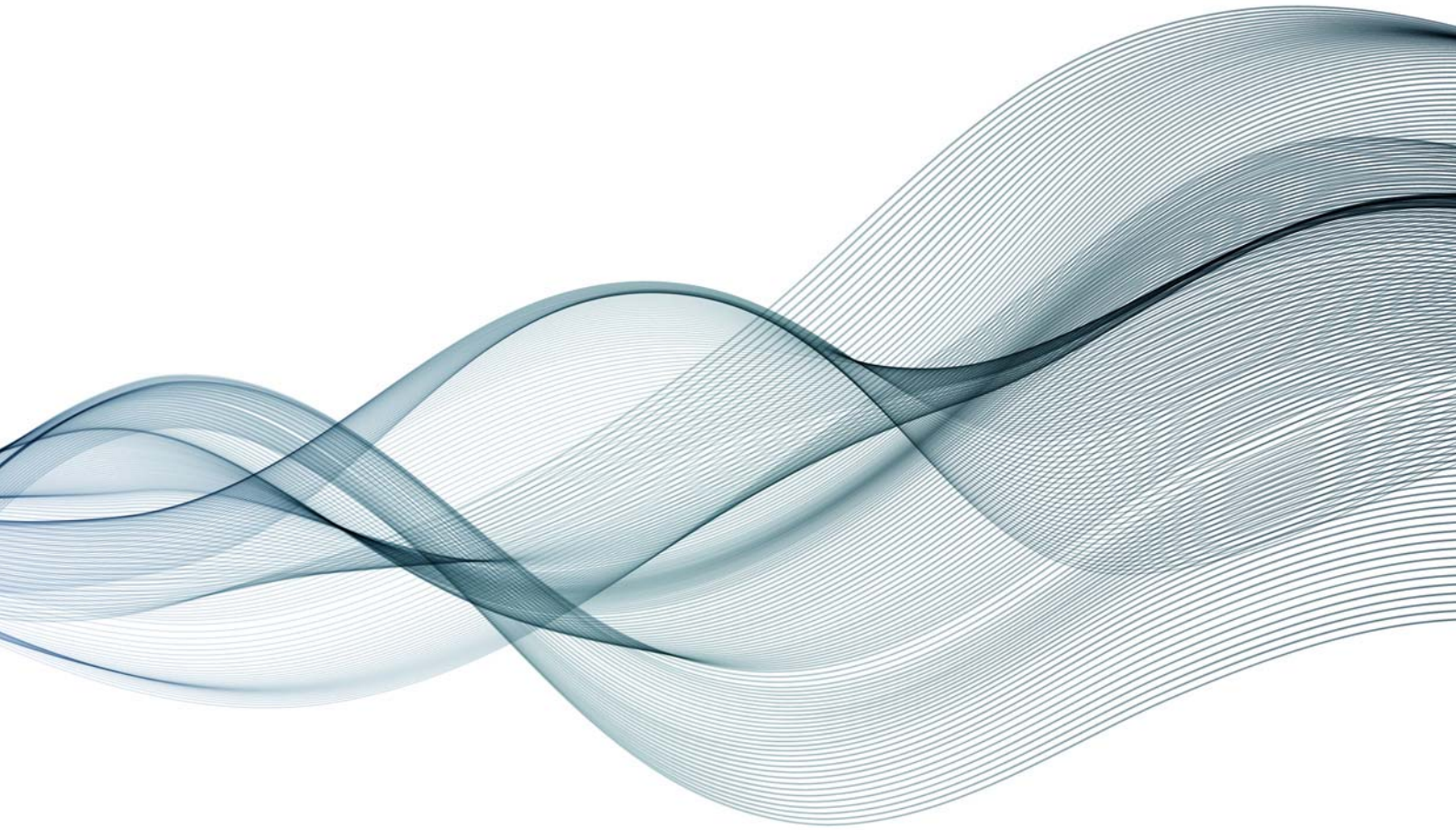

Operation and Maintenance Manual for the Enclosed HLB Helium Speech Unscrambler

Part Number: CO363AX-E24

Document Number: CO-OM-6605
Revision: 0

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APPROVAL SHEET

Document Information				
Advitium No	**Title**	**Classification**	**Current Revision**	**Date**
CO-OM-6605	Communications Helium Unscrambler for Hyperbaric Lifeboats 24VDC	Commercial in confidence	0	04/11/2015

Revision History					
Rev	**Date**	**BY**	**CHK**	**APP**	**Comments**
0	04/11/2015	J. Lastakauskiene	L. Wedekind	M. Hossack	Original for issue

Original Approvals			
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LIST OF ABBREVIATIONS

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

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TABLE OF CONTENTS

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CHAPTER 1 - INTRODUCTION

Fig 1.1 Enclosed Speech Unscrambler

The CO363AX-E24 24Vdc Helium Speech Unscrambler has been designed into an enclosed version of the standard CO363AX helium unscrambler. The enclosure provides protection for the unit when installed in a Hyperbaric Lifeboat (HLB). The unit is supplied with a clear PVC cover that provides extra protection for the unit while it is in storage. The front panel of the cover can be lifted up to allow access to the controls when required.

The main function of the HLB Unscrambler is to provide clear, two way voice communications between the diver and a supervisor, using three independent communications circuits – Channel 1, Channel 2 and Channel 3 (chamber). Note: Only channel 3 has helium speech unscrambling capability. Channel 3 is able to support two independent HLB Comms boxes. Throughout the manual all channels will be referred to as ‘divers’. Channel 1 and channel 2 are commonly placed around the HLB to allow the supervisor to talk to the HLB crew.

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 CO363AX-E24 converts the helium affected speech back to a usable audio source that is easy to understand and communicate with.

The HLB Unscrambler has round robin functionality that will allow the divers using the unit to communicate with each other. When round robin is switched on, Channel 1, Channel 2 and Channel 3 can communicate with each other.

There is a supervisor round robin mode which when enabled will allow the supervisor to communicate with all three channels without using a push to talk (PTT) button. When supervisor round robin is switched off the supervisor will use a PTT button to talk with each channel individually via that channels PTT or all three channels at the same time with the “ALL PTT” button.

The HLB 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 HLB 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.

CHAPTER 2 - FUNCTIONAL DESCRIPTION

CONTENTS

2.1 POWER SUPPLY

The HLB Unscrambler has three DC/DC converters installed within the enclosure. The unit is designed to receive a DC voltage of 24 Volts. The input for the power to the unit is though a set of fused DIN terminals on the top of the enclosure. The input terminals are fused using 2 Amp anti-surge fuses.

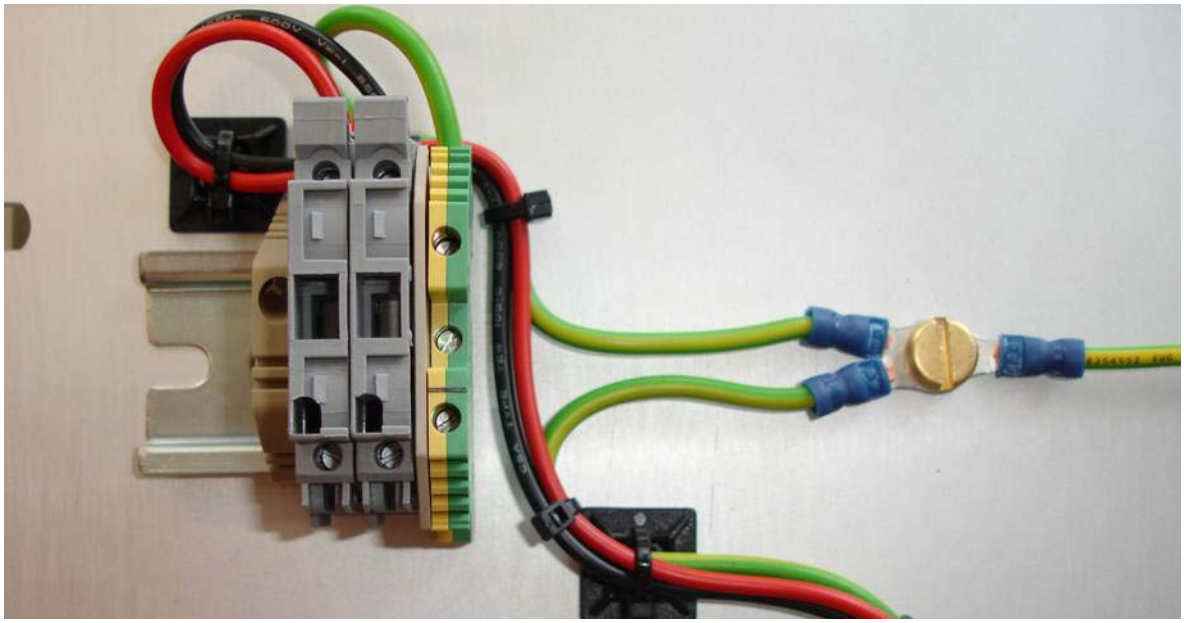

Fig 2.1 DC Power Input Terminals

2.2 GENERAL

The main function of the HLB Unscrambler is to provide a means of communication within a Hyperbaric Lifeboat. 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 divers voice (Channel 3) 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 divers 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 three DC-DC converters which convert the incoming 24Vdc supply to +12Vdc and -12Vdc (the third is a supply for the DSP). The DSP power supply has a PCB that converts the 12Vdc voltage down to 7Vdc for the DSP PCB.

The front panel contains all the main user interface elements that are used to adjust the operating parameters of the unscrambler and is split into two main sections. 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, PTT switches and round-robin functionalities 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 the 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

CONTENTS

3.1 Front Panel Power and Audio Controls

The front panel contains the power on/off switch which is a black push button switch. When pressed the Unscrambler powers on and the 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 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. When supervisor round robin is switched on the supervisors audio will also be audible from the speaker.

The top section seen in Fig 3.2 shows the supervisor and diver round robin switches. When supervisor round robin is switched on this will allow supervisor to diver communications without the use of the PTT switches.

When the diver round robin is switched on the divers will be able to communicate with one another. When diver round robin is on, comms are open between Channel 1, Channel 2 and Channel 3. Each channel has its own dedicated round robin volume control.

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.

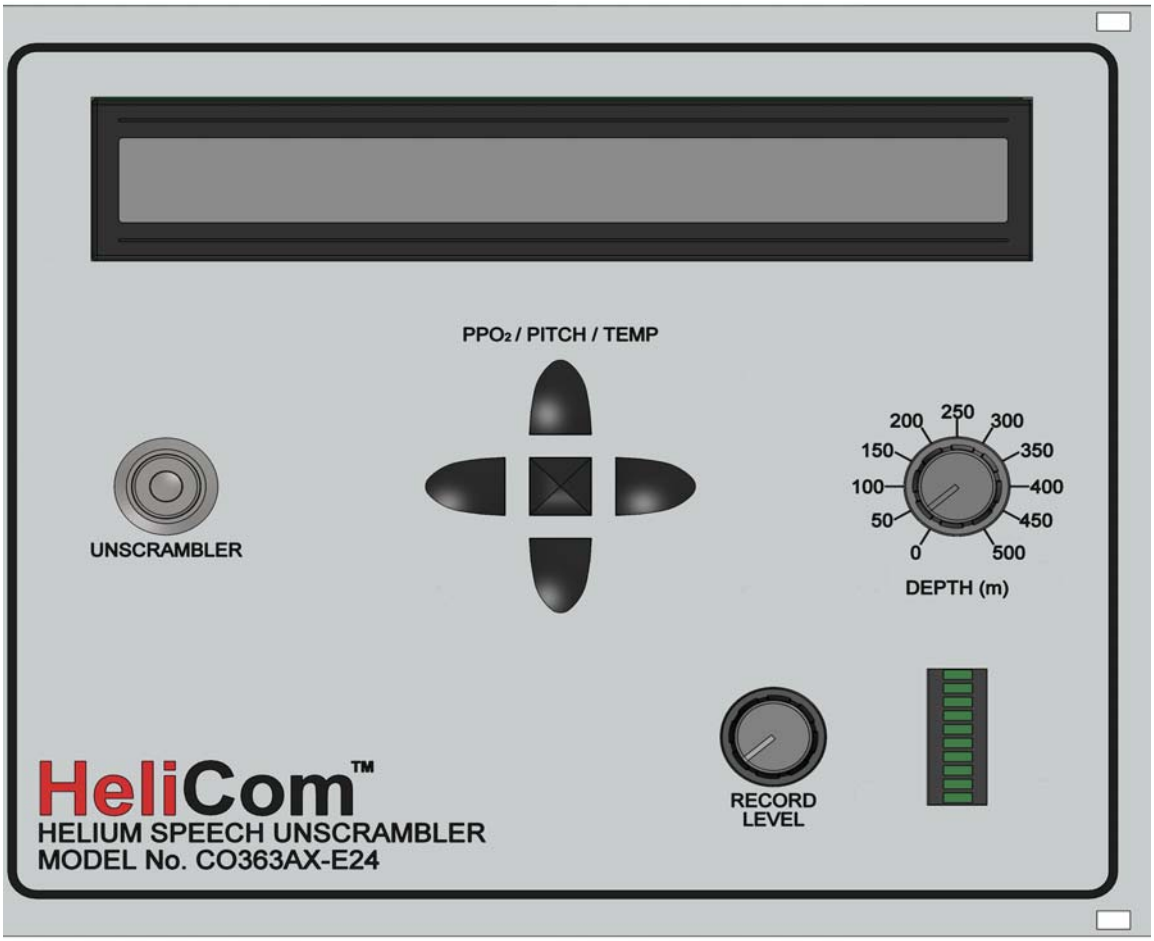

Fig 3.3 HCU Controls

To switch the unscrambler on, push the black push-button switch on the front panel. The user interface LCD will illuminate once the unit has been powered 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 divers. The depth pot varies over a range of 0m to 500m.

3.3 TOP PANEL

The top panel of the HLB Unscrambler houses all of the electrical connections into the unscrambler. See Fig 3.4 below for the audio connections into the unscrambler.

NOTE
Glands will be fitted to the enclosure during installation

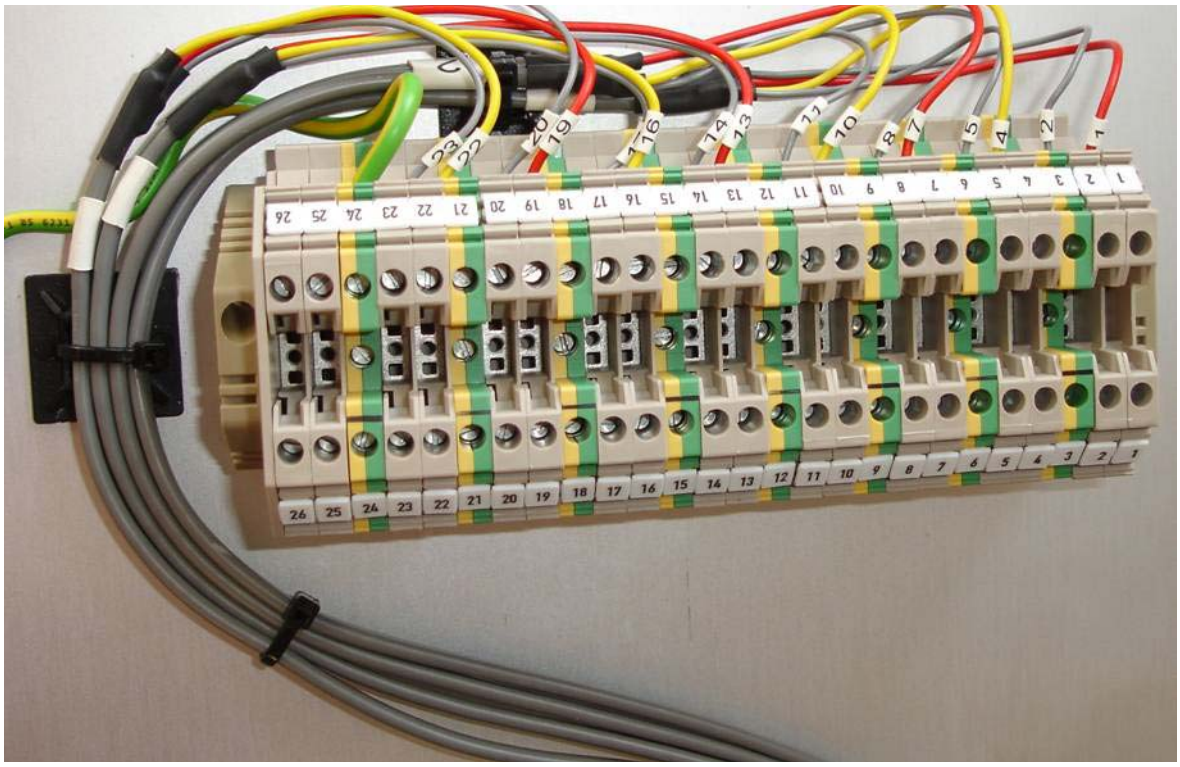

Fig 3.4 Electrical Input Connections for HLB Unscrambler

The audio inputs into the unscrambler are onto a set of standard DIN rail terminals as seen above. The terminals allow for the connections to be installed quickly and changed with ease if required.

All of the internal communications cabling will be pre installed. The user will only need to fit the glands and route the signal cabling to the appropriate terminal. All communications cabling will go to the longer set of DIN terminals on the top plate. There are earth terminals between each pair of audio terminals which allows an earth connection for screens on the communications cabling.

The power connections to the HLB Unscrambler will be routed to the smaller set of fused din terminals on the top plate (See Fig 2.1 on page 4). The fused terminals are fitted with 2A anti-surge fuses.

See Table 3.2 for the wiring details of the audio and power connections on the top plate.

3.4 WIRING TABLES (DIN TERMINALS)

Wiring table for communications terminals

Terminal	Description	Wire Colour (Internal)
1.	CH1 Mic Sig	Red
2.	CH1 Mic Rtn	Grey
3.	Earth	N/C
4.	CH1 Phones Sig	Yellow
5.	CH1 Phones Rtn	Grey
6.	Earth	N/C
7.	CH2 Mic Sig	Red
8.	CH2 Mic Rtn	Grey
9.	Earth	N/C
10.	CH2 Phones Sig	Yellow
11.	CH2 Phones Rtn	Grey
12.	Earth	N/C
13.	CH3 (1) Mic Sig	Red
14.	CH3 (1) Mic Rtn	Grey
15.	Earth	N/C
16.	CH3(1) Phones Sig	Yellow
17.	CH3(1) Phones Rtn	Grey
18.	Earth	N/C
19.	CH3 (2) Mic Sig	Red
20.	CH3 (2) Mic Rtn	Grey
21.	Earth	N/C
22.	CH3(2) Phones Sig	Yellow
23.	CH3(2) Phones Rtn	Grey
24.	Earth	N/C

Table 3.2 Communication Terminals Connections

Wiring table for power input terminals

Terminal	Description	Wire Colour (Internal)
X1	+24V	Red
X2	0V	Black

Table 3.3 Power Terminals

CHAPTER 4 - OPERATION

CONTENTS

4.1 DIVER COMMUNICATIONS

The audio path for the signals received from a diver is: divers Headset to Unscrambler Terminals to Audio Module PCB to Mixer PCB to the DSP PCB (channel 3). After the audio has been unscrambled it is then routed to the supervisor headset and speaker. If divers round robin is active the signal will also be routed to the headsets of the other divers.

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 audio signals are mixed together in the mixing PCB before being processed through the DSP to be digitally unscrambled (only channel 3 is unscrambled). The diver 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.

When diver round robin is switched on channels 1, 2 and 3 are able to communicate with each other. Each channel has its own dedicated volume control for diver round robin.

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 dial.

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 diver earphone terminals on the top plate and the speaker if supervisor round robin is switched on.

The supervisor will only be heard by the divers when the individual channels PTT or the "All Divers" PTT button is pressed while not on supervisor round robin. When supervisor round robin is active the supervisors microphone output will be open and live to all channels until the round robin switch is switched off.

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 HLB 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 HLB 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

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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.

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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 (PPO_2, Temperature & Pitch Reduction) and an editing mode where a nominated field can be incremented or decremented.

Depth and PPO_2 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.

