time.

Power Amplifier

Drive transistors TR4 and TR6 form a push-pull amplifier, voltage clamping and protection are provided by D6 and D7. T1 provides a nominal 200V peak to peak drive signal to the transmitter array via the step up transformer.

1.3.9.4 Power Control Logic

TR11 is used to control the d.c. voltage applied to the power amplifier stage and therefore controls the output level. Envelope shaping is provided by slewing the edges of X-Gate R13, D8, and C11 slew the rising edges and R12, C11 slew the falling edges. TR12 switches in R9 on low power to limit the maximum d.c. level of TR11 gate, and hence reduce the HT voltage for low power.

1.3.9.5 Telemetry Logic

Two independent, serial data, half duplex, links are provided within the Subsea Unit. Selection between these two telemetry modes is automatically controlled by whichever of the two supply options are used. If the constant current output from the Surface Control Unit is connected to the subsea constant current receiver, then the frequency shift keyed (FSK) telemetry is used. If the vehicle supply is connected then a bidirectional RS422 link is provided.

1.3.9.6 Telemetry Mode Selection Logic

The PLD (IC8) is configured as a serial data multiplexer which connects the UART data lines on the processor (Data Uplink, Data Downlink) to the current telemetry channel. IC9 provides a 2.457MHz square wave reference which IC8 gates to provide the two FSK uplink frequencies, ie.

UPLINK logic 1 - 307kHz
logic 0 - 409kHz

These frequencies support an uplink serial Baud rate of 62.5Kbs.

The multiplexer states are as follows:

If there is no constant current supply then IC8 pin 11 is low. This logic condition causes the serial stream on Data Uplink to be connected to RS422 Output and Data Downlink to RS422 Input.

The direction of the communications link is controlled by the talk/listen signal from the Subsea Processor Board which is output directly to DE/RE. The FSK UPLINK signal is low in this mode.

Enabling the constant current will drive IC8 pin 11 high. The logic device now routes the FSK serial communications to the processor as follows:

TTL serial data on FSK DOWNLINK is routed to DATA DOWNLINK and DATA UPLINK is used to generate the two key frequencies for the FSK uplink during transmission. The Tx/Rx signal is identical to talk/listen and switches the line driver IC6 into a high impedance state during serial reception. During FSK operation DE/RE is low.

1.3.9.7 RS422 Telemetry

IC7 is an RS422 transceiver which transmits and receives RS422 data. R28 and R29 provide line termination and D14, D15, ZD3 and ZD4 provide protection.

1.3.9.8 FSK Telemetry

The subsea system provides a bidirectional FSK telemetry link whose frequencies are modulated onto the constant current lines CC + and CC- on the Constant Current Receiver Board. IC6 provides the uplink drive, frequencies of:

409kHz - Logic 0
307kHz - Logic 1

The signal Tx/Rx indicates the direction of communication with respect to the Subsea Unit. The downlink frequencies are:

87.5kHz - Logic 1
100kHz - Logic 0

These provide a downlink data rate of 9600 Baud. The differential amplifier, IC3, generates a single ended frequency reference which is passed through a 95kHz band pass filter based on IC4. The Phase Lock Loop, IC5, demodulates the frequencies to provide a TTL serial output on pin 7.

1.3.10 Switchband Receiver Board (Figures 1.33 and 1.34)

This card is a superhetrodyne sonar receiver which operates with a 5kHz bandwidth, the centre frequency is tunable from 150kHz to 1.5MHz. Gain control over a range of 90dB is provided. In order that "bright" targets may be highlighted, a Reverberation Controlled Gain (RCG) circuit is also provided.

1.3.10.1 Gain Control and Signal Conditioning

The gain control voltage varies from 0 (OdB) to -5 Volts (9OdB) and is found on PL2 pins 13 and 26. The gain control voltage is derived under software control from the Subsea Processor Board. The voltage waveform should be a periodic decaying waveform from 0 to -5V. Increasing the gain at the Surface Control Unit should move the waveform down (increasing -Ve d.c. offset). The first stage of IC1 provides filtering of any noise on the gain control voltage and unity gain buffering. The next two stages of IC1 are identical and provide level shift and scaling of the gain control voltages for the two AGC stages. The two variable resistors RV1 and RV2 are **factory set** to control the gain offset so that OdB gain occurs at 0 Volts on the gain control input.

1.3.10.2 AGC Amplifier

Two identical AGC stages are provided. These are wideband 150kHz - 1.5MHz and have 45dB of gain control each. TP2 and TP3 allow access to the RF sonar signal with a gain of 45dB maximum at the former and 90dB at the latter.

1.3.10.3 Gain and Limiter

This stage sets a saturation level of 4V peak to peak.

1.3.10.4 Oscillator Diff Amp

The local oscillator reference frequency is derived on the frequency synthesiser card under the control of the Subsea Processor Board. The local oscillator signal on PL2 Pins 1 and 14 should be a square wave with one of the following frequencies:

Oscillator Frequency	Sonar Frequency
955kHz	500kHz
655kHz	200kHz
1.455MHz	1 MHz

IC9 provides unity gain buffering for the local oscillator frequency.

1.3.10.5 Mixer

The purpose of the mixer is to mix the sonar carrier frequency with the local oscillator frequency to obtain a constant intermediate frequency of 455kHz. IC10 is the analogue multiplier which generates the IF output.

1.3.10.6 Ceramic Filter

The ceramic filter CF1 produces a 0.6V P/P full scale signal output and has a -8dB insertion loss. The filter has a 455kHz centre frequency and a 6dB band width of 30kHz.

1.3.10.7 Variable Gain Stage

IC11 provides a **factory set** gain to obtain a 5V peak to peak output. RV3 provides the adjustment for variations in gain of CF1, plus an adjustment for variation in any stage after this point.

1.3.10.8 Precision Rectifier

The combination of IC12 and IC13 provide a 1 Volt peak maximum rectified output at TP5.

1.3.10.9 2nd Order Low Pass Filter

This discrete filter provides a cut off frequency of 4kHz with an attenuation of 40dB per decade.

1.3.10.10 Switched Capacitor Filter

IC15 provides a 5kHz cut off frequency with fifth order filtering.

1.3.10.11 Level Shift and Drive

The final stage provides d.c. level shift adjustment (RV4) to achieve a demodulated sonar output of 0 to -5V peak. The circuitry consisting of D9, R80, R79 and C70 detects a rapid rise in sonar output which is fed into the gain control and signal conditioning block to suppress the gain. This circuitry implements the Reverberation Controlled Gain (RCG) within the sonar design.

1.3.11 Pre-Amplifier Board (Figures 1.35 and 1.36)

This board is located in the transducer head and it performs two main functions; it matches the signal for transmission to the transducer, it also provides the first stage amplification on the received signal.

1.3.11.1 Transmit

L3 and C13 provide matching of the transmit signal to the transducer.

D4 and D5 are present for 1 MHz operation, they present a short circuit to the transmit signal and an open circuit to the low level received signal. This is necessary as in 1 MHz operation, the same transducer is used for transmit and receive. LK1 and LK2 are in place for 1 MHz operation, commoning up the transmit and receive lines.

1.3.11.2 Receive

R1 and D1 provide input protection for the receive circuitry. T1 provides common mode rejection of noise on the received signal.

R11 and R5 generates a regulated +5V from the incoming +12V supply. This 5V is used to d.c. bias the received signal to allow bipolar amplification.

IC1 and TR1 form a transconductance amplifier which is tuned to 500kHz by L1, C3, C4 and C5.
R4 forms the load for the amplifier, giving a voltage gain of approximately seven at 500kHz.

IC2 and IC3 drive a differential output, with IC2 producing the positive side and IC3 the negative.

