Sub MkIIIF

User Manual

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Warnings, Cautions and Notes

Warnings and Cautions are used in this Manual to highlight potential hazards and safety risks. Notes are used to provide supplementary information that is not hazard-related.

WARNING: THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN DEATH OR SERIOUS INJURY.

CAUTION: THIS INDICATES A POTENTIALLY HAZARDOUS SITUATION THAT, IF NOT AVOIDED, COULD RESULT IN EQUIPMENT DAMAGE OR LOSS OF DATA.

NOTE: THIS INDICATES INFORMATION THAT IS CONSIDERED IMPORTANT BUT IS NOT HAZARD RELATED.

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1 Safety Information

Refer to the safety warning information in Section 13 and Section 8.4.

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2 Package Contents Checklist

- Analox Sub Mk III F Operator Console.
- Analox Sub Mk III F Remote Sensor Units (REM) appropriate to the system (either one, two or three sensor modules)
- Cables and connectors to connect Operator Console to REM units
- Gas sensor calibration adaptors and tubing
- User Manual
- Test Certificate

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3 Abbreviations

ABBREVIATION	DESCRIPTION
CO2	Carbon Dioxide
FSUB	Analox Fixed Sub
LCD	Liquid Crystal Display
LED	Light Emitting Diode
O2	Oxygen
REM1	Analox Remote Sensor Type 1 (O2+CO2+Depth)
REM2	Analox Remote Sensor Type 2 (Temperature and Humidity)
REM3	Analox Remote Oxygen Injection Controller (O2 only)

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4 Quick Start Guide

This section is intended to aid the reader find the appropriate part of the manual, depending upon their needs at the time. Glance through the typical queries in the table below, and see if you can find appropriate guidance. If you can't find what you want, please contact Analox for further assistance. We are here to help !

ID	Query	Guidance
1	I'm new to these systems – what do they do?	Please read through the introduction in Section 5 to get an overview, then perhaps come back to this table for further guidance.
2	I've been given the job of installing this system – what do I have to do?	There are generally 3 phases to installation. You'll have to mechanically install the system (Section 6.2) make all of the necessary electrical connections (Section 6.3), and then make the necessary gas connections where appropriate (Section 6.4). When you are ready to switch on and test, come back to this table for further guidance.
3	I'm ready to switch on for the 1st time. Where should I start?	First question would be whether all of the wiring is correct or not. If you haven't checked your wiring, it is worth checking first that everything appears to be OK. The system is fairly robust in the event of something being wrong, but it's always best to be sure ! When you are ready to switch on, read through Section 7 . If you have problems, refer to the suggestions in Section 11. If you are still puzzled, contact Analox to help you through your problem.
4	Everything switches on OK - what about checking/calibration?	You'll need access to some calibration gas which has a known content of oxygen, carbon dioxide etc. When any of the sensors are exposed to a known level of gas etc, you just need to check that the measured reading is within the tolerance (refer Section 15) allowed by the system. If its not, then you'll need to calibrate the system (see the item below)
5	How do I calibrate the system?	Calibration is detailed for each of the sensor types in Section 8.4. Please don't attempt calibration unless you have suitable calibration equipment – cal gas, flow adaptors etc. You'll need to understand the calibration menus (Section 8.4) to perform calibration. If you are at all unsure about what to do, please contact Analox for advice
6	The system's up and running – how do I change alarm settings?	The alarm functions are described in Section 7.4, and the menu system for the alarms is described in Section 8.3. Don't interfere with the alarm settings unless you have a good appreciation of the significance of the settings. If for instance you set the low oxygen alarm at a level well below normal life-support use, then you will effectively have disabled the low oxygen alarm. Be warned – take care and set up sensible alarm limits. The alarm settings are generally shown on the main display to help you avoid making mistakes.

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ID	Query	Guidance
7	Can I get any data out of the system?	Yes. The system has specifically been configured for data output which is particularly helpful when analysing the overall system performance. . Refer to Section 9. Data gathered from the port is easily imported into a spreadsheet to allow graphical representation of readings taken over variable periods of time.
8	I have spares I need to fit. What do I do?	First read Section 12, or any specific instructions supplied with the spares. If you're in any doubt about what to do after that, please contact Analox for advice.
9	It's all gone horribly wrong – I've tried recalibrating and can't. Where do I go next?	Sorry, but you've reached a point beyond the scope of this manual. Please contact Analox and we'll do our best to resolve the problem.

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5 Introduction

5.1 Sensor Measurement Techniques

The Analox Sub Mk III F is an atmosphere monitoring system capable of measuring oxygen (O_2), carbon dioxide (CO_2) and pressure (depth). Temperature and humidity sensors may optionally be added. An optional controller module may also be added to provide oxygen injection to maintain oxygen levels at pre-set levels.

Parameter	Sensing technology	Sensor Location
Oxygen	Electrochemical cell	REM1 / REM3
Carbon Dioxide	Infra-red absorption	REM1
Pressure	Strain gauge	REM1 / REM3
Temperature	Platinum Resistor	REM2
Humidity	Capacitive	REM2

5.2 System Types

The system is preconfigured by the manufacturer to provide a number of different functionalities. Various configurations include the following:

System No	Variant	Identity	Brief Details
1	-	Basic Analox Sub	Operator Console connected to a single REM1 typically providing O2, CO2 and depth monitoring in a hyperbaric (or hypobaric) chamber
2	-	Standard Analox Sub with T/H	An Enhancement of System 1 , with an Operator Console connected to one REM1 and one REM2, providing temperature and humidity measurement over and above the basic features
3	-	Multi-Channel Monitor	Operator Console connected to either one, two or three REM1's measuring oxygen, optionally carbon dioxide and depth/pressure. Essentially matches System 4, offering backup monitoring to support the control function of System 4.
4	-	Multi-Channel Oxygen Controller	Operator Console connected to either one, two or three REM3's measuring oxygen and depth/pressure and providing an oxygen control function in conjunction with a connected injection solenoid valve. (Note that for safety requirements, it will usually be necessary to have an independent means of monitoring the oxygen levels. (see System 3)
5	Customer Specific	Discuss with Analox	Variants of system by utilising various configurations of remote sensor units.

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A complete system therefore consists of:

An Operator Console intended for installation in control rooms. (It is assumed the control room is at normal atmospheric pressure. Special versions are available if it is required to mount in the hyperbaric environment).

One or more sensor units of types REM1, REM2 and/or REM3 intended for installation in hyperbaric (or hypobaric) environments. Note special versions of REM1 and REM3 may be configured to be mounted externally, and take sample flow from a hyperbaric chamber.

Systems will normally be purchased to operate over a defined range of pressures. For instance a hyperbaric saturation diving system may be rated between 0.8 and 35 bar absolute (other variants also available); a hyperbaric air diving system may be rated between 0.8 and 10 bar absolute; whilst a hypobaric flight simulator chamber may use a system rated between 0.1 and 2 bar absolute.

5.3 Brief Overview

A large graphic display on the Operator Console shows the value of each measured parameter. The remote units provide local displays of the monitored parameters (although note that some special versions of remote sensor are not fitted with displays).

The Operator Console provides audio and visual alarms for the measured gas parameters. The alarm set-points may be easily adjusted using the pushbuttons on the Operator Console. The Remote sensor can also provide audio and visual alarm indication.

The overall system can be powered by a single supply connected to the rear of the Operator Console. The remote unit may be connected to the Operator Console, from which it can obtain its power, or it can be separately powered.

The sensors are housed in splash proof enclosures that are vented to prevent implosion/explosion in hyperbaric/hypobaric environments. Gas levels are monitored by sensors built into the REM1 (and REM3 when fitted) unit. Gas enters the sensors through waterproof membranes.

The user should ensure that the gas inlet ports remain as clean as possible to prevent the waterproof membranes becoming blocked. The sensor enclosure vent must also be kept clean.

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6 Installation

6.1 General System Overview

The drawings below shows various configurations of common installations.

Figure 1 shows the Operator Console mounted externally to a chamber, with both a REM1 and a REM2 sensor mounted internally. The system wiring has to pass through penetrators.

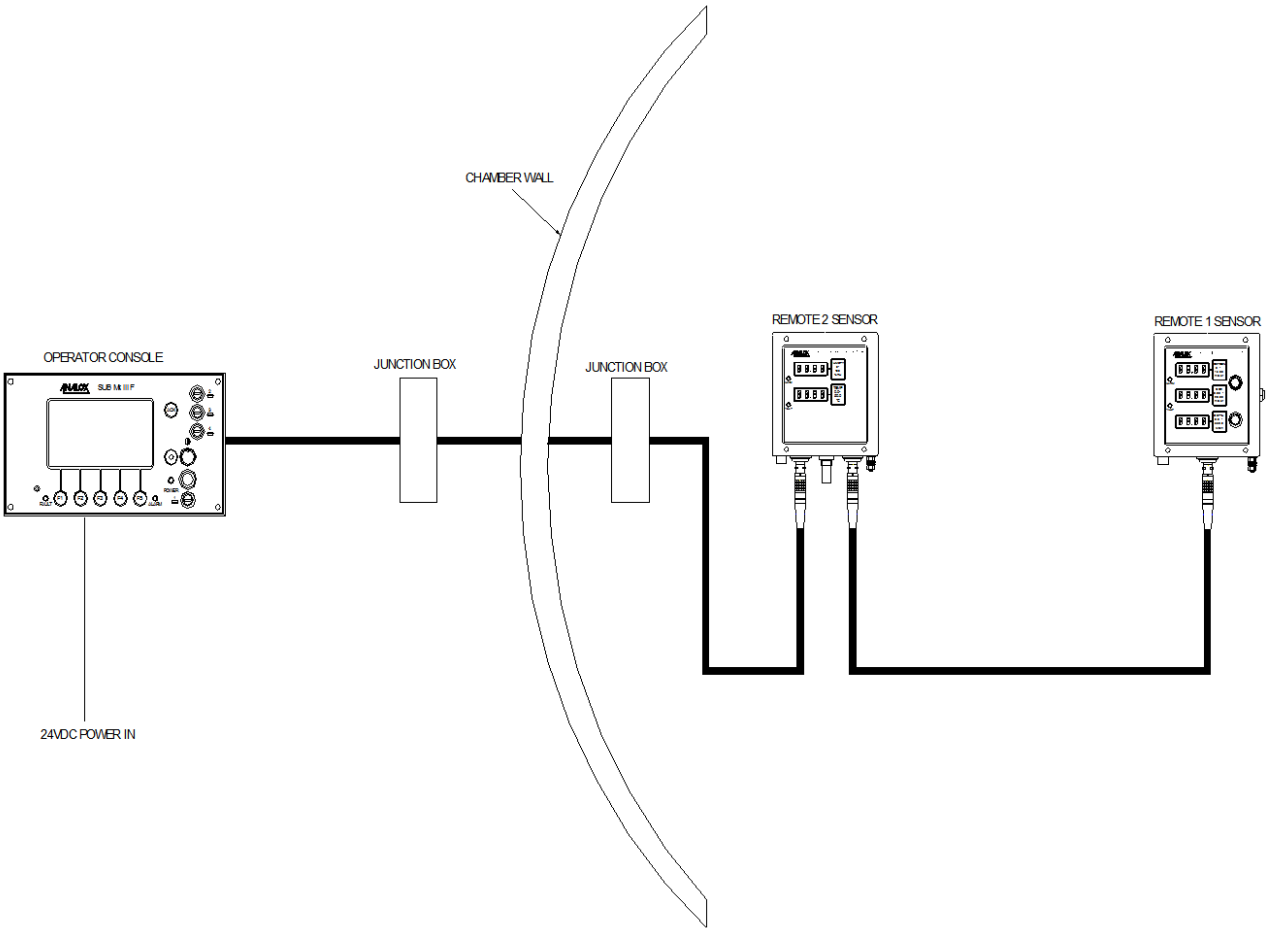

Figure 1 Standard system on a chamber using 1x REM1 and 1x REM2

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Figure 2 shows a typical monitoring system installed inside a submarine rescue type vehicle with two compartments. The Operator Console is mounted inside the Pilot Compartment, together with a REM1 sensor unit monitoring that compartment. A second REM1 is mounted in the Rescue Compartment and connects via penetrators to the operator console.

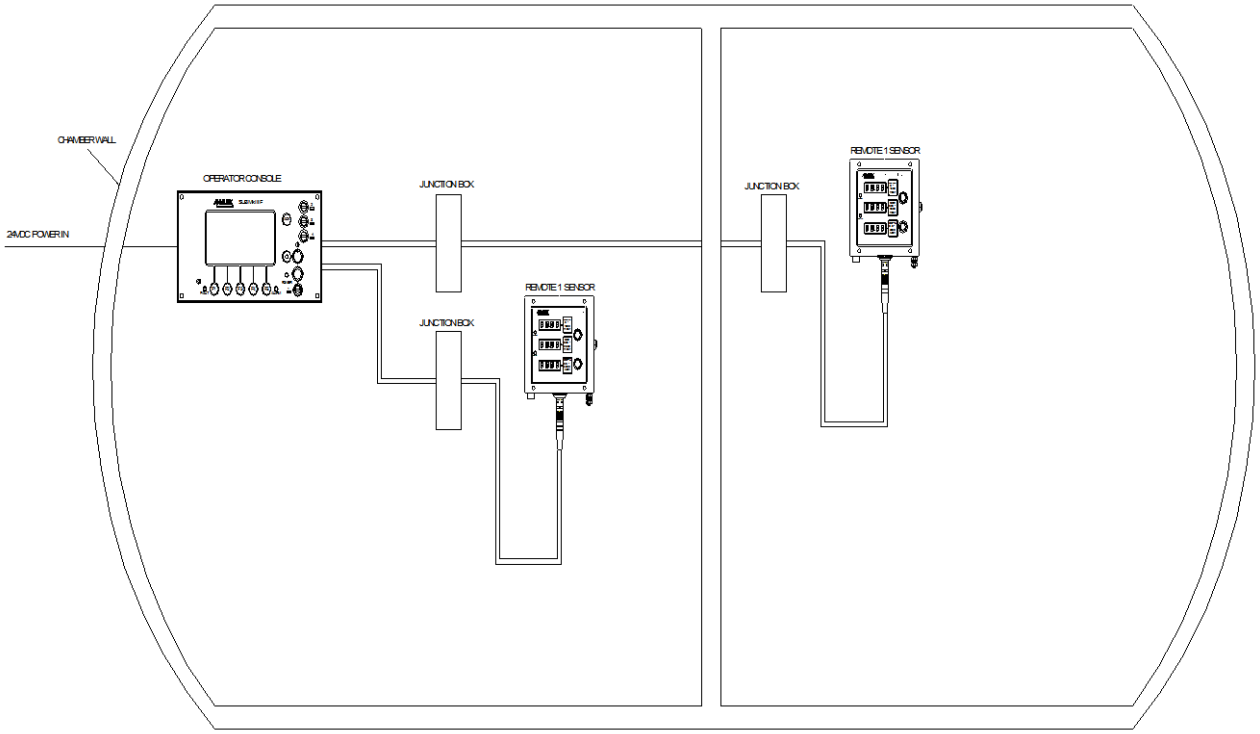

Figure 2 Typical Monitoring System in a Submarine Rescue Vehicle (2 compartments)

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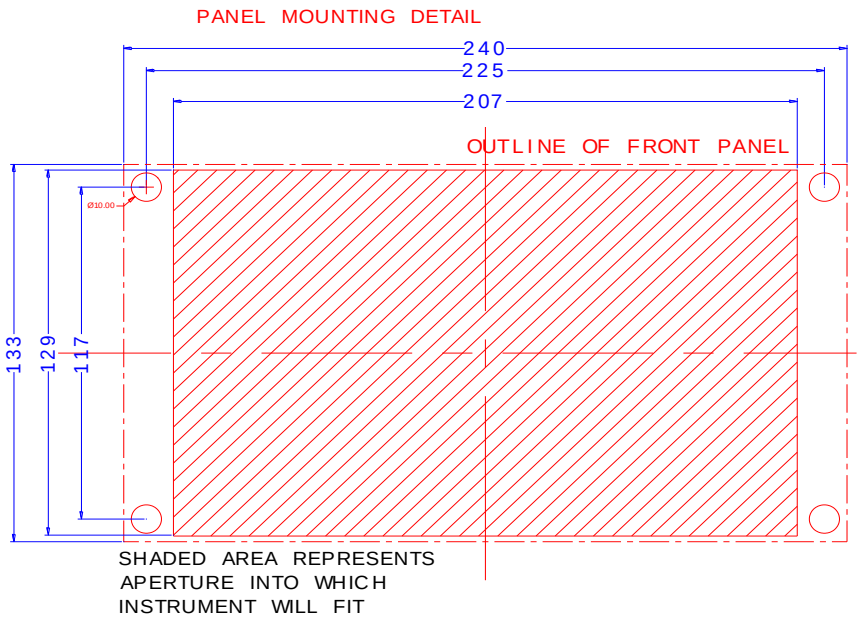
6.2 Mechanical Installation

6.2.1 Operator Console Mechanical Installation

The standard Operator Console is designed to be panel mounted as shown below. The shaded area represents the aperture into which the Operator Console will fit. 10mm diameter mounting holes will accept the M5 fixings supplied with the system.



NOTE: **ADDITIONAL SPACE WILL BE REQUIRED BEHIND THE UNIT FOR THE MATING CONNECTORS.**

NOTE: **THE CONSOLE IS USUALLY SUPPLIED WITH A PROTECTIVE FILM OVER THE FRONT PANEL LABEL AND DISPLAY VIEWING WINDOW. THIS PROTECTIVE FILM IS INTENDED TO BE REMOVED TO PROVIDE BETTER VISIBILITY OF THE DISPLAY.**

NOTE: **A NON-STANDARD OPERATOR CONSOLE IS ALSO AVAILABLE WHICH IS BUILT INTO A DIECAST ALUMINIUM IP65 RATED ENCLOSURE. MOUNTING DETAILS ARE AS SHOWN USING M6 SCREWS.**

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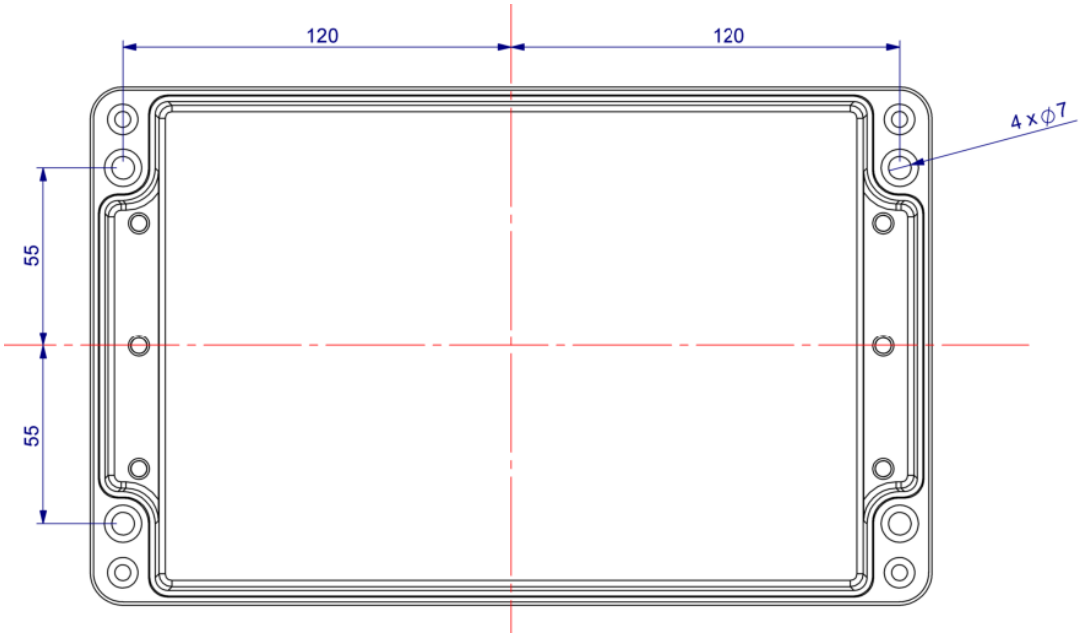
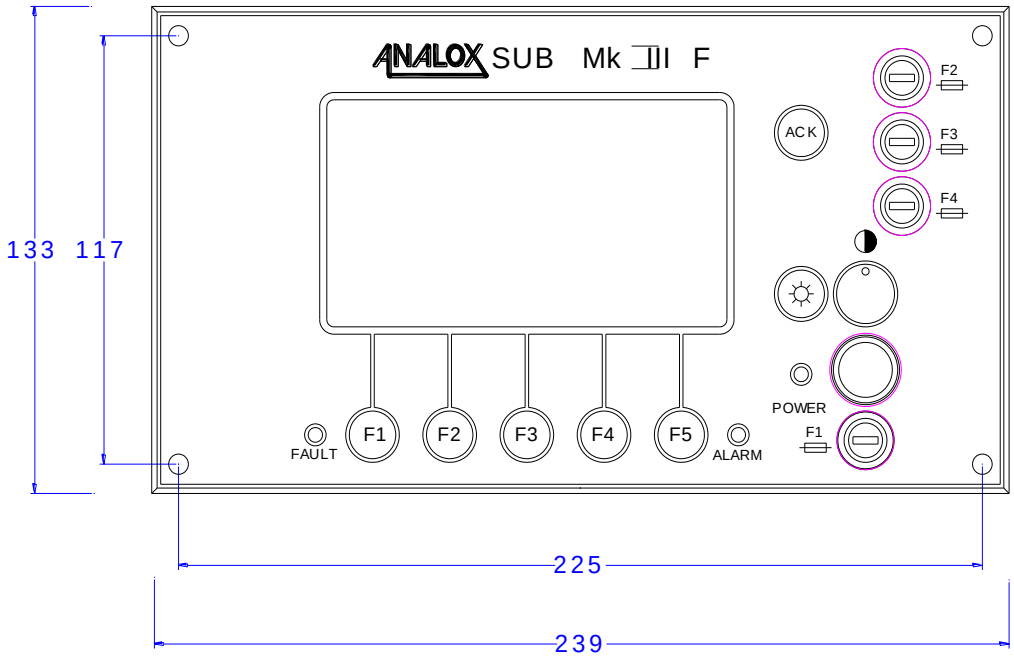


Operator Console Dimensions

FRONT PANEL VIEW



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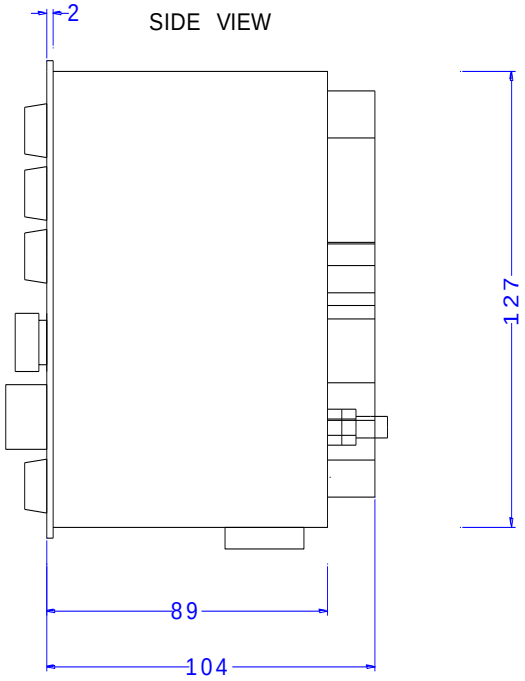

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6.2.2 Remote Sensor Mechanical Installation

The various sensor modules are built into different enclosures to suit particular system versions. The diagrams below show the standard enclosures which are mounted using M8 fixing bolts.

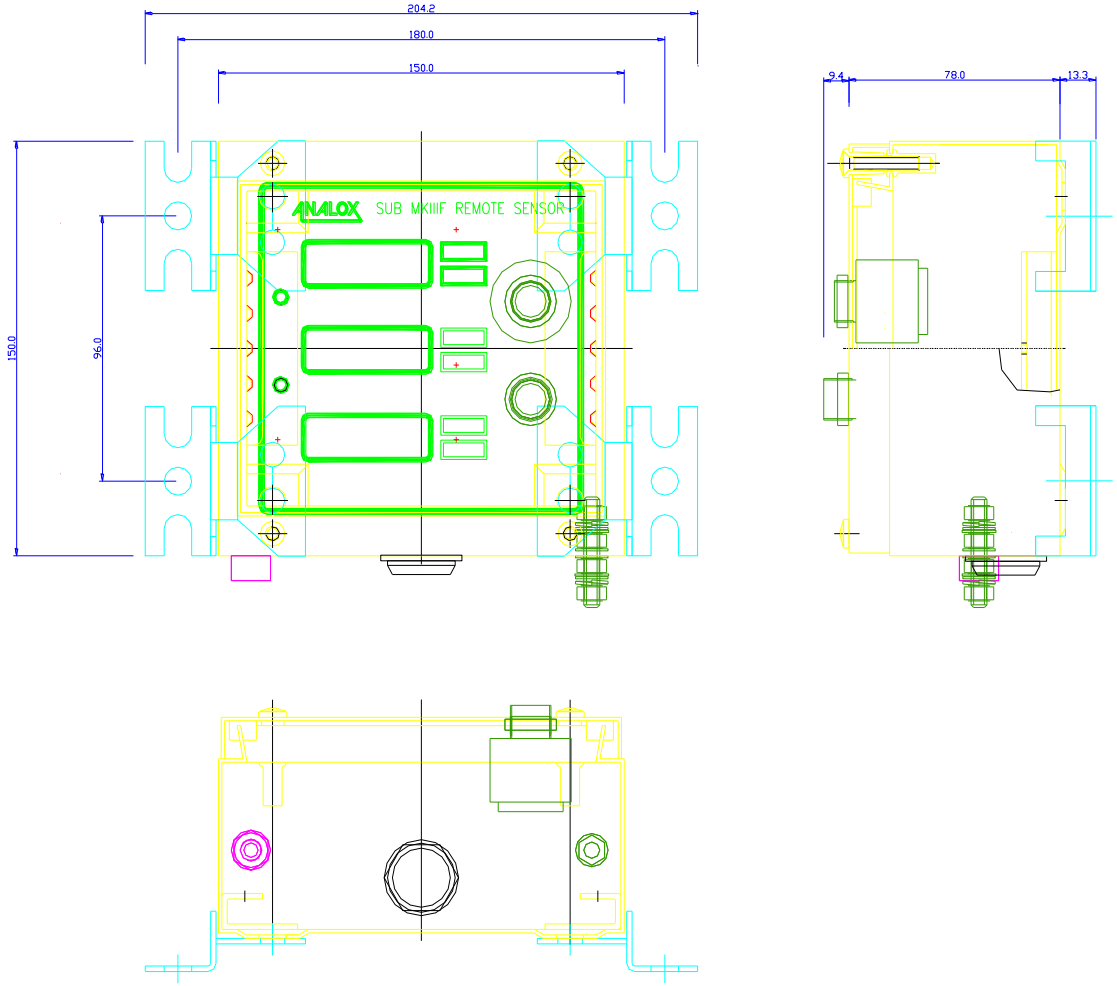

Figure 3 REM1 Remote Sensor Dimensions

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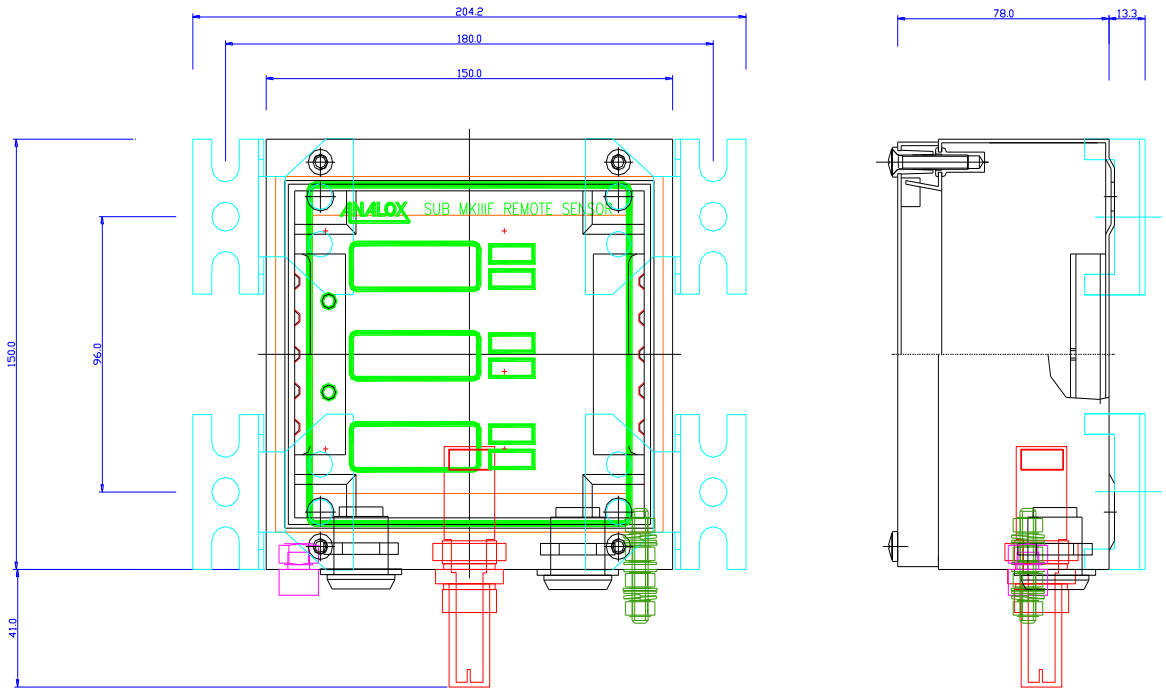

Figure 4 REM2 Remote Sensor Dimensions

The REM3 shares the basic dimensions of the REM1, although in standard form it does not have a CO2 sensor fitted.

All enclosures intended for hyperbaric/hypobaric conditions are fitted with a vent to prevent implosion/explosion. Ensure that the vent is not obstructed.

Ensure that the remote sensor units are positioned sensibly with regard to the gases being monitored, and the protection to personnel that the sensors are to provide. Gas sensors should not be mounted in locations where air circulation is likely to be restricted. Access for calibration must also be provided.

REM3's being used as part of oxygen injection systems should not be positioned too closely to the injection point(s) in the chamber.

Note also that sensor modules with displays are usually supplied with a protective film over the front panel label and display viewing window. This protective film is intended to be removed to provide better visibility of the displays.

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6.3 System Electrical Installation

Connections for typical systems are shown below.

Figure 5 shows a chamber monitoring system comprising an Operator Console mounted externally to the chamber, with both a REM1 and a REM2 sensor mounted internally.

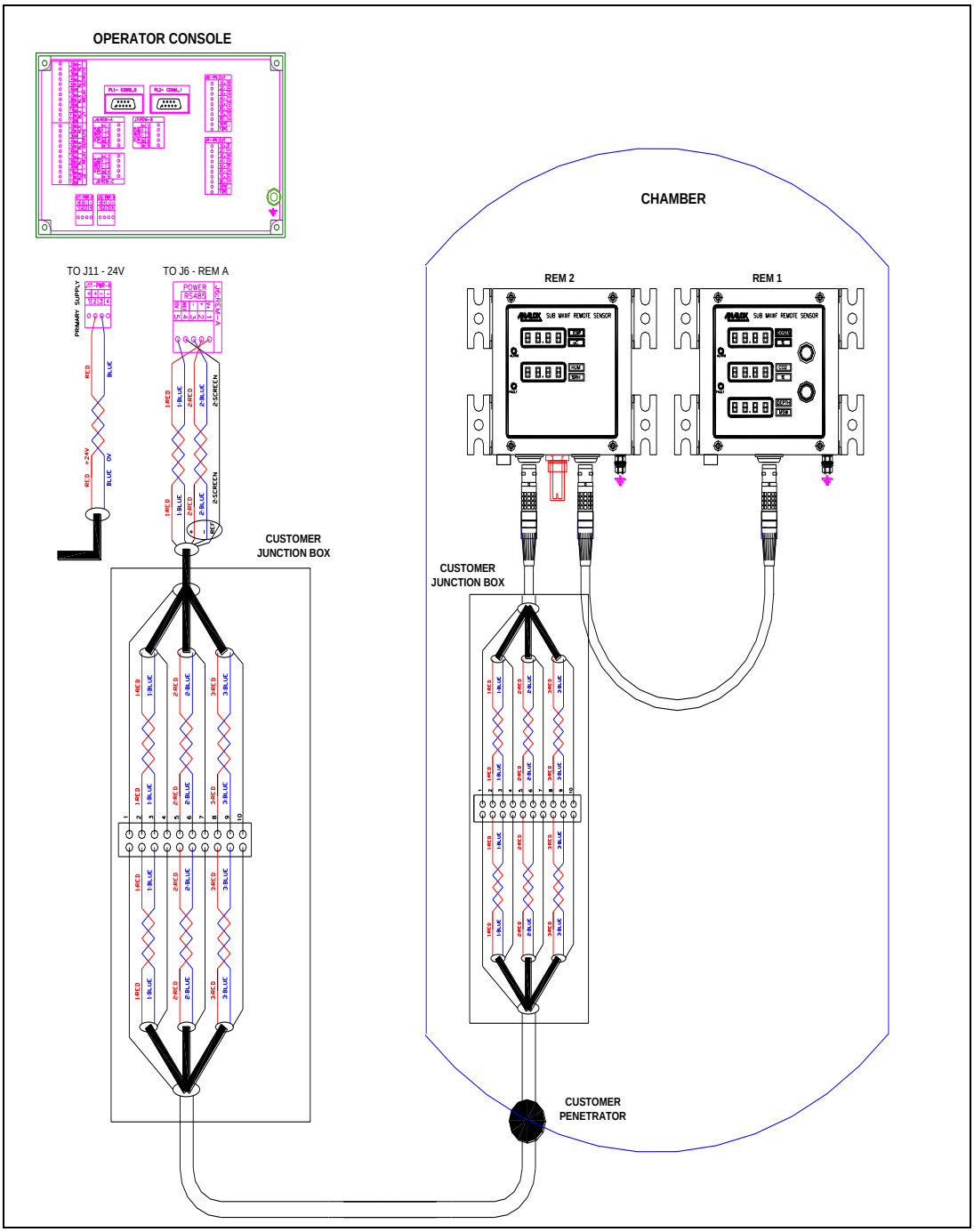

Figure 5 Connection for a Chamber Monitor with a REM1 and REM2 sensor

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Figure 6 shows a monitoring system inside a Submarine Rescue Vehicle (2 compartments). This comprises an Operator Console mounted in the Pilot Compartment and two REM1 sensor units; one in the Pilot Compartment, and the other in the Rescue Compartment.

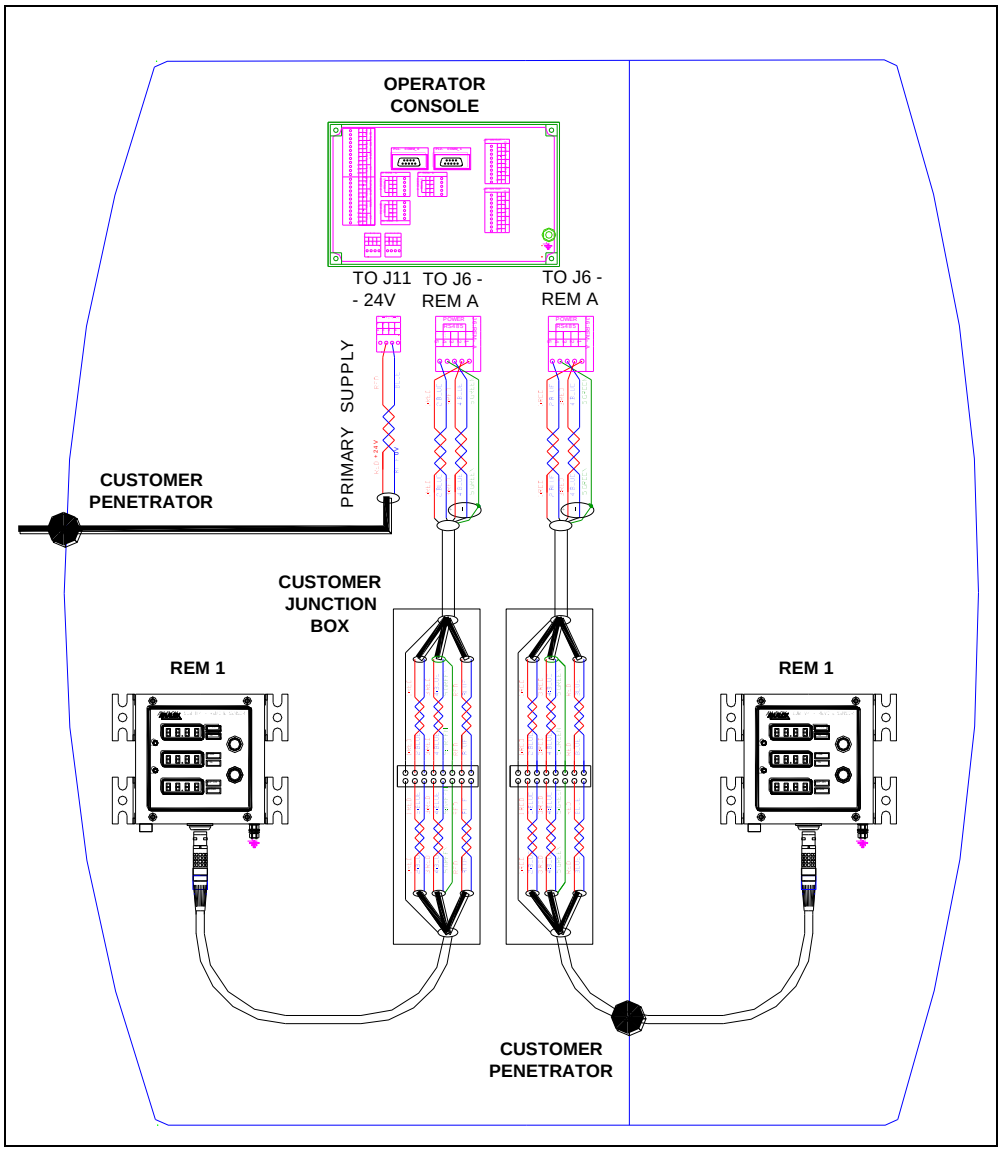

Figure 6 Monitoring System in Submarine Rescue Vehicle

Each system is supplied with temporary cabling which allows the customer to power the system up without first installing it. The Remote sensor connection cables are provided with intermediate terminal blocks. It is anticipated that the customer will wire these up to junction boxes within each chamber/lock and discard the terminal blocks supplied.

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6.3.1 Operator Console Electrical Installation

The standard version of the operator console is designed for panel mounting, with direct access to the rear mounted terminals.

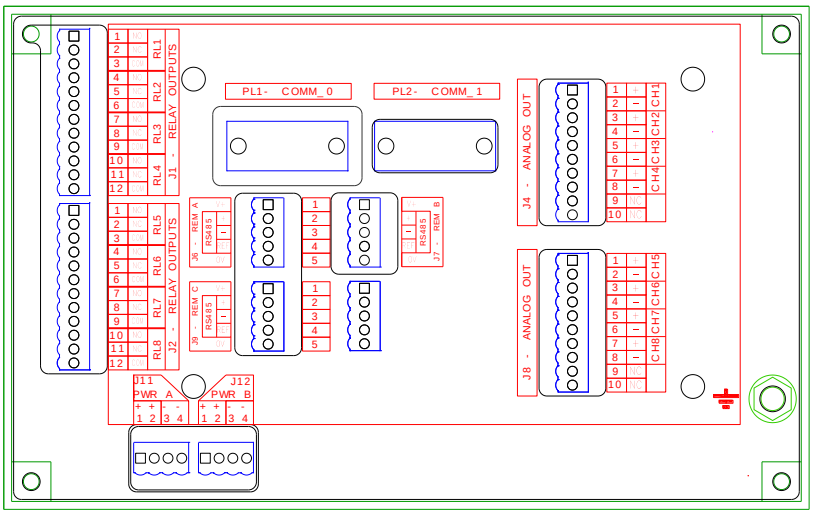
The main connections to the Operator Console are made using Klippon BL3.5 Series 2 part connectors. These provide screwdriver terminals for each wire connection on the rear panel, whilst also being simply disconnected without a screwdriver. Analox supply both parts of the required connectors with each delivered system.

Serial data output (where required) is made via a 9 way D-type connector (female), (Not supplied).

The system can be operated from two power supplies, each capable of powering the system independently. Connections J11 and J12 cater for this configuration. If a single power supply is deemed adequate, it may be connected to either J11 or J12.

Output connections are provided for up to 8 relay and 8 analogue outputs.

A rear mounted earth stud permits earthing of the front panel metalwork.



Operator Console – Rear Panel Connectors

A non-standard operator console is also available which is built into a die cast aluminium IP65 rated enclosure. This is fitted with appropriate cable glands to permit the required customer connections. This must be discussed with Analox such that provision is made for the necessary cables.

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Connector J11: external 24V DC power input

Connector	Weidmuller BL3.5 4 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	External +24V DC supply input (approx 2A, 48W)	+	Duplicated pins to permit redundant cable cores, or facility to loop power out.
2		+	
3		-	
4		-	

Connector J12 : external redundant 24V DC power input

Connector	Weidmuller BL3.5 4 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	External +24V DC supply input (approx 2A, 48W)	+	Duplicated pins to permit redundant cable cores, or facility to loop power out.
2		+	
3		-	
4		-	

Connector J6: REM A : Power and RS485 communications to Remote Sensors

Connector	Weidmuller BL3.5 5 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Power to Remote Sensor	+24V	
2	RS485 Communications to Remote Sensor	+	
3		-	
4		Screen	
5	Power to Remote Sensor	0V	

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Connector J7: REM B : Power and RS485 communications to Remote Sensors

Connector	Weidmuller BL3.5 5 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Power to Remote Sensor	+24V	
2	RS485 Communications to Remote Sensor	+	
3		-	
4		Screen	
5	Power to Remote Sensor	0V	

Connector J9: REM C : Power and RS485 communications to Remote Sensors

Connector	Weidmuller BL3.5 5 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Power to Remote Sensor	+24V	
2	RS485 Communications to Remote Sensor	+	
3		-	
4		Screen	
5	Power to Remote Sensor	0V	

Please note that Connector J6 is used either for the first REM in a system, or for all REMs when the REMs are 'daisy-chained' together (such as a chamber monitoring system with a REM1 and REM2). In systems where each REM has its own dedicated channel back to the operator console, Connector J7 is used for a second sensor and J9 for a third sensor if fitted.

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Connector J1: Relay Outputs RL1 to RL4

Connector	Phoenix Contact 3.5mm 12 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Relay 1	NO	All relay contacts are presented as single pole changeover contacts.
2		NC	
3		COM	
4	Relay 2	NO	
5		NC	
6		COM	
7	Relay 3	NO	
8		NC	
9		COM	
10	Relay 4	NO	
11		NC	
12		COM	

Connector J2: Relay Outputs RL5 to RL8

Connector	Phoenix Contact 3.5mm 12 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Relay 5	NO	All relay contacts are presented as single pole changeover contacts.
2		NC	
3		COM	
4	Relay 6	NO	
5		NC	
6		COM	
7	Relay 7	NO	
8		NC	
9		COM	

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Connector	Phoenix Contact 3.5mm 12 way		
10	Relay 8	NO	
11		NC	
12		COM	

In a standard system comprising one REM1 and one REM2, the following relay allocations are factory defined.

	Relay 1	Relay 2	Relay 3	Relay 4	Relay 5	Relay 6	Relay 7	Relay 8
O2 Low	X							
O2 High		X						
O2 Fault	X	X						
CO2 Hi			X					
CO2 HiHi				X				
CO2 Fault			X	X				
Pressure Low					X			
Pressure Hi						X		
Pressure Fault					X	X		
Temp Low							X	
Temp High							X	
Temp Fault							X	
Hum Low								X
Hum Hi								X
Hum Fault								X

In a standard system comprising two REM1 sensors, the following relay allocations are factory defined.

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	Relay 1 (REM1)	Relay 2 (REM1)	Relay 3 (REM1)	Relay 4 (REM2)	Relay 5 (REM2)	Relay 6 (REM2)	Relay 7 (NA)	Relay 8 (NA)
O2 Low	X			X				
O2 High	X			X				
O2 Fault	X			X				
CO2 Hi		X			X			
CO2 HiHi		X			X			
CO2 Fault		X			X			
Pressure Low			X			X		
Pressure Hi			X			X		
Pressure Fault			X			X		

In battery powered systems, such as submarine rescue vehicles, in order to reduce power consumption, if the user does not require relay functionality, the relays will be left unpowered.

Each relay is assigned to an alarm/fault condition, or group of alarm/fault conditions. It is also assigned a fail-safe or non fail-safe mode. In Fail-safe mode, when the instrument is switched off, the relays are de-energised, and this is taken as the alarm state. Therefore when switched on, the relays will be energised whenever there is no alarm/fault present. Alternatively, in non 'Fail-Safe' mode, the relays are energised when the alarm/fault condition is present.

So for instance, a relay could be set to provide an 'Oxygen Low' indication. This contact can optionally also indicate any fault condition associated with the oxygen sensor (over-range, calibration error, no communications with REM1).

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Connector J4: Analogue Outputs Channels CH1 to CH4

Connector	Weidmuller BL3.5 10 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Analogue Out 0	+	
2		-	
3	Analogue Out 1	+	
4		-	
5	Analogue Out 2	+	
6		-	
7	Analogue Out 3	+	
8		-	
9	Not Used	N/A	
10		N/A	

Connector J8: Analogue Outputs Channels CH5 to CH8

Connector	Weidmuller BL3.5 10 way		
Mating Connector	Accepts wire size 0.5 to 1.5mm2 or ferrules, and provides screwdriver terminal for each core.		
Pin No	Service	Signal	Comments
1	Analogue Out 4	+	
2		-	
3	Analogue Out 5	+	
4		-	
5	Analogue Out 6	+	
6		-	
7	Analogue Out 7	+	
8		-	
9	Not Used	N/A	
10		N/A	

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Each analogue output may be configured to indicate one of the parameters measured by the system.

Standard systems are configured for 4-20mA. 0-20mA and 0-10V voltage output options are also possible.

Refer to documentation supplied with the system for specific allocations.

Note that current outputs are locally powered (active outputs). They are isolated from the 24V DC supply, but not from one another. The –ve return connections are common between channels.

In a standard system comprising one REM1 and one REM2, the following analogue allocations are typical with the 4-20mA output being set to the range of each sensor.

Output Channel	Parameter
0	O2
1	CO2
2	Pressure
3	Temperature
4	Humidity
5	N/A
6	N/A
7	N/A

In a system comprising two REM1sensors the following analogue allocations are factory defined.

Output Channel	Remote	Parameter
0	A	O2
1	A	CO2
2	A	Pressure
3	N/A	N/A
4	B	O2
5	B	CO2
6	B	Pressure
7	N/A	N/A

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6.3.2 Remote Sensor Electrical Installation

Each remote sensor is fitted with an IP68 chassis mounted Lemo Series 2K male connector. A cable is also supplied with a matching Lemo 2K series connector. This cable is to be cut down to length (if necessary) and terminated at a junction box within the chamber. Wiring from that junction box is then to be routed through a penetrator back to the Operator Console. For any further guidance or advice, please contact Analox.

The pre-made cables are made from the following cable type : DEF STAN 61-12 (Part 25) cable – Raychem 62628A (NSN 6145-99-892-0076).

Each metal enclosure has an M6 earth stud for equipotential bonding purposes as required.

PIN NO	Cable Core	FUNCTION
1	Pair 1 Red	Power In +24V DC
2	Pair 1 Blue	Power In 0V DC
3	Pair 2 Red	RS485 Comms +
4	Pair 2 Blue	RS485 Comms -
5	Pair 2 Screen (Green)	RS485 Comms Screen
6	Pair 3 Red	Auxiliary Pair +
7	Pair 3 Blue	Auxiliary Pair -
8	NC	NC
Screen		Earth Screen

The Auxiliary Pair are only used on a REM3 which performs Oxygen Injection. The pair is a powered 24V DC Output which may power an external gas solenoid valve directly.

However it is usual to wire this through a relay contact on an independent monitoring system, such that the injection can be overridden if the monitoring system determines that the oxygen level is too high.

6.4 System Gas Handling Installation

All of the remote sensors are ambient monitors. They must be mounted such that they can 'see' the gas atmosphere that they are measuring. The only connection required is at the time of calibration via Analox supplied flow adaptors and tubing.

Special versions of REM1 and REM2 are designed for mounting external to a chamber and will require a sample flow with an in-line flowmeter.

6.4.1 Injection Systems

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The REM3 oxygen injection controllers provide a powered 24 VDC output capable of operating an injection solenoid valve.

Analox do not normally supply the injection valve, although are happy to be provide some advice if asked.

It is vitally important that the injection valve and other associated fittings (regulators, pipework etc.) are cleaned for oxygen service.

The injection valve is fed with an oxygen supply from either a fixed pressure regulator or from a dome loaded regulator.

When using a fixed pressure regulator, the pressure must be set above the maximum chamber pressure at which injection is required.

When using a dome loaded regulator, the regulator output pressure is automatically adjusted to be a set pressure (e.g. 2 to 3 bar) above the chamber pressure into which oxygen is to be injected.

Personnel designing the oxygen injection system must be competent in the safe use of oxygen.

The injection system operates by opening the injection valve for a short time interval which is dependent on the deficiency of oxygen in the chamber. The valve open period becomes longer as the oxygen level falls. When the oxygen level exceeds the desired set-point, the valve remains closed. After each injection of oxygen, the system waits for a pre-set time ('Mixing Time', typically 30 seconds), before determining the next open period.

Figure 7 shows the standard timing characteristic. Read from the left hand axis when operating in partial pressure mode, and from the right hand axis when working in percent mode.

The oxygen is best distributed around the chamber if possible. Customers have previously used a rail running along the chamber roof space with several outlets along its length. However, even with a single-point injection, the oxygen will still mix fairly quickly in the chamber, especially if there is any forced circulation in the chamber (e.g. from CO2 scrubbers etc.).

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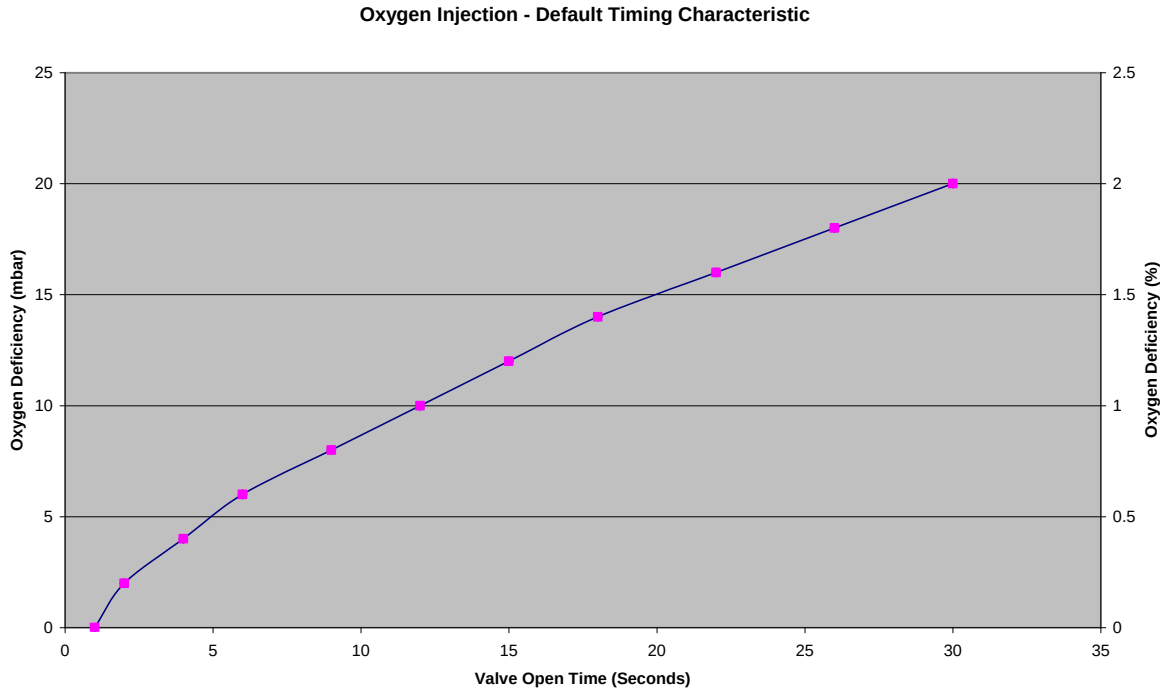

Figure 7 Injection Valve Timing

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7 Operation

The Operator Console provides

a) a 240x128 pixel liquid crystal display
b) 5 function key pushbuttons F1-F5 which align with key legends on the display
c) an Acknowledge pushbutton to acknowledge alarms and faults
d) a backlight pushbutton to control the display back light
e) a yellow alarm indicator lamp
f) a red fault indicator lamp
g) an audible sounder to annunciate alarms and faults
h) a contrast control for the display
i) a power switch controlling power to the instrument and to the remote sensor units
j) a system fuse

Additional fuses are mounted on the front panel of some versions to segregate power to each of the sensor modules, when for instance separate REM1 sensors are mounted in individual chambers.

Operator Console

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Remote Sensor

The remote sensors are fitted with

a) Up to three 4-digit 7-segment LCD displays.
b) A yellow alarm indicator lamp
c) A red fault indicator lamp
d) A selectable audible sounder to annunciate alarms and faults
e) A red/green indicator

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7.1 Switching On And Off

The Operator Console and the Remote Sensors are switched on by operating the Power switch on the Operator Console. Note that it is permissible for a user to have installed a remote sensor independently with an independent power supply, hence some remote sensors will not be affected by this power switch.

If the operator console does not switch on, check the following:

a) Check that the external power supply is healthy.
b) Check the condition of any fuses in the supply line
c) Check the condition of the front panel fuse F1 (below the power switch)

If the operator console does switch on, but the remote sensor does not, check the following:

a) Check that the remote sensor is physically connected
b) Check that there is power on the connection to the remote sensor
c) Check the condition of fuses in the circuit to the remote sensor

Note 1:

The front panel fuses F2, F3 and F4 power each of the remote sensors. On standard systems with one REM1, or with a REM1 and REM2, F2 will power the sensor units.

Note 2:

If the remote sensors are powered from the operator console and a low current 24V supply is being used (less than 2.5A), due to the inrush current of the remote sensors the F2, F3 or F4 fuses may need uprating

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The power up sequence at the operator console is as follows:

a) The green power LED will illuminate indicating that the power supply is working
b) Both the Fault and Alarm indicators will illuminate to prove their operation
c) The audible buzzer will pulse for a few seconds to prove its operation
d) The Operator Console screen will appear as shown below.

Analox Sensor Technology Limited Fixed Sub Building Block MkIII F Configuring…..

e) After a few seconds, (typically 10 seconds) this will then change to show the name and version number of the system configuration.

Analox Sensor Technology Limited Fixed Sub Building Block MkIII F Configured ASF xxxxx - xxx

f) The screen is then cleared, the alarm and fault indicators turned off, and the main application screen appears. Initially, sensor readings will appear as '- - - -', but this will be replaced after a brief period with actual sensor readings, or alternatively with fault messages. Note that infra-red gas sensors will show 'Warm up' for a few seconds at power up.

g) If connected correctly, the remote units will go through their own initialisation sequence

h) All 3 displays will show the word 'Code' followed by from top to bottom – the node address of the sensor, the software reference, and the software version.

i) Each display will then show a diagnostic whilst the on-board watchdog circuit is tested. All segments of each of the displays, and each of the LED indicators will be turned on during this test. If the watchdog test fails, the display ' DOG' will appear (contact Analox)

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j) The displays will then revert to show the sensor readings with the backlights turned on (if enabled).

k) The operator console may determine that it is necessary to download a configuration to the sensor module. During this sequence, each of the displays will show "Con0". Additional messages may appear if there are faults in the configuration process.(Con1 through Con 9 – report to Analox).

l) If the configuration works correctly, the displays should then revert to normal sensor readings

7.2 Main Display Screen

The Main Display screen will show readings and alarm values for the attached remote sensors. An example is shown below:

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The screen is divided into several parts as follows:

a) Along the bottom of the screen, there are legends which align with the function keys.

b) The main centre area of the screen shows the sensor readings. Note that the range and units of measurement may change for specific instruments.

c) Readings in alarm states are highlighted with a black background (reverse video). These readings correspond to those shown on the Remote Sensors.

d) On instruments with two or less remote sensors, alongside the sensor reading the present settings of the alarm set-points are shown (each sensor may be configured with two from the following)

- << a very Low alarm,
- < a Low alarm,
- > a high alarm and
- >> a very high alarm.

Note that oxygen controllers, when fitted, show the set-points as a deviation band around a set-point. The set-point is shown as ' S ', and the deviation alongside the symbol ' ± '.

The Time of day is displayed in the top corner of the display

The contrast of the LCD display may be adjusted by turning the contrast control.

Pressing the backlight button (to the left of the contrast adjuster) alternately toggles the display backlight on and off.

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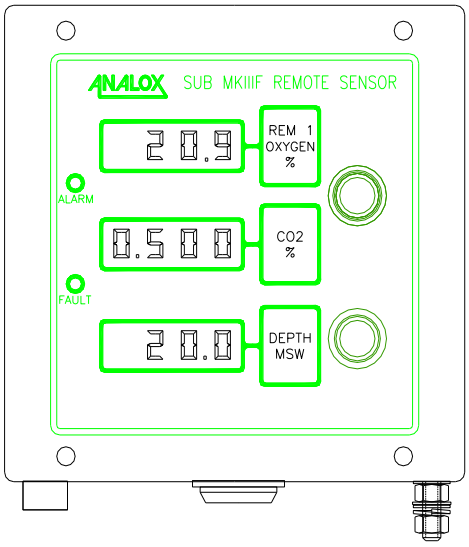
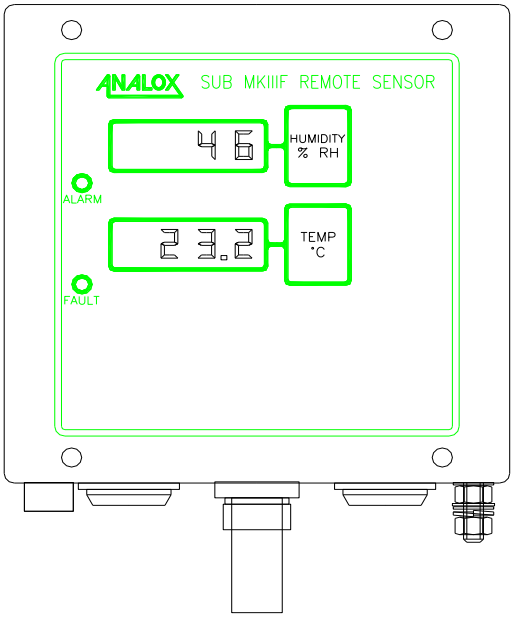
7.3 Remote Sensor Displays

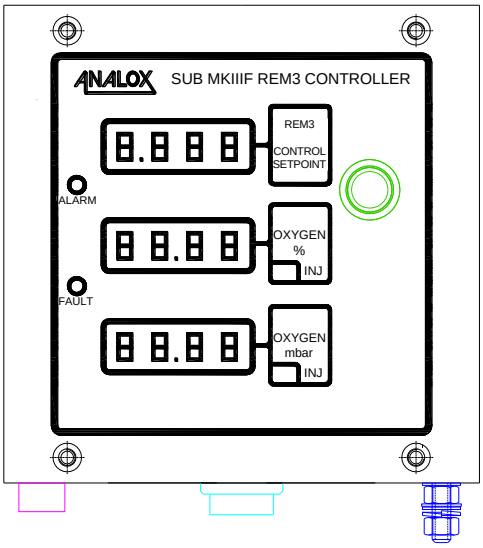
REM1



REM2



REM3



Text alongside the display indicates the type of reading (CO2, Oxygen, Pressure/Depth, Temperature or Humidity) and the units of measurement.

Readings on the displays will alternate with fault or alarm messages if there are any faults or alarms detected. A simple priority sequence is assigned in the case where there are multiple faults or alarms present. For instance if a sensor is showing a low alarm but also a sensor fault alarm, then the fault alarm would display since it has a higher priority.

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A full list of messages that may appear is shown below. Note that O2 and Pressure are classed as non-OEM sensors, whereas CO2, temperature and humidity are classed as OEM sensors.

ID	LCD Characters				Description
	4	3	2	1	
0	' '	' '	' '	' '	Blank Message
1	'C'	'O'	'N'	'0'	No configuration or DCM is currently configuring
2	'C'	'O'	'N'	'1'	Invalid REM checksum
3	'C'	'O'	'N'	'2'	Number of sensors exceeded
4	'C'	'O'	'N'	'3'	No sensors enabled
5	' '	'D'	'O'	'G'	More than 3 watch dog resets must turn power off
6	'E'	'N'	'B'	'L'	Sensor fitted but not enabled
7	'C'	'A'	'L'	'0'	Calibration Zero fault – OEM sensor
8	'C'	'A'	'L'	'S'	Calibration Span fault – OEM sensor
9	'C'	'A'	'L'	'L'	Calibration Low fault - non-OEM sensor
10	'C'	'A'	'L'	'H'	Calibration High fault - non-OEM sensor
11	' '	' '	'L'	'0'	Sensor low value alarm
12	'L'	'0'	'L'	'0'	Sensor very low value alarm
13	' '	' '	'H'	'I'	Sensor high value alarm
14	'H'	'I'	'H'	'I'	Sensor very high value alarm
15	'b'	'b'	'b'	'b'	OEM sensor WARMUP or sensor value with an OEM sensor comms fault
16	' '	'U'	'-'	'R'	Sensor output under-range
17	' '	'O'	'-'	'R'	Sensor output over-range
18	' '	'L'	'C'	'D'	Excessive number of parameters selected for display
19	' '	'S'	'C'	'F'	OEM sensor communications fault
20	'F'	'A'	'I'	'L'	OEM sensor fail
21	'N'	'O'	'F'	'L'	No GAS flow – displayed on appropriate LCD
22	' '	'3'	'2'	'0'	REM Type
23	'C'	'O'	'N'	'4'	Too many injection controllers have been configured

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ID	LCD Characters				Description
	4	3	2	1	
24	'9'	'9'	'9'	'9'	Display high limit
25	'-'	'9'	'9'	'9'	Display low limit
26	'C'	'O'	'N'	'8'	Configuration zero gain error - used in conversion calculations
27	'C'	'O'	'N'	'5'	Configuration conversion divide by zero error
28	'S'	'P'	'I'	'1'	ADC SPI Fault
29	'S'	'P'	'I'	'2'	EEPROM SPI Fault
30	'S'	'P'	'I'	'3'	DISPLAY SPI Fault
31	'S'	'P'	'I'	'4'	RTC SPI Fault
32	' '	'F'	'L'	'O'	Flow Fault
33	' '	'C'	'N'	'T'	Watch dog\stack under\overflow counters
34	'C'	'O'	'N'	'6'	Pressure selection configuration error
35	' '	'C'	'A'	'L'	Calibration value passed to OEM sensor is out of range
36	'C'	'O'	'N'	'7'	EEPROM dbase too large - at configuration time
37	'C'	'O'	'D'	'E'	Checksum code error
38	' '	'R'	'A'	'0'	REM RAM fault 0 detected - read\write fault
39	' '	'R'	'A'	'1'	REM RAM array under\overflow error detected
40	'F'	'L'	'S'	'H'	REM FLASH fault detected
41	' '	'E'	'E'	'2'	Configuration eeprom checksum error
42	'T'	'E'	'C'	'H'	In technician mode
43	'C'	'O'	'N'	'9'	Error between XML download and manufacturer configuration
44	'B'	'O'	'O'	'T'	Boot loader

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7.4 Alarm System

The primary alarm conditions monitored by the system are the oxygen, carbon dioxide, pressure (or depth), temperature and humidity alarms. These conditions are referred to as Alarms in the system.

The design of the system is such that in trying to gather the correct information, various faults that may occur can be detected. These conditions are referred to as Faults in the system.

Both Alarms and Faults cause the Audible Sounder to pulse.

An Alarm condition occurring causes the 'ALARM' Indicator on the Operator Console to flash.

A Fault condition occurring causes the 'FAULT' Indicator on the Operator Console to flash.

The Acknowledge switch on the Operator Console may be pressed to silence the audible sounder. It will also cause the Fault and/or Alarm Indicators to stop flashing. If the alarm or fault condition still exists, the Alarm or Fault indicator will remain turned on.

When the Alarm or Fault condition ceases to exist, the alarm or fault indicators will be turned off and then remain turned off.

The system can be user-configured to work in latched or non-latched alarm mode.

In non-latched mode, if an alarm or fault condition occurs, but then ceases to exist, then the Audible sounder will silence and the indicators will turn off without the Acknowledge switch having been pressed.

In latched mode, the user must press the acknowledge switch to acknowledge that an alarm has occurred. Only then, can the alarm indicators be turned off if the alarm condition no longer exists.

Alarm and Fault conditions are generally originated at the remote sensor modules. LED indicators on the remote are controlled according to these conditions. An internal buzzer is also available, which can be enabled from the Operator Console). By default, these are turned off, so as not to raise anxiety amongst chamber occupants. Status is then transferred to the Operator Console, which in turn will provide audible and visual indications. An operator may then acknowledge the alarm at the Operator Console. This status is transferred back to the Remote Sensor to acknowledge the condition at the Remote Sensor.

A few fault conditions originate at the Operator Console (eg REM COMMS TIMEOUT, which indicates loss of communications with remote sensor. These alarms/faults are not transferred to the Remote sensor.

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7.4.1 List of Alarm Conditions

The Table below provides details of all of the usual alarm conditions annunciated by the system (not all will be present on a particular system).

ALARM NAME	CONDITION CAUSING ALARM
Oxygen Low	Oxygen content is less than the low alarm set-point
Oxygen High	Oxygen content is greater than the high alarm set-point
Carbon Dioxide High	CO2 content is greater than the high alarm set-point
Carbon Dioxide Very High	CO2 content is greater than the very high (HI HI) alarm set-point
Depth Low	Depth is less than the low alarm set-point
Depth High	Depth is greater than the high alarm set-point
Temperature Low	Temperature is less than the low alarm set-point
Temperature High	Temperature is greater than the high alarm set-point
Humidity Low	Humidity is less than the low alarm set-point
Humidity High	Humidity is greater than the high alarm set-point

Whenever any of these alarm conditions are recognised, the appropriate reading on the display is highlighted on a Black background (reverse video). The corresponding Remote Display will flash.

Hysteresis is applied to each of the alarm thresholds. The hysteresis band is usually configured to 2% of the alarm set-point. Thus if a low oxygen alarm set-point is set at 180mBar, the alarm will be raised when the oxygen level falls below 180mBar oxygen, and the alarm will be cleared when the oxygen level rises to 180mBar oxygen +2% (=183.6mBar oxygen).

Similarly if a high oxygen alarm set-point is set at 230mBar, the alarm will be raised when the oxygen level rises above 230mBar, and the alarm will be cleared when the oxygen level falls to 230mBar oxygen -2% (=225.4mBar oxygen).

7.4.1.1 CO2 Alarm Option

A configurable option exists for customers who measure CO2 in either % or ppm units to treat the alarm set-points as a %SEV or ppmSEV setting.

The alarm set-point is internally corrected with depth according to the calculation 'ppm Set-point / Absolute Pressure Bars', or '%Set-point/ Absolute Pressure Bars'. Thus an alarm level of 5000 ppm becomes 2500ppm at 2BarAbs, and 500ppm at 10BarAbs. The following table shows the effective alarm operating point for a set-point of 5000ppm SEV.

Please contact Analox to enable this option.

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CO2 Alarm Operating Point (ppm) Related to Depth (BarA) assuming Set-point set to 5000ppmSEV											
	Depth (BarA)										
	Depth	**0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Depth (BarA)	**0**						10000	8333	7143	6250	5556
	1	5000	4545	4167	3846	3571	3333	3125	2941	2778	2632
	2	2500	2381	2273	2174	2083	2000	1923	1852	1786	1724
	3	1667	1613	1563	1515	1471	1429	1389	1351	1316	1282
	4	1250	1220	1190	1163	1136	1111	1087	1064	1042	1020
	5	1000	980	962	943	926	909	893	877	862	847
	6	833	820	806	794	781	769	758	746	735	725
	7	714	704	694	685	676	667	658	649	641	633
	8	625	617	610	602	595	588	581	575	568	562
	9	556	549	543	538	532	526	521	515	510	505
	10	500									

CO2 Alarm Operating Point (%) Related to Depth (BarA) assuming Set-point set to 0.50%SEV											
	Depth (BarA)										
	Depth	**0**	**0.1**	**0.2**	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**0.9**
Depth (BarA)	**0**						1.000	0.833	0.714	0.625	0.556
	1	0.500	0.455	0.417	0.385	0.357	0.333	0.313	0.294	0.278	0.263
	2	0.250	0.238	0.227	0.217	0.208	0.200	0.192	0.185	0.179	0.172
	3	0.167	0.161	0.156	0.152	0.147	0.143	0.139	0.135	0.132	0.128
	4	0.125	0.122	0.119	0.116	0.114	0.111	0.109	0.106	0.104	0.102
	5	0.100	0.098	0.096	0.094	0.093	0.091	0.089	0.088	0.086	0.085
	6	0.083	0.082	0.081	0.079	0.078	0.077	0.076	0.075	0.074	0.072

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CO2 Alarm Operating Point (%) Related to Depth (BarA) assuming Set-point set to 0.50%SEV											
Depth (BarA)											
	7	0.071	0.070	0.069	0.068	0.068	0.067	0.066	0.065	0.064	0.063
	8	0.063	0.062	0.061	0.060	0.060	0.059	0.058	0.057	0.057	0.056
	9	0.056	0.055	0.054	0.054	0.053	0.053	0.052	0.052	0.051	0.051
	10	0.050									

7.4.2 List of Fault Conditions

The table below provides details of all of the fault conditions annunciated by the system.

FAULT INDICATION	CONDITION CAUSING FAULT	SUGGESTED REMEDIAL ACTION
"REM Comms Fault" appears in place of sensor reading,	Operator Console cannot communicate with the Sensor Unit	Ensure that sensor is connected and powered up. If it is, check fuses and wiring
"Failure" appears in display window	The remote sensor unit has detected a fault associated with one of its sensors	Ensure first that there is not a significant excess of CO2 present. Flush sensor with zero gas and attempt calibration. If the fault persists fit spare sensor unit – contact Analox for repair of faulty unit.
"Under Rnge" appears in display window	Sensor is deemed to be under-range	It is necessary to perform a zero calibration as it should not be possible to measure a negative amount of gas. Refer to Section 10.
"Over Range" appears in display window	Sensor is deemed to be over-range	In gas terms, there could be a dangerous excess of gas present. Exercise caution until it is known whether the over-range is valid or not. If not, attempt recalibration of the sensor. If unsuccessful, fit spare sensor unit – contact Analox for repair of faulty unit.
"Calib Span" appears in the display window	When trying to calibrate the span of an infra red sensor (CO2), it has been determined that the sensor is too far from the correct point in order to perform a calibration successfully.	Attempt recalibration of the sensor using the correct gas and procedure. If the fault persists, fit spare sensor unit – contact Analox for repair of faulty unit.

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FAULT INDICATION	CONDITION CAUSING FAULT	SUGGESTED REMEDIAL ACTION
"Calib Zero" appears in the display window	When trying to calibrate the zero of an infra red sensor (CO2), it has been determined that the sensor is too far from the correct point in order to perform a calibration successfully.	Attempt recalibration of the sensor using the correct gas and procedure. If the fault persists, fit spare sensor unit – contact Analox for repair of faulty unit.
"CAL LO ERR"	When trying to calibrate the Cal-L point of a sensor, it has been determined that the sensor is too far from the correct point in order to perform a calibration successfully.	Attempt recalibration of the sensor using the correct gas (or temp/humidity) and procedure. If the fault persists, fit spare sensor unit – contact Analox for repair of faulty unit.
"CAL HI ERR"	When trying to calibrate the Cal-H point of a sensor, it has been determined that the sensor is too far from the correct point in order to perform a calibration successfully.	Attempt recalibration of the sensor using the correct gas (or temp/humidity) and procedure. If the fault persists, fit spare sensor unit – contact Analox for repair of faulty unit.
"OEM Sensor Fault" appears in place of sensor reading,	The Remote sensor unit is unable to obtain readings from an infra-red sensor (CO2) or a Temperature/Humidity sensor	Power system down and then restart. If the fault persists fit a spare sensor unit – contact Analox for repair of faulty unit.
"No flow" appears in the display window	The remote sensor unit cannot detect gas flow through the sensor unit (only for systems with flow switches fitted (ie sample fed, and/or pump drawn samples)	Check that there is sample flow through the unit (feel exhaust). If fault persists , investigate operation of flow switch and fit spare if necessary
"ADC Flt" appears in the display window	The remote sensor unit has detected a fault with its internal ADC.	Power system down and then restart. If fault persists fit spare sensor unit – contact Analox for repair of faulty unit
"EEPROM Flt" appears in the display window	The remote sensor unit has detected a fault with its internal EEPROM	Power system down and then restart. If fault persists fit spare sensor unit – contact Analox for repair of faulty unit
"CODE ERR" appears in place of time field	There is corruption detected within the code space of the Operator Console	Contact Analox for assistance
"RAM ERROR" appears in place of time field	There is corruption detected within the RAM memory space of the Operator Console	Repower the system once. If the fault persists contact Analox for assistance.
"E2 ERROR" appears in place of time field	There is corruption detected within the E2PROM configuration space of the Operator Console	Contact Analox for assistance

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7.5 Oxygen Injection System

The Injection module is designed to operate a solenoid valve to control the flow of oxygen to the area being controlled. If the measured oxygen value is greater than the injection set-point, then no action is taken by the instrument.

Two modes of operation are possible. The system may operate as a %Oxygen controller or as a partial pressure oxygen controller. Two LED indicators show which mode, if any, is operating.

If the measured value of oxygen falls below the Injection set-point, then the solenoid valve is activated and oxygen is injected for a time period proportional to the difference between the set-point and the measured value. On completion of the injection period, the module allows a Pre-set Mixing Period of *x* seconds to permit mixing of the recently injected oxygen.

Opening times for the injection valve are stored within the Remote Sensors configuration memory in an EEROM based Lookup table. It should not be necessary to adjust these after fairly simple commissioning tests. If the times do need to be changed, contact Analox for advice.

Mixing Time is essentially determined by the size of the chamber and the positioning of injection points within the chamber. After the Mixing period, a further check is made of the oxygen concentration to determine if the solenoid valve should be re-opened.

When the oxygen level is above the set-point, no injection is required. The mixing period is therefore not required. The unit will wait for the oxygen level to fall to a value at which further injection is required and then immediately perform an injection cycle.

The LED indicators on the REM3 Injection unit have the following significance:

LED INDICATOR	SIGNIFICANCE
OFF	Injection is currently disabled
ON	Injection is currently enabled, but the injection solenoid is not currently open (Mixing Time)
Flashing	Injection is currently enabled, and the injection solenoid is currently open.
RED ON	Injection is enabled but cannot occur due to a fault. These faults are: The occurrence of all fatal faults. The occurrence of under-range / over-range faults on the O2 sensor or pressure sensors The occurrence of calibration faults on the O2 or pressure sensors.

It is highly dangerous to use an oxygen control system without an independent monitoring system. It is not envisaged that anyone will use an Analox oxygen controller in the absence of another monitoring system, whether that be supplied by Analox or anyone else.

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Analox recommend that the electrical output to the injection solenoid is interlocked with an alarm from the monitoring system. By simply wiring a 'high oxygen' alarm contact in series with the injection valve, the user can prevent incorrect injection of oxygen to the chamber.

Manual isolation valves should also be provided. These will be required if the injection solenoid jams in the open position.

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8 Function Keys

When first powered up, the operator console defaults to the top menu. There are 5 function keys, each one selecting a different option. The function of each key is shown on the bottom line of the display. Pressing any of the keys will cause a new menu to appear, re-assigning the option available on each key. At lower menu levels F4 and F5 function keys are sometimes assigned to TOP and BACK.

BACK will always go back to the previous menu. Ultimately, repeated pressing of BACK will get back to the top menu. Alternatively, when a TOP function is provided, a single key press of TOP is a quick way to go back to the top main menu.

For menus on which there are more options than can be assigned to the five keys, a MORE key allows more options to be shown.

For sake of clarity on the diagrams that follow, the BACK and TOP functions are not drawn

On some menus there are blank keys which have no option. These are assigned to other functions in different products that use the same software.

If a system is left for a prolonged period without pressing any keys, it will revert to the top level main menu automatically.

8.1 Top Level Main Menu

TOP: MAIN MENU

SETUP	ALARM SETPNT	CALIB	CONTROL	

At the top level menu, the functions available are

Key	Function	Comment	Refer Section
F1	Setup	the date and time to be set, and access to test functions	
F2	Alarm Set-point	Adjust alarm set-points for all sensors	
F3	Calibration	Calibrate function for each sensor	
F4	Control	System control	
F5			

A ‘hidden’ menu item exists on F5. Maintain F5 pressed, and then press the backlight button. Version details of the Operator Console (DCM) and the Remote sensors, together with the version of their configuration files will be displayed.

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Use the F3:Next key to reveal the version numbers for the operator console and sensor unit e.g.

XLS Version [xxxxx] [yyyyy] [zzzzz]

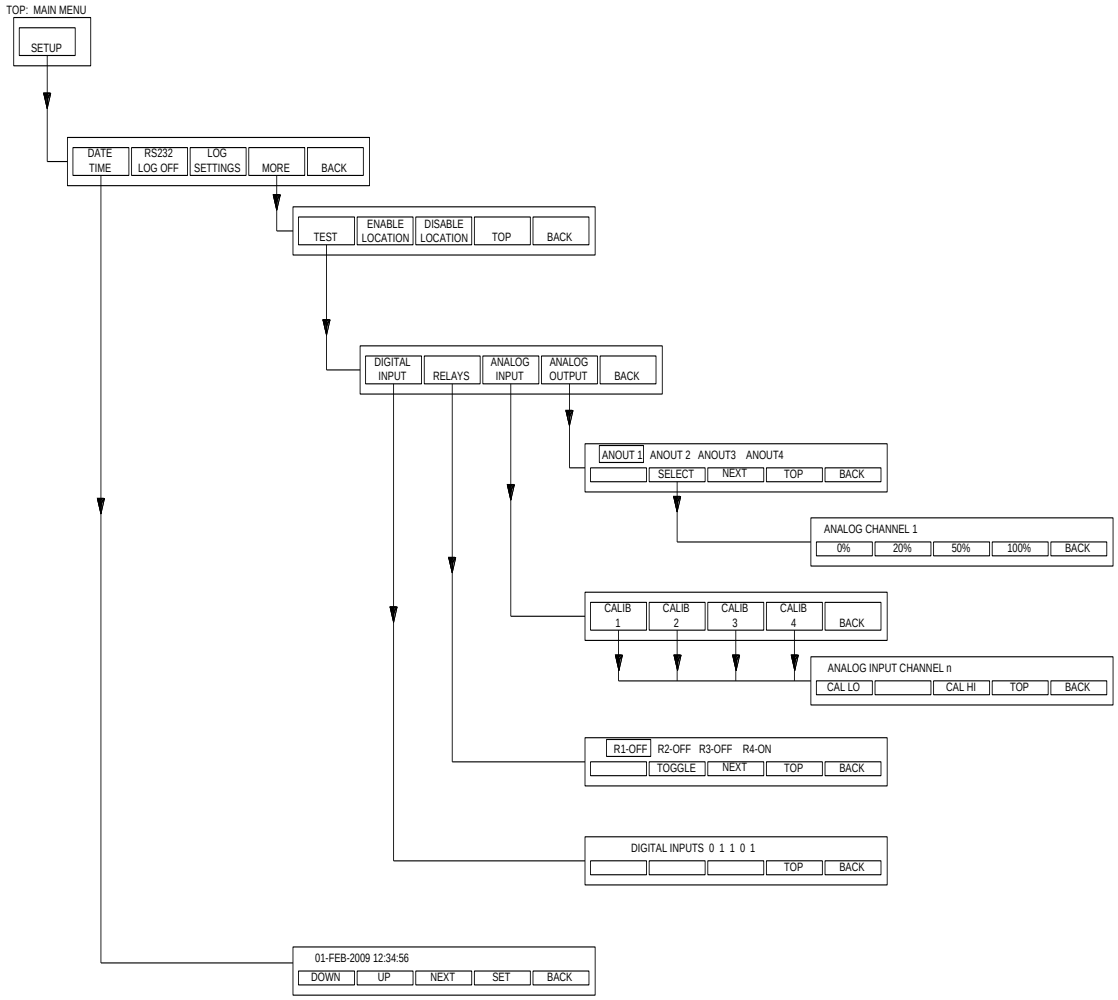
REM Version [aaaaa]

DCM Version [bbbbb]

XML 'vvvvvvvvvvvvvvvvv'

8.2 Setup Menu

The Setup menu is accessed by pressing SETUP at the top level menu. The functions available are shown in the diagram below.



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Key	Function			Comment
F1	Date and Time			Adjust date and time
F2	RS232 Log On/Off			Used to toggle RS232 data output on and off
F3	Log Settings			Used to define interval between each set of readings for RS232 output
F4	More	F1	Test	Hardware Test Function
		F2	Enable Location	Allows sensor module to be enabled (normal operating mode)
		F3	Disable Location	Allows a sensor to be disabled (perhaps when it is faulty or returned for repair)
		F4	Top	
		F5	Back	Go back to previous menu (SETUP)
F5	Back			Go back to top main menu

8.2.1 Date and Time Entry

Initially, the current date and time will be displayed above the function key legends. The day field will be highlighted. Use the NEXT key to move the highlight through each of the fields: day, month, year, hour, minute and second. To adjust the highlighted field, press either UP or DOWN. When the correct date and time has been obtained on the screen, press SET to set the on-board clock with the correct date and time.

Note that the year can only be adjusted in the range 2000-2099. The days can only be adjusted within the range for the month shown. If the days have been adjusted to 31, and the month is changed from March back to February, the 31 Feb will appear as the date. However, if SET is pressed, it will register as an invalid date. Similarly 29 Feb can be selected via the Up/Down keys, but if the year is not a leap year, then pressing SET will also register as an invalid date.

The date and time setting is not critical to operation of the system. The time is shown in the top left hand corner of the screen for convenience only, and as an indication that the system is running. The date is used for data output time stamping. On board batteries maintain the time whilst the system is switched off.

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8.2.2 Test Menu

The Test Menu allows simple functional checks of the inputs and outputs on the operator console.

Even when not configured for use, the test menu allows physical access to these facilities.

Key	Function	Comment
F1	Digital Inputs	Factory use only
F2	Relays	RL1 – Alarm relay
F3	Analogue Input	Factory use only
F4	Analogue Output	Factory use only
F5	Back	Go back to previous menu

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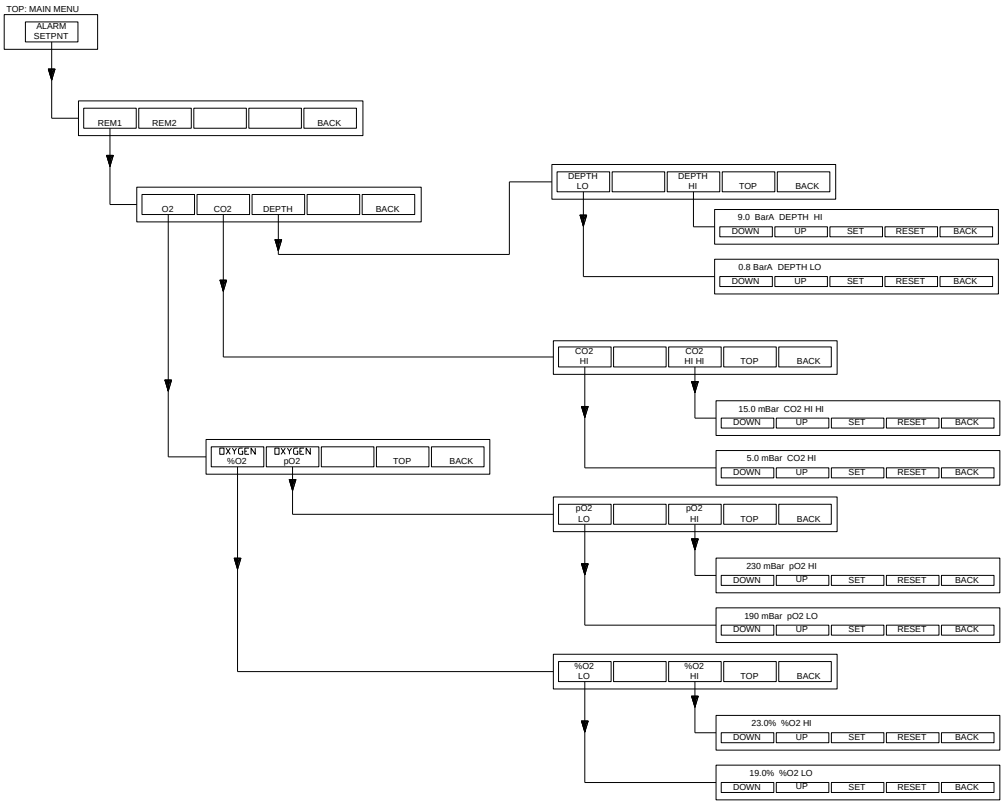
8.3 Alarm Set-point Menu

The exact structure of this menu depends upon the physical sensors which are installed in a system. Note the labels REM1, REM2. in the following diagrams may be replaced in specific versions with more appropriate text. For instance it is possible to assign a name to a chamber for instance – such as PC and RC for Pilot Compartment and Rescue Compartment. Alternative names are fairly easy to configure – please consult Analox if necessary.

The alarm set-point menu provides the functionality to modify alarm set-points within the system. Refer to the diagrams below. Note that different units of measurement will apply for different systems.



Each sensor has two set-points, selected at the factory from very low, low, high and very high. Therefore common cases could be two lo going alarms (low and very low), a high and a low alarm, or two high going alarms (high and very high).

Typically oxygen and depth will have a low and high set-point, whereas toxic gases have a high and a very high set-point.

Oxygen is treated as a special case. For life support, it is generally the partial pressure of oxygen that is important. However, for fire risk, it is the percentage of oxygen that is of more concern.

Oxygen therefore can be provided with two types of alarms – one pair of alarms on the partial pressure of oxygen (pO2), and the other on the percentage of oxygen (%O2).

From the function keys (see figure above), the user will select the appropriate set-point to be altered. The existing set-point is shown. Pressing F1 (DOWN) or F2 (UP) will decrease or increase

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the value of the set-point by a step change pre-defined within the instrument. The value is limited by a pre-set minimum and maximum value. Pressing F3 (SET) will programme the new set-point into the instrument, and return to the previous menu. Alternatively pressing RESET will restