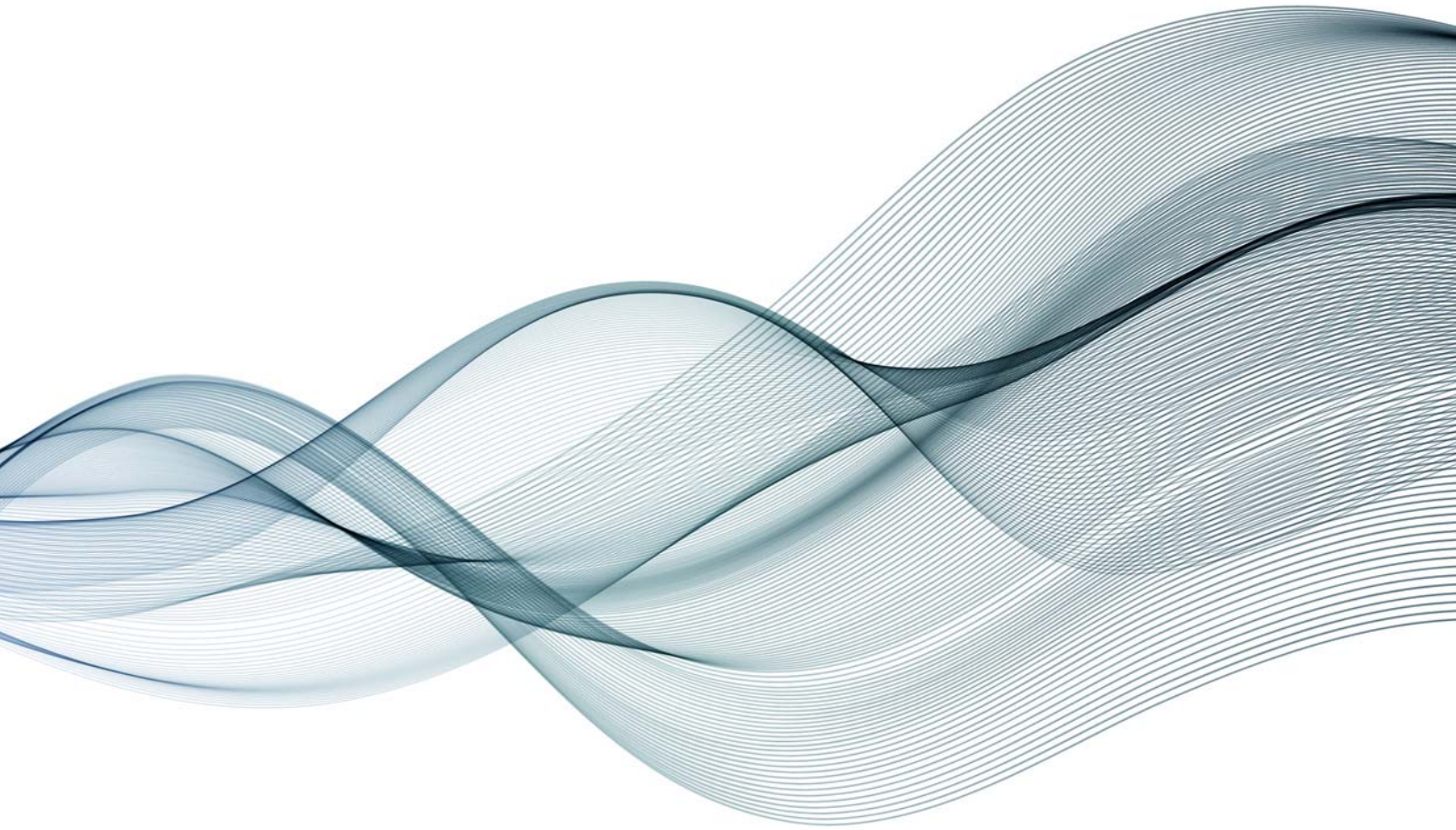

Operation and Maintenance Manual for the SAT Control Helium Speech Unscrambler

Part Number: CO363AC/1

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Revision: 4

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APPROVAL SHEET

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Responsibility	**Name**	**Position**	**Date**
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Copyright Details

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LIST OF ABBREVIATIONS

Abbreviation	Definition
Comms	Communications
A	Amp
DSP	Digital Signal Processor
HLB	Hyperbaric Lifeboat
m	Meters
msw	Meters of Sea Water
Heliox	A gas mixture of Helium and Oxygen
PTT	Push to Talk
Hz	Hertz
I/O	Input / Output
LCD	Liquid Crystal Display
LED	Light Emitting Diode
PCB	Printed Circuit Board
POT	Potentiometer
PPO2	Partial Pressure of Oxygen
STP	Screened Twisted Pair
AC	Alternating Current
DC	Direct Current
Vac	Voltage (AC)
Vdc	Voltage (DC)

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CHAPTER 1 - INTRODUCTION

Fig 1.1 Sat Control Helium Speech Unscrambler (CO363AC/1)

The CO363AC/1 Sat Control Helium Speech Unscrambler has been designed into a 19" rack enclosure which contains the electronics that perform the unscrambling and communications functions.