SECTION 2 MAINTENANCE PROCEDURES

2.1 INTRODUCTION

This section will cover the following areas:

* Preventative Maintenance.

* System Fault Diagnosis.

* Assembly/Disassembly.

2.2 PREVENTATIVE MAINTENANCE

To help increase the life, serviceability and general appearance of the equipment, the following procedures are recommended as a basis for system maintenance.

2.2.1 Surface Control Unit (Figure 2.1)

The air in which the Surface Control Unit operates should be as clean and dry as possible. Dirt and dust will eventually settle, especially around high d.c. voltage areas where electrostatic attraction is strong, and these deposits can become conductive, (carbon from diesel exhausts, etc.), and hence constitute a potential source for faults.

The Surface Control Unit is coated with a corrosion resistant paint, and to maintain the appearance of the unit and prevent corrosive deposits building up, the external housing should be cleaned periodically with a damp cloth, and dried. Do not use any chemical cleaning agents, for example, degreasers or detergents, as they may be harmful to plastic materials.

2.2.1.1 Fan Filter

This is located on the left-hand side of the unit and is accessed by removing six screws securing the top panel and lifting clear.

The filter (Sheet 1 item 29) should be checked and cleaned or replaced at regular intervals.

Ensure the equipment is stored in a suitable environment when not in

2.2.2 Subsea Unit (Figure 2.2)

The Subsea Unit should be washed with fresh water after each recovery to remove seawater, mud, silt and any other contaminants.

Also check that the pre-charged seal indicator pin (Figure 2.3) has not fallen to below 5mm from the surface of the end cap. If it has, follow charging procedure (2.2.2.1).

The Subsea Unit contains a high performance rotating seal mechanism, incorporating an active compensation device. This seal is pre-charged with lubricant and for this reason it is important that the components are not removed or loosened in any way, as any such action would result in a de-pressurisation of the compensator.

2.2.2.1 Seal Re-Charging Procedure (Figure 2.3)

The procedure for re-charging the seal assembly is as follows:

a) Remove the filter port plug (diametrically opposite the indicator) to expose the grease nipple.

b) Connect a grease gun, charged with SHELL ALVANIA MULTI PURPOSE GREASE, to the grease nipple.

c) Begin to charge the unit from the grease gun, observing the position of the indicator.

d) Stop filling when the indicator is 1-2mm below the surface of the end cap.

e) Remove the grease gun.

f) Pack the filler port with grease and **replace the plug.**

2.2.2.2 Seal Life

The shaft and seal sleeve are designed for a service free maintenance period of 3,000 hours in normal operating conditions.

Sonavision recommend component replacement at 2,500 hour intervals, or every two years (whichever is sooner) by returning the unit to our Service Department for inspection and maintenance.

2.3 SYSTEM FAULT DIAGNOSIS (Figure 2.4 to 2.7)

This sub-section contains flowcharts to enable fault isolation and repair by replacement to sub-assembly level.

2.3.1 Preliminary Procedure

Initially go to the system fault analysis flowchart (Figure 2.4) starting at the top of the flowchart (box 1). Carry out that instruction in the box. Depending on the result of the instruction or text, follow along the appropriate path to the next box and carry out that instruction or test.

The system fault flowchart will indicate if the fault is most likely to be in the Surface Control Unit, Subsea Unit or a telemetry error which could be either unit or the umbilical. By then proceeding to the appropriate fault analysis flowchart, a fault can be traced to the most likely sub-assembly and replaced.

The numbers in the boxes refer to paragraphs of text which detail the measurement to be carried out in greater detail.

In order to gain access to test if sub-assemblies are functional, the Surface Control Unit and the Subsea Unit may need to be disassembled as per Section 2.4.

WARNINGS

* **The following procedures should only be undertaken by a technician suitably trained and experienced in the maintenance of marine electronic and mechanical equipment.**

* **Lethal voltages are exposed within the Surface Control Unit when the front panel is lowered or the top panel is removed. The Surface Control Unit should always be disconnected from the main supply before removing or opening any of the access panels.**

* **If there is to be a measurement on the Subsea Unit using an oscilloscope, the ground of the oscilloscope must be removed before power is applied or taken away from the Subsea Unit in FSK mode.**

* **If the ground is left on whilst power is applied or taken away, the Constant Current PSU will detect a LIM fault.**

2.3.2 System Fault Analysis (Figure 2.4)

Contained within this sub-section are detailed descriptions on how to carry out the tests within each box of the system fault analysis flowchart.

References are made to S-VHS and Non S-VHS systems in this Section. To determine which system you have, see Section 2.3.3 part 6. Alternatively, press "HELP" on the control unit. If the "Video Clock" field reports "External Clock" then your system is S-VHS, "Internal Clock" indicates your system is VHS.

1, 2	IS THE SYSTEM INSTALLED PROPERLY? Refer to Section 2 of the SONAVISION 4000 Scanning Sonar Operating and Installation Manual
3	ARE THE SURFACE CONTROL UNIT FRONT PANEL LEDS LIT? Ensure the mains is applied tot he Surface Control Unit. Push the “power” button and check that the front panel Led light.
4, 5	IS THE MAINS INPUT FUSE INTACT? Switch the mains tot he Surface Control Unit off. Remove the a.c. power input connector at the rear of the Surface Control Unit. Pull the fuse drawer out from the connector to gain access tot he fuse. Using a multimeter verify that the fuse has a resistance of less than 0.1 ohm.
6, 7	IS THE MAINS INPUT VOLTAGE WITHIN SPECIFICATION? Using a multimeter measure the mains input voltage tot he unit. Refer to Section 1.2.1 of the SONAVISION 4000 Scanning Sonar Operating and Installation Manual.
8	GO TO THE SURFACE CONTROL UNIT FAULT ANALYSIS. Go to box 1 of the Surface Control Unit fault analysis flowchart (Figure 2.5).
9	DOES THE SURFACE CONTROL UNIT PRODUCE PROPER VIDEO? Upon power up of the unit does a diagnostic display similar to Figure 2.4 appear on the display, then after all the tests are complete does a sonar display image similar to Figure 2.4 sheet 3 appear.
10, 11	IS MONITOR FUNCTIONAL AND COMPATIBLE? Does the monitor support the video standard being produced by SONAVISION 4000? LOW RESOLUTION FORMATS R, G, B, SYNC and PAL 624 line 50Hz *factory set R, G, B, SYNC and NTSC 524 line 60Hz HIGH RESOLUTION FORMATS R, G, B, SYNC and PAL 1250 line 50Hz R, G, B, SYNC and NTSC 1050 line 50Hz
	The set-up video format may be obtained by comparing the switch setting of the Graphics Board with Section 1.2.6 of the SONAVISION 4000 Maintenance Manual.
12	GO TO THE SURFACE CONTROL UNIT FAULT ANALYSIS. Go to the top box of the Surface Control Unit fault analysis flowchart (Figure 2.5).
13	DOES ALL SURFACE CONTROL UNIT POWER UP DIAGNOSTICS PASS?

	On power up does all Surface Control Unit diagnostics pass?
14	GO TO THE SURFACE CONTROL UNIT FAULT ANALYSIS. Go to box 1 of the Surface Control Unit fault analysis flowchart (Figure 2.5).
15	SUBSEA COMMS TEST DIAGNOSTIC PASS? Upon power up of the Surface Control Unit in the power up diagnostic display does the “Subsea Comms Test” PASS.
16	GO THE TELEMETRY FAULT ANALYSIS. Go to the top box of the telemetry fault analysis flowchart (Figure 2.7).
17	DOES THE REST OF SUBSEA POWER UP DIAG. PASS? On power up does all Subsea Unit diagnostics pass? Ignore subsea comms test.
18	GO TO THE SUBSEA UNIT FAULT ANALYSIS. Go to the top box of the Subsea Unit fault. Go to the top box of the Subsea Unit fault.
19	IS THERE EXPECTED SONAR DATA ON THE MONITOR? Does the video image after the diagnostic screen appear as shown in Figure 2.4 sheet 3 with sonar information as appropriate to the environmental conditions.
20	DOES SONAR HEAD TYPE AGREE WITH SUBSEA UNIT? In the power up diagnostics does the sonar head type agree with the head type on the Subsea Unit.
21	SET THE SWITCHES ON THE CPU/GRAPHIC BOARD. To set up the sonar head type refer to Section 1.2.6.8 of the SONAVISION 4000 Maintenance Manual.
22	GO TO THE SUBSEA UNIT FAULT ANALYSIS. Go to the top box of the Subsea Unit fault analysis flowchart (Figure 2.6).
23	IS THE SUBSEA UNIT RESPONDING TO COMMANDS? By varying the range from 10%, 20%, 50% to 100% and varying the control mode from “rotate”, “scan” and “flybk” does the Subsea Unit respond without causing error messages to be flashed up on the screen.
24	GO TO THE S.S.U. FAULT ANALYSIS. Go to the top box of the Subsea Unit fault analysis flowchart (Figure 2.6).
25	SYSTEM FUNCTIONAL. If the system is not fully functional return the product to: SONAVISION LTD Denmore Road Bridge of Don ABERDEEN AB23 8JW

2.3.3 Surface Control Unit Fault Analysis (Figure 2.5)

Contained within this sub-section are detailed descriptions on how to carry-out the tests within the numbered boxes of the Surface Control Unit fault analysis flowchart.

1	ONLY CONNECT VIDEO AND MAINS TO SURFACE CONTROL UNIT. Disconnect the Subsea Unit from the Surface Control Unit to get the system to a known configured quantity.
2	SONAR DISPLAY ON MONITOR. Upon power up of the unit does a diagnostic display similar to Figure 2.4 sheet 2 appear on the displays then after all tests are complete does a sonar display areas similar to Figure 2.4 sheet 3 appear?
3	MEASURE THE MAINS WIRING. Power down the unit and remove the mains calve from the rear of the unit. Using a multimeter measure and verify that the main wiring is as per the system drawing Figure 1.37.
4	IS THE +5V, ±12V SUPPLIES PRESENT? With the Surface Control Unit front panel folded down, power up the unit and using a multimeter measure if the +5V, ±12V supplies are present on the Front Panel Processor Board (Figures 1.7, 1.8).
5	IS THE GRAPHICS CARD VIDEO SWITCHES SET? With reference to sub-section 1.2.6.8 set the switches to the desired video format.
6	IS THE VIDEO/TELEMETRY BOARDS COMPATIBLE? Marked on the ejector handles of the Video Telemetry Board is the model number. 2050-3012 is a PAL S-VHS board. 2050-3013 is a NTSC S-VHS board. 2050-3005 is a PAL Non-S-VHS board. 2050-3009 is a NTSC Non-S-VHS board.
7	IS THERE RS422 TO FRONT PANEL? With the front panel folded down, power up the unit. Using an oscilloscope verify TTL level on IC2 Pin 7 and 8 of the Front Panel processor Board (Figure 1.7 and 1.8).
8	IS VIDEO TELEMETRY CARD PRODUCING PIXEL CLK AND SYNCS? Using an oscilloscope, monitor TP18 of the Video Telemetry Board (Figure 1.9, 1.10). There should be a 7MHz TTL square-waveform for PAL boards and 6.3mhz TTL square-waveform for NTSC boards. Monitor TP21 for horizontal sync's at a frequency of 15624Hz for PAL and 15734Hz for NTSC. Monitor TP22 for vertical sync's at a frequency of 50Hz for PAL and 60Hz for

	NTSC.

2.3.4 Subsea Unit Fault Analysis (Figure 2.6)

Contained within this sub-section are detailed description on how to carry out the tests within the numbered boxes of the Subsea Unit fault analysis flowchart.

1	IS THE SUBSEA UNIT IN THE EXPECTED TELEMETRY MODE? During power-up the telemetry mode is displayed in the diagnostic page. It is also displayed on the sonar text box area on the active display.
2	MEASURE THE INPUT VOLTAGE AT CONNECTOR. Power down the system. Disconnect the umbilical from the Subsea Unit. Remove the outer housing of the Subsea Unit. Reconnect the umbilical to the Subsea unit and power up the unit. Using a multimeter measure the voltage on SKT9 Pins 7 to 6 (Figures 1.19 and 1.20).
3	MEASURE THE CONSTANT CURRENT. Power down the system. Disconnect the subsea umbilical connector from the Surface Control Unit. Using a multimeter attach the leads tot he surface unit subsea connector SKT2 Pin C and D. Power up the Surface Control Unit and measure the current (580mA) (Figure 1.37).
4	IS THE 0V PRESENT ON THE MOTHERBOARD? Using a multimeter measure the voltage between TP4 and SKT9 Pin 6 on the motherboard. If the auto-start is functional there will be less than 0.1 Volts here (Figures 1.19 and 1.20).
5	POWER DOWN UNIT IS THE HEAD MECH. JAMMING? Power down the Subsea Unit. Physically rotate the head and ensure that a constant smooth torsional force is required to rotate the head.

6	IS THE RECEIVER LOCAL OSCILLATOR PRESENT? Using an oscilloscope measure the amplitude of the oscillator at TP4 wrt 0V on the Switchband Receiver Board (typically 4Vpk to pk at 955kHz for the 500kHz head) (Figure 1.33).
7	CHECK TRANSDUCER CONTINUITY. Remove the preamplifier from the sonar head. Using a multimeter ensure that the RX+ and RX- signal lines are not shorted together PL1 pins 1, 2. (Figures 1.35 and 35).
8	SET SONAR TO TX HIGH POWER, SONAR TRANSMITTING? Set the sonar to 100 metre range, continuous scan and transmission power to high. If the sonar is transmitting power an audible noise will be heard when close to the subsea transducer unit.

2.3.5 Telemetry Fault Analysis (Figure 2.7)

Contained within this sub-section are detailed descriptions on how to carry out the tests within each box of the telemetry fault analysis flowchart.

1	IS THE SUBSEA UNIT INSULATED? Remove power from the Subsea unit. Remove the outer housing. Using a multimeter measure the resistance of the 0V (TP4 on motherboard) to chassis (Figures 1.10 and 1.20). <u>NOTE</u> Do not use a mega meter because there are two capacitors between 0V and chassis which are only 50V rated.
2	IS THE 0V PRESENT ON THE MOTHERBOARD? Using a multimeter measure the voltage between TP4 and SKT9 Pin 6 on the motherboard. If the auto-start is functional there will be less than 0.1 Volt between them (Figures 1.19 and 1.20).
3	DOES CONSTANT CURRENT PSU INDICATE SHUTDOWN ON J2? Using a multimeter measure the voltage at IC8 Pin 12 on the J2 Interface Board. The voltage should be a TTL high (Figures 1.13 and 1.14).
4	IS THE EXTERNAL SUPPLY ON THE SUBSEA UNIT PRESENT? Is the external power supply for the Subsea Unit between 18 and 32V d.c.?
5	IS THE TELEGRAM PRESENT ON SUBSEA PROCESSOR BOARD? Using an oscilloscope monitor PL2 Pin 12 on the Subsea Processor Board. The downlink telegram should consist of a block of characters, each character consisting to ten bits each 104 micro seconds of duration (Figures 1.27 and 1.28).
6	IS CPU RESPONDING TO DOWNLINK TELEGRAM? Using an oscilloscope monitor PL2 Pin 8 on the Subsea Processor Board. The uplink telegram should consist of block of data, each data bits being of 16 micro seconds duration (Figures 1.27 and 1.28).
7	IS RS422 (+) (-) ON MOTHERBOARD? Power up the Subsea Unit. Attach the scope probe ground to TP4 on the motherboard, monitor PL3 Pin 4 and 8 and verify there is data present (Figures 1.19 and 1.20).
8	IS RS422 UPLINK DATA ON JS? Attach the scope probe ground to 0V TELA on the J2 Interface Board. Monitor IC6 Pin 6 and Pin 7, verify they are generating RS422 data (Figures 1.13, 1.14).
9	IS THE CPU RESPONDING TO THE DOWNLINK TELEGRAM? Attach the scope probe ground to the Subsea Processor)V bar and monitor PL2 Pin 8 on the Board, is there TTL data, in response to the downlink telegram? (Figures 1.27 and 1.28).

2.4 <u>ASSEMBLY/DISASSEMBLY</u>

2.4.1 General Description

The following procedures should only be undertaken by a technician suitably trained and experienced in the maintenance of marine electronic and mechanical equipment.

Before attempting any of the tasks **all power** should be removed from the system.

All assembly/disassembly tasks should be undertaken in a suitable clean area using the correct tools as required for each operation. Normal electrostatic handling precautions should be observed when dealing with any of the printed circuit boards.

Any o-ring seals disturbed or exposed should be treated as follows:

* Remove the o-ring, clean and check its integrity.

* If in any doubt about its condition - RENEW IT.

* Clean and confirm the integrity of the o-ring groove and sealing face.

* Lightly grease the o-ring with DOW CORNING MS4 SILICONE COMPOUND (or equivalent).

* Replace the o-ring in the groove to effect the seal.

Certain areas within the units may experience an increase in temperature during operation. Therefore, caution should be exercised to avoid contact with any such area, during assembly/disassembly, to prevent injury to personnel.

Threaded fixings mounting into plastic materials should not be tightened to a torque greater than 75cNm. Screws securing the front and rear panels of the Surface Control Unit should not be overtightened as this will result in damage to the polycarbonate fascia.

2.4.2 Surface Control Unit (Figure 2.1)

The Surface Control Unit is a 19" rack mounting assembly. It contains the processing and control electronics, power supply and mounted on the front panel, the operator controls.

Most maintenance tasks can be carried out without major disassembly of the unit as the front panel is hinged affording access to the internal components. To open the front panel, withdraw the four securing screws (Sheet 2 item 6) along the top edge of the panel, pull the panel forward and downwards. Visible inside the unit are the two main modules, the constant current supply (Sheet 1 item 3) on the right, and the VME card rack (Sheet 1 item 2) on the left. The two boards (Sheet 1 items 38 and 39) and the VME power supply (Sheet 1 item 40) are released from the rack by loosening the two screws (one at each end of the appropriate module) and pressing the ejector handles outwards. The module can then be slid out of the rack. Prior to removing either of the two cards, the cable harness (Sheet 1 item 27) and connector (Sheet 1 item 103) should be removed by loosening the two fixing screws and pulling clear of their mating halves .

To remove the constant current supply (Sheet 1 item 3) requires the top panel (Sheet 1 item 17) to be removed from the unit. Unscrew the six countersunk screws (Sheet 1 item 63) and lift off the top panel (Sheet 1 item 17). Ensure the earth tag is disconnected. Remove the four cap head screws (Sheet 4 item 12) securing the base of the constant current supply to the unit. Disconnect the D-type connector (Sheet 1 item 125) from the rear of the constant current supply and gently using the blue labelled lifting points, lift the supply clear of the unit. Please be careful as this assembly is very heavy.

To remove the J2 Interface Board (Sheet 1 item 37) requires the top panel (Sheet 1 item 17) to be removed from the unit as described above. The rear panel (Sheet 1 item 13) requires to be removed by removal of eight pan head screws (Sheet 1 item 67). Remove all connectors from the board by loosening the jackscrews then withdrawing them (Sheet 1 items 22, 23, 24, 25, 26, 144, 147). Unscrew the nine M2.5 X 6 pan head screws (Sheet 1 item 47) which secure the J2 interface PCB to the card rack. The J2 Interface Board can now be removed.

To gain access to the video telemetry board (Sheet 1 item 38) for test purposes, the top panel (Sheet 1 item 17) has to be removed from the unit as described above. Then remove the lid to the card rack (Sheet 3 item 1) by removing the six top plate screws. The video telemetry board test points can now be accessed for debugging.

Assembly is achieved by reversing the appropriate section of the above procedure.

2.4.3 Subsea Unit (Figure 2.2)

To disassemble the Subsea Unit and gain access to the various subassemblies therein, follow the procedure below:

2.4.3.1 Pressure Housing

a) Clean and dry the Subsea Unit prior to commencing disassembly.

b) Remove the three M5 cap screws (Sheet 1 item 84) securing the connector and remove the connector from the end of the Subsea Unit.

c) Using two suitable strapwrenches, unscrew the end cap (Sheet 1 item 2) from the housing (Sheet 1 item 1) (right hand thread). This will expose the chassis carrying the printed circuit boards.

2.4.3.2 Printed Circuit Boards

a) Remove the three M3 slotted screws (Sheet 1 item 106) securing the PCB retaining plate (Sheet 1 item 17) and the six main boards can be removed or replaced.

   Each board is keyed to prevent insertion in the wrong slot, however, care must be exercised to avoid damage occurring from attempts to forcefully insert a board in the wrong position.

b) To remove the motherboard (Sheet 1 item 57) first disconnect the three mating connectors (motor, sliprings and external connector) then remove the six M3 slotted screws (Sheet 1 item 106) securing the board, and lift the board free of the chassis. Preamplifier (Figure 2.2) a) Clean and dry the Subsea Unit prior to commencing disassembly.

2.4.3.3 Preamplifier (Figure 2.2)

a) Clean and dry the Subsea Unit prior to commencing disassembly.

b) Remove the six M4 cap screws (Sheet 1 item 87) securing the cover plate (Sheet 1 item 3), and lift off the cover plate.

c) Remove the two M3 cap screws (Sheet 1 item 101) securing the preamplifier (Sheet 1 item 64) and gently prise out the board.

SECTION 3 PARTS LISTS

3.1 INTRODUCTION

This section details the replaceable sub-assemblies of the **SONAVISION 4000** units, followed by tables listing the components which comprise the units.

Please quote Sonavision stock numbers when ordering components.

3 2 SURFACE CONTROL UNIT SUB-ASSEMBLIES

Replaceable sub-assemblies of the Surface Control Unit as shown in Table 3.1.

TABLE 3.1

Sub-Assembly	Sonavision Stock No.
F/P Assembly	2050-1001
CPU/Graphics (PAL)	2050-3004
CPU/Graphics (NTSC)	2050-3010
S-VHS Video/Telemetry (PAL)	2050-3012
S-VHS Video/Telemetry (NTSC)	2050-3013
VME PSU	2050-5001
CC PSU	2050-1003
J2 Interface	2050-3003
VHS Video/Telemetry (PAL)	2050-3005
VHS Video/Telemetry (NTSC)	2050-3009

3.3 SUBSEA UNIT SUB-ASSEMBLIES

Replaceable sub-assemblies of the Subsea Unit are shown in Table 3.2.

TABLE 3.2

Sub-Assembly	Sonavision Stock No.
Transducer Head Assembly (500kHz)	2360-02-010
Motor Assembly	2360-03-017
Indicator Assembly	2360-03-015
Motherboard	2360-3005
Sonar Rx	2360-3003
TX / Telemetry	2360-3004
CPU	2360-3001
12V PSU	2360-3009
5V PSU and Motor PSU Board	2360-3008
CC/Receiver	2360-3007
Pre-amplifier	2360-3011