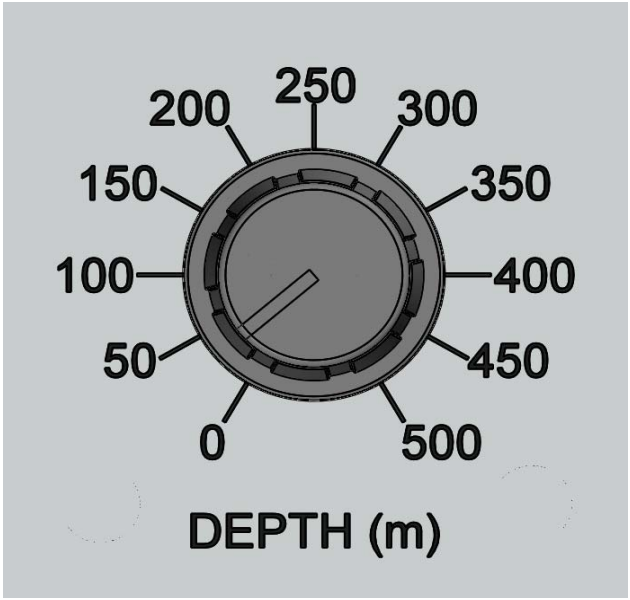

Fig 4.4 Depth Potentiometer

The gas mixture (PPO_2) 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 PPO_2 value is 0.8 atm and it can be adjusted over a range of 0.0 to 2.0 atm.

Fig 4.5 shows the user interface PPO_2 page.

Fig 4.5 User Interface PPO_2 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 4.6 shows the PPO_2 page after the select button is pressed.

Fig 4.6 User Interface PPO_2 Edit page

Pressing the ← or → buttons on the keypad changes the PPO_2 value by increments of 0.01 and pressing the ↑ or ↓ buttons changes the PPO_2 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 0.01 and pressing the ↑ or ↓ buttons changes the PRR value by increments of 0.1.

Fig 4.7 shows the user interface PRR page.

Fig 4.7 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 PPO_2 value by increments of 5.

Fig 4.8 shows the user interface Temperature page.

Fig 4.8 User Interface Temperature page

4.4 MAINTENANCE

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

Identification	Procedure	Interval
1.	Check top plate DIN terminal connections and tighten if 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 diver and supervisor round robin switches	6 monthly
5.	Check operation of rotary diver round robin volume switches	6 monthly
6.	Check operation of rotary channel volume switches	6 monthly
7.	Check operation of PTT switches	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 fused terminals on the top plate of the HLB Unscrambler.

Location	Fuse	Description	Fuse Rating
Top plate power terminals	F1 & F2	Power Supply - Input	2A

Table 4.2 Fuse Ratings

	WARNING
	RISK OF EQUPMENT DAMAGE. Only suitably rated fuses should be installed on the HLB 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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CHAPTER 5 - TECHNICAL SPECIFICATIONS

CONTENTS

5.1 MECHANICAL

Chassis Dimensions:

19” Sub-rack Enclosure (Suited to HLB Environment)

Height:	500mm
Width:	515mm
Depth:	200mm
Weight:	16.5kg

5.2 ELECTRICAL

5.2.1 Mains Power Inlet

Input:	24Vdc
Fuses:	2 Amp (Anti-surge)

5.2.2 Internal Power Supplies

DC/DC Converter (Main System)	+12V DC output, 35W
DC/DC Converter (Main System)	-12V DC output, 35W
DC/DC Converter (DSP power)	+12V DC output, 35W

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

5.2.6 General

Channel 1 - 4 wire system, screened twisted pairs

Channel 2 - 4 wire system, screened twisted pairs

Channel 3 - 2 x 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	CO363209
Audio Module PCB Channel 2	CO363210
Audio Module PCB Channel 3	CO363211
Audio Mixer PCB	CO363212
Power and Transformers PCB	CO363154

6.2 FRONT PANEL COMPONENTS

User Interface LCD	CO363307
Keypad Assembly	CO363314
Depth Potentiometer	EM2076
Power Switch	EM3584

6.3 ANCILLARY ITEMS

Supervisor Headset	CO23986
Diver Headset	CO23985
Clear Cover	CO363392
2A Anti-Surge Fuses	EM13357
HLB Comms Box	CO436
Comms Box Speaker	CO437

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