Divers in saturation breathe a gas mixture of Helium and Oxygen (Heliox) which distorts the human voice to sound high pitched and difficult to understand. The CO363AC/1 converts the Helium affected speech back to a usable audio source that is easy to understand and communicate with.

The main function of the Sat Control Unscrambler is to provide clear, two way voice communications between the divers and a supervisor, using three independent communications circuits – Main Lock, Entry Lock and Bunks.

The supervisor will use a PTT (Push to Talk) button to talk with each channel individually via that channel's PTT or all three channels at the same time with the "PTT ALL DIVERS" button.

The Unscrambler has a Liquid Crystal Display (LCD) for the user interface that will indicate specific unscrambling parameters such as Depth (msw), Partial Pressure (PPO2), Pitch and Temperature. All of these parameters may be manipulated individually via the user interface.

The Unscrambler is also fitted with a loudspeaker so that the diver's speech is audible to the supervisor independently of the supervisor's headset. It is possible to have the loudspeaker switched ON or OFF, as desired. The Unscrambler is also fitted with a record function. The audio to and from the Unscrambler can be recorded on an external device via a BNC connector on the rear panel.

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CHAPTER 2 - FUNCTIONAL DESCRIPTION

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2.1 POWER SUPPLY

The Unscrambler has two switch mode power supplies installed within the enclosure. The unit is designed to receive a mains voltage of 85 to 264 Volts with a frequency of 47 to 63Hz. Generally it is powered using either 110VAC or 230VAC.

The power inlet is a twin fused IEC socket on the rear panel. The socket is fused using 2 Amp anti-surge fuses.

Fig 2.1 AC Power Inlet

	WARNING
	RISK OF ELECTRIC SHOCK. Only qualified personnel conversant with operation of electrical systems should perform hook up, repair or maintenance.

2.2 GENERAL

The main function of the Unscrambler is to provide a means of unscrambling within a Sat Control system. There are two main sections to the Unscrambler, the power supply section and the PCB/ Audio section.

Within the 19” rack enclosure are several Printed Circuit Boards (PCB’s) that provide the function of helium speech unscrambling as well as routing for the audio signals. There is a digital signal processor (DSP) PCB which digitally corrects the helium speech effect on the chamber occupant’s voice when the Unscrambler is turned on.

There are five modular PCB cards that fit onto a main routing or “Backplane” PCB. The backplane PCB is the largest PCB in the unscrambler and is responsible for connecting and routing signals between the different cards inside the unscrambler. Three of the these cards are the audio module PCB's. The audio module PCB's are responsible for the volume control for each of the diver channels. The other two cards are the audio mixing PCB which mixes the three audio signals before they are unscrambled via the DSP PCB and the input transformer PCB which controls the PTT functions, the VU display and houses the audio input transformers.

The power supplies are mounted onto an acetal plate along with the DSP power supply. There are two switch mode power supplies which have an output voltage of +/- 12Vdc. The DSP power supply converts the incoming AC voltage down to 7.2Vdc to supply the DSP PCB.

The front panel contains all the main user interface elements that are used to adjust the operating parameters of the unscrambler. The section on the left of Fig 2.2 is the power and audio controls. This section contains the controls for the audio functions of the unit. The adjustable gains and PTT switches are all controlled from the front panel.

The right hand side of Fig 2.2 shows the DSP interface which contains the Unscrambler on/off button and the DSP controls. The DSP has a set of unscrambling parameters that can be adjusted. The user interface is displayed on an LCD. The keypad below the LCD will allow the user to navigate through the unscrambling properties and adjust to suit. The depth control is controlled via the depth potentiometer which will update the DSP and the LCD will give a readout of the current depth setting.

Fig 2.2 Front Panel

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CHAPTER 3 - PANEL COMPONENTS

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3.1 Front Panel Power and Audio Controls

The front panel contains the power on/off switch which is a green illuminating push-button switch. When pressed the Unscrambler will power on and the power button and LCD display will illuminate.

Next to the power on/off switch is a jack socket for a supervisor headset and the speaker power switch. The speaker switch will illuminate with a blue LED when the speaker is on.

The supervisor headset (CO23986) can be plugged into the ¼" jack socket on the front panel of the unscrambler. The Supervisor headset and Diver headsets are not to be mistaken as being the same. Only the supervisor headset with a ¼" jack plug can be used on the front panel.

The supervisor's headset connector uses an industry standard ¼" jack socket located on the front panel of the unscrambler. The below image shows the jack which is on the supervisor headset.

Fig 3.1 Headset Jack Connections

Pin number	Function
Centre	Supervisor Microphone Signal
Sleeve	Supervisor Mic/Earphone Return
Tip	Supervisor Earphone Signal

Table 3.1 Headset Jack Connections

The speaker can be switched on when the headset is in use and the audio from the divers will be audible from the speaker.

The 'Master' or 'All Diver' controls contain the master volume controls and the all divers PTT button. The master volume controls will change the volume for all channels when adjusted. The diver to supervisor and supervisor to diver master volumes can be adjusted. The 'PTT All Divers' enables the supervisor to address all divers at the same time using one button.

Each diver communications channel is equipped with its own set of dedicated volume controls which have a minimum listening level. The volume controls available for each individual channel include the diver to supervisor volume and the supervisor to diver volume. Each channel has its own PTT switch so the supervisor can address an individual channel at a time.

Fig 3.2 shows the power on/off switch and audio control switches.

Fig 3.2 Power & Audio Control Switches

3.2 FRONT PANEL DSP INTERFACE

Fig 3.3 shows the user interface section of the front panel.

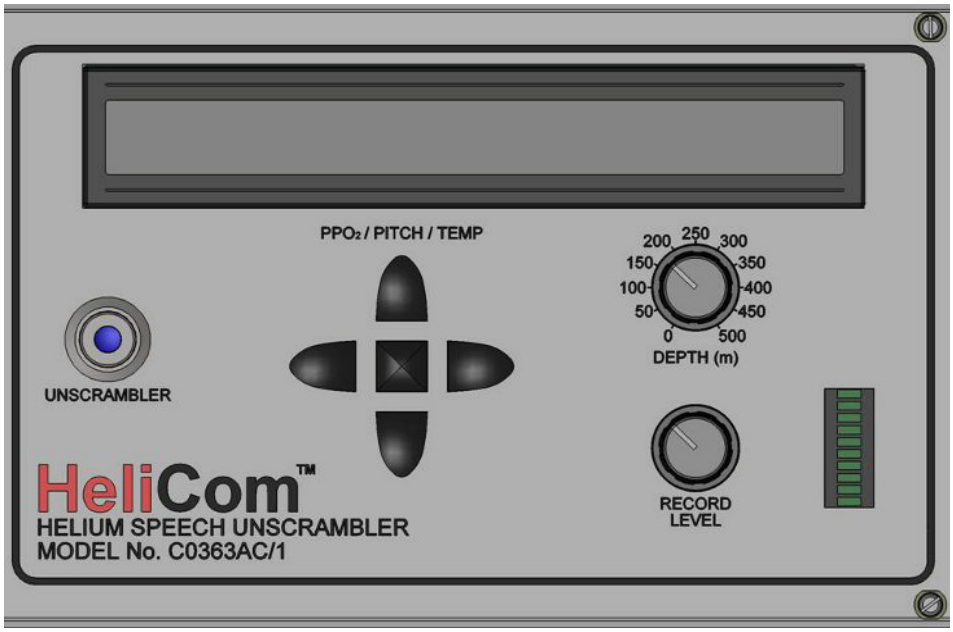

Fig 3.3 Unscrambler Controls

To switch the Unscrambler on, push the illuminating push-button switch on the front panel. The Unscrambler power switch will illuminate with a blue LED when the unscrambler is on.

The user interface Liquid Crystal Display (LCD) shows parameters used by the unscrambling algorithm and allows adjustments of these parameters to the users preference. The keypad is used to scroll through and set the chosen parameters. For detailed information on the user interface see section 4.3.

The depth pot is the main control for the Helium unscrambling function and this alone can be used to set the Unscrambler parameters to match the depth and gas mix of any given chamber occupant. The depth pot varies over a range of 0m to 500m.

3.3 REAR PANEL

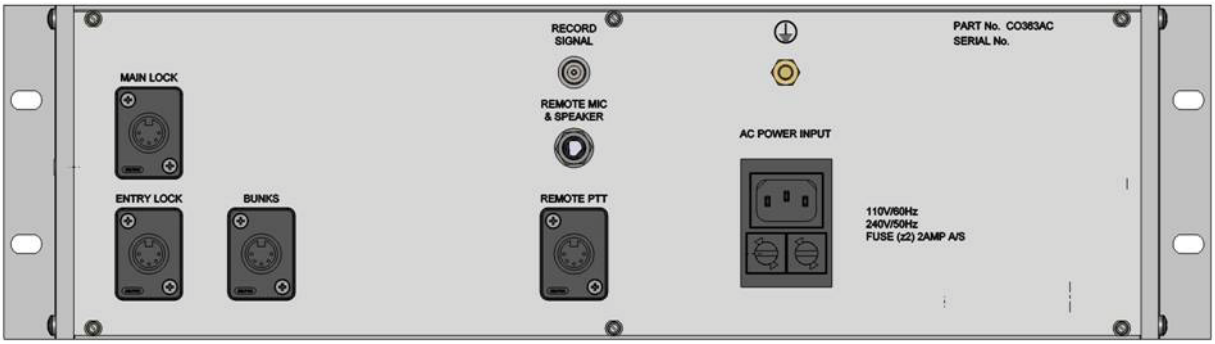

Fig 3.4 Rear facia

The rear facia of the Unscrambler is where the signal cabling to and from the unit will be connected. The rear facia houses all of the chamber audio connections and the remote PTT connections on 5 way XLR sockets. The power socket and earth stud for the unit are also both located on the rear facia.

The comms cables from the chambers can be connected to Main lock, Entry Lock and Bunks connectors on the rear of the unit - as per the pin allocations shown in section 3.4.

Remote PTT's can be connected to the remote PTT socket on the rear of the unit - as per the pin allocations shown in section 3.5.

The Jack socket on the front panel can be used to connect a supervisor headset and the jack socket on the rear panel can be used to connect an external microphone and speaker.

The Record Signal output can be accessed from the BNC socket on the rear of the unit – as per the pin allocations shown in section 3.8.

Ensure that the Power switch on the front of the unit is switched off and connect the supplied Mains Power Lead to the IEC bulkhead socket on the rear of the unit as shown above in Fig 3.4.

3.4 REAL PANEL AUDIO CONNECTORS

Signal wiring to the Unscrambler is via the five way XLR cable assemblies (CO363180) which connect onto the three sockets on the left side of the rear panel. The five way cable assemblies (Part No. CO363180) are used for Main Lock, Entry Lock and Bunks connections.

See below image of rear panel 5 pole XLR socket diagrams.

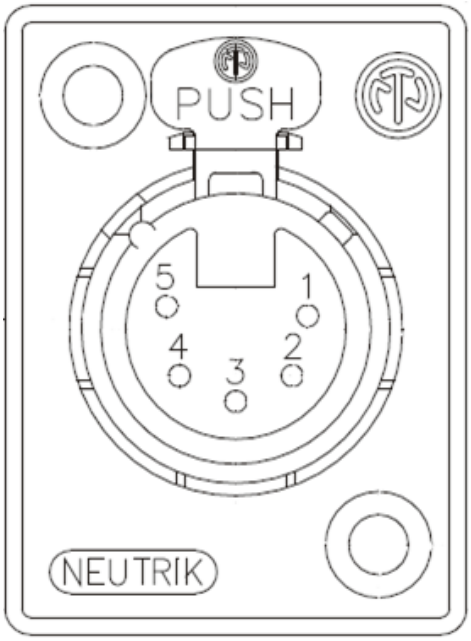

Fig 3.5 Rear Panel Audio Output XLR Socket Face view

The cable assemblies are to be installed to connect the unscrambler to the audio field wiring from the chambers.

(Main Lock, Entry Lock and Bunks- 5 pin Panel Mount Socket) Pin out allocation

Functional Name	Wire Colour	Function	Pin number
Mic (Rtn)	Grey (Red Screen)	Microphone Return	1
Mic (Sig)	Red	Microphone Signal	2
Ear (Rtn)	Grey (Yellow Screen)	Earphone/Speaker Return	3
Ear (Sig)	Yellow	Earphone/Speaker Signal	4
Screen	Grey	Headset screen	5

Table 3.2 Comms Input Connector Details

3.5 REMOTE PTT CONNECTIONS

There is another 5 way XLR socket for remote PTT connections. This supplies a means of remote press to talk where a five way cable assembly (Part No. CO363181) can be connected between the socket and a remotely located set of switches, typically located on Sat Control panels. This carries the same function as the front panel press to talk switches.

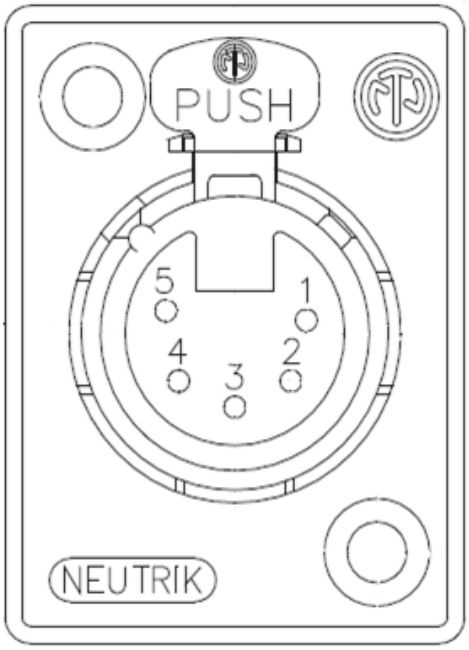

Fig 3.6 Rear Panel PTT XLR Socket Face view

(Remote PTT Switches: All Divers – 5-pin Panel Mount Socket) pin out allocation

Functional Name	Wire Colour	Function	Pin number
PPT Common	Red	PTT Switch Common	1
PTT Contact Ch 1	Grey	PTT Switch Contact Channel 1	2
PTT Contact Ch 2	White	PTT Switch Contact Channel 2	3
PTT Contact Ch 3	Black	PTT Switch Contact Channel 3	4
PTT All Diver	Green	PTT Switch Contact All divers	5

Table 3.3 Remote PTT Connector Details

3.6 5 WAY XLR SIGNAL CABLE ASSEMBLY

The 5 way XLR cable assembly (CO363180) connects to the rear panel XLR sockets to provide the chamber audio input/output. The cable has a 2M tail with two STP (Red/Black) and (Green/Black) and a screen wire. The Green and Black pair is known as pair 1 and the Red and Black pair is known as pair 2.

See below for a pin layout of the XLR cable connector.

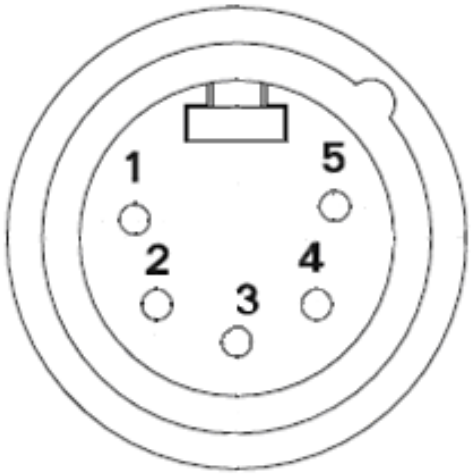

Fig 3.7 XLR Cable Mount Plug Face view

(CO363180 Cable Assembly-5 pin XLR Cable Connector) Pin out allocation

Functional Name	Wire Colour	Pin number
Mic (Rtn) / PTT Wiper	Black (Pair 1)	1
Mic (Sig) / PTT Ch 1	Green (Pair 1)	2
Ear (Rtn) / PTT Ch 2	Black (Pair 2)	3
Ear (Sig) / PTT Ch 3	Red (Pair 2)	4
Screen / PTT All	Grey (Screen)	5

Table 3.4 Signal Cable Plug Connections

3.7 5 WAY XLR REMOTE PTT ASSEMBLY

The 5 way XLR Cable assembly (CO363181) connects to the “REMOTE PTT” XLR socket on the rear panel to provide the remote PTT connections. The cable has a 2M tail with three pair STP (Red/ Black), (Green/Black) and (White/Black). The Green and Black pair is known as pair 1, the Red and Black pair is known as pair 2 and the White and Black pair is known as pair 3.

See below for a pin layout of the XLR cable connector.

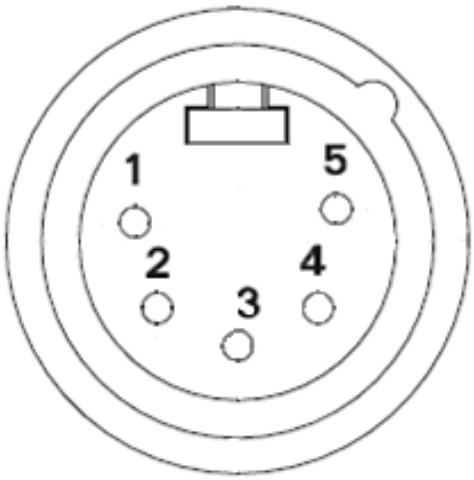

Fig 3.8 XLR Cable Mount Plug Face view

(CO363181 Cable Assembly- 5 pin XLR Cable Connector) Pin out allocation

Functional Name	Wire Colour	Pin number
PPT Common	Black (Pair 1)	1
PTT Contact Ch 1	Green (Pair 1)	2
PTT Contact Ch 2	Black (Pair 2)	3
PTT Contact Ch 3	Red (Pair 2)	4
PTT All Diver	White (Pair 3)	5

Table 3.5 PTT Cable Plug Connections

3.8 RECORD OUTPUT CONNECTOR

The record out socket is a standard BNC socket and is located on the rear panel of the Unscrambler. Comms are available for recording at all times from this connector. The audio output from this connector is set at a standard line level output.

Fig 3.9 Record out Connector

Pin	Function
Centre	Record Output
Outer	0V

Table 3.6 Record out Connector Details

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4.1 DIVER COMMUNICATIONS

The audio path for the signals received from a Chamber Comms Box is: Chamber Comms Box to Unscrambler XLR sockets to Audio Module PCB to Mixer PCB to the DSP PCB. After the audio has been unscrambled it is then routed to the supervisor headset and speaker.

Audio signals are routed within the Unscrambler to the audio module PCB's where the signals are amplified depending on the position of the volume controls. Each channel has its own dedicated audio module. The three audio signals are mixed together in the mixing PCB before being processed through the DSP to be digitally unscrambled. The unscrambled audio is then routed back to the audio output connectors, speakers or supervisor headset.

The divers can talk to the supervisor and the diver microphone outputs will always be audible at the surface end. The diver microphone output has a minimum listening level so the volume of a diver can not be turned down so low that they cannot be heard.

The diver to supervisor volume can be adjusted for each channel individually via the channels volume control or the volume of all channels to the supervisor can be adjusted using the master volume control.

4.2 SUPERVISOR COMMUNICATIONS

The audio path for the signals from the supervisor headset is: Headset to 1/4" jack to Audio Module PCB to the audio outputs.

Signals are routed within the Unscrambler to the audio module PCB's where the signals are amplified depending on the position of the volume controls. The supervisor microphone output is routed to the comms box speakers via the audio output terminals.

The supervisor will only be heard by the divers when the individual channel's PTT or the "All Divers" PTT button is pressed. The PTT also has a set of remote PTT connections which allows the use of a set of remote PTT switches which will perform the same functions as the PTT buttons on the front panel. See section 3.4 for the remote PTT connector and section 3.6 for the remote PTT cable assembly.

The supervisor to diver volume can be adjusted for each channel individually via the channel's volume control or the volume of all channels to the supervisor can be adjusted using the master volume control.

4.3 USER INTERFACE

The User Interface & associated Keypad is responsible for user interaction and communication of environmental parameters to the Unscrambler. It provides the means by which the gas and environmental parameters of the unscrambling operation can be changed.

The Sat Control Unscrambler gives the user full control over the setup and updating of each of the parameters relating to unscrambling the Helium speech.

If unscrambling is deemed unnecessary, for example when the chamber depths are near 0 msw, the Unscrambler on/off switch can be switched to the off position and no unscrambling will take place.

Turn the Unscrambler on using the round push-button switch on the user interface section of the front panel marked “UNSCRAMBLER”. The “UNSCRAMBLER” pushbutton will illuminate blue when the unscrambler has been switched on.

Fig 4.1 shows the User Interface and Keypad.

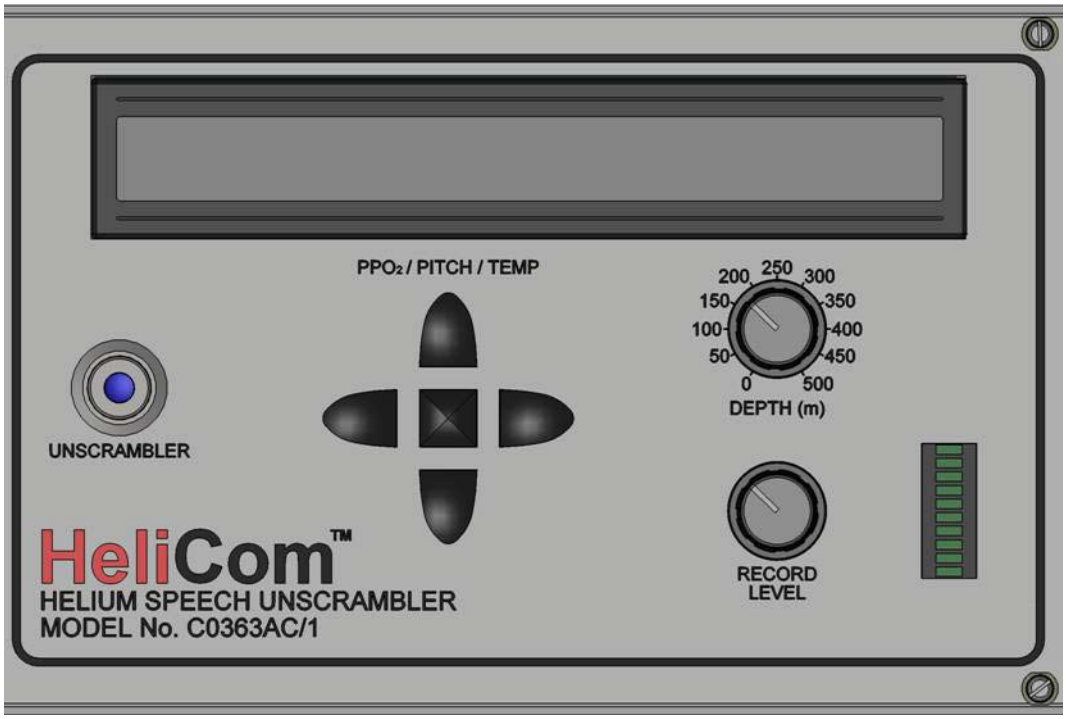

Fig 4.1 User Interface & Keypad

There are a number of user interface pages which can be viewed and/or adjusted. The power up page is shown in Fig 4.2.

Fig 4.2 User Interface Power up Page

After power up the user interface defaults to the home page which displays the depth at which the depth pot is set at. Fig 4.3 shows the user interface home page.

Fig 4.3 User Interface Home Page

All user interactions are by means of the four direction buttons ↑ ↓ ← →, the select button (centre) and the depth control potentiometer. The LCD provides feedback to the user and prompts them for the appropriate key selection to either scroll to the next field or to edit the displayed field.

The depth control potentiometer can be adjusted at any time and updated parameters will be transmitted automatically to the Unscrambler DSP. There is also a real time update to the LCD which displays a digital read out of the depth at which the potentiometer is set.

The User Interface operates in two modes, a scrolling mode where by the ↑ & ↓ buttons will take the user through the environmental fields (PPO2, Temperature & Pitch Reduction) and an editing mode where a nominated field can be incremented or decremented.

Depth and PPO2 are the dominating parameters in the operation of the Unscrambler. The Depth parameter is expressed in meters of sea-water (msw) and operates over a range of 0 to 500 msw. The depth adjustment is the controlling factor behind the unscrambling operation and can be operated on its own without any interaction on the user interface to successfully unscramble Helium speech.

The gas mixture (PPO2) is defined by the normalised ratio of the partial pressures of the Helium and Oxygen components of the Heliox atmosphere. No other gas components are considered in the software algorithms.

The default PPO2 value is 0.8 atm and it can be adjusted over a range of 0.0 to 2.0 atm.

Fig 4.4 shows the user interface PPO2 page.

Fig 4.4 User Interface PPO2 Page

To adjust the value, the select button (centre) should be pressed and upon doing so the user interface enters edit mode, this applies to each page that can be edited. Fig 4.5 shows the PPO2 page after the select button is pressed.

Fig 4.5 User Interface PPO2 edit page

Pressing the ← or → buttons on the keypad changes the PPO2 value by increments of 0.01 and pressing the ↑ or ↓ buttons changes the PPO2 value by increments of 0.1.

Pitch Reduction Ratio (PRR) refers to a reduction in the pitch of the un-scrambled speech and can improve the 'naturalness' of the divers voice, but may not necessarily improve intelligibility - it may make long term listening less tiring.

The default PRR value is 1.00 and it can be adjusted over a range of 0.6 to 1.00. Under normal circumstances PRR can be left in its default state.

Pressing the ← or → buttons on the keypad changes the PRR value by increments of 0.1 and pressing the ↑ or ↓ buttons changes the PRR value by increments of 1.

Fig 4.6 shows the user interface PRR page.

Fig 4.6 User Interface PRR page

Temperature also has a minor effect on the Unscrambler function although under normal circumstances is usually left in its default state.

The default temperature value is 18^{o}C and it can be adjusted over a range of 0^{o}C to 30^{o}C.

Pressing the ← or → buttons on the keypad changes the temperature value by increments of 1 and pressing the ↑ or ↓ buttons changes the PPO2 value by increments of 5.

Fig 4.7 shows the user interface Temperature page.

Fig 4.7 User Interface Temperature page

4.4 MAINTENANCE

The following maintenance check list should be followed to ensure the Sat Control Unscrambler remains operational to high standard.

Identification	Procedure	Interval
1	Check rear facia connections and tighten in necessary	6 monthly
2	Check operation of the main power switch	6 monthly
3	Check operation of unscrambler power switch	6 monthly
4	Check operation of rotary channel volume switches	6 monthly
5	Check operation of PTT switches	6 monthly
6	Check operation of remote PTT switches (If installed)	6 monthly
7	Check operation of Record out function and VU meter	6 monthly
8	Check operation of depth potentiometer	6 monthly
9	Check operation of user interface buttons	6 monthly

Table 4.1 Maintenance Check List

There are two anti-surge fuses installed into the fuse holder on the IEC socket.

Location	Fuse	Description	Fuse Rating
Rear IEC Socket	F1 & F2	Power Supply - Input	2A

Table 4.2 Fuse Ratings

WARNING

RISK OF EQUIPMENT DAMAGE
Only suitably rated fuses rated should be installed on the unscrambler. Refer to Table 4.2 when selecting fuses.

WARNING

RISK OF ELECTRIC SHOCK.
Only qualified personnel conversant with operation of electrical systems should perform hook up, repair or maintenance.

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5.1 MECHANICAL

Chassis Dimensions:

19” Sub-rack (Width over mounting flanges = 482.6mm or 19”)

Height:	3U (1U = 44.45mm or 1¾”)
Width:	84 HP (1HP = 5.08mm or 2/10”)
Depth:	355mm
Weight:	6.5kg

5.2 ELECTRICAL

5.2.1 Mains Power Inlet

Input:	85VAC - 264VAC 50 / 60 Hz
Fuses:	2 Amp (Anti-surge)

5.2.2 Internal Power Supplies

Switch Mode Power Supply (Main System)	+12V DC output, 30W
Switch Mode Power Supply (Main System)	-12V DC output, 30W
AC/DC Converter (DSP power supply)	+7V DC output

5.2.3 Digital Signal Processing PCB

One DSP PCB providing one channel of

Voice Correction Range down to 500 m

5.2.4 Power Amplifiers- One per channel

Output	– 10 Watts into 8ohms
Frequency Response	– 300Hz to 12kHz

5.2.5 Input Frequency Response - 300Hz to 12kHz General

Main Lock - 4 wire system, screened twisted pairs

Main Lock - 4 wire system, screened twisted pairs

Bunks - 4 wire system, screened twisted pairs

5.3 ENVIRONMENTAL

5.3.1 Temperature

Operation:	-10^{o}C to +40^{o}C
Storage:	-20^{o}C to +60^{o}C

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CHAPTER 6 - SPARES

6.1 PCB'S

DSP PCB	CO362100
Audio Module PCB Channel 1	CO363201
Audio Module PCB Channel 2	CO363202
Audio Module PCB Channel 3	CO363203
Audio Mixer PCB	CO363204
Power and Transformers PCB	CO363168
Volume Pot PCB	CO363142

6.2 FRONT PANEL COMPONENTS

User Interface LCD	CO363307
Keypad Assembly	CO363314
Record Out Volume Pot	EM2075
Depth Potentiometer	EM2076
Power Switch	EM3030

6.3 ANCILLARY ITEMS

Supervisor Headset (Lightweight)	CO363175
Supervisor Headset (Rugged)	CO23986
Chamber Occupant Headset	EM3342
Chamber Comms Box	CO435
Flush Mount Comms Box (Bunk Box)	CO426
Chamber Comms Speaker	CO437
2A Anti-Surge Fuses	EM13357
HLB Comms Box	CO436
Comms Box Speaker	CO437

6.4 CABLE ASSEMBLIES

Audio Interface Cable	CO363180
Remote PTT Cable	CO363181
IEC Power Cable with UK mains plug	EM996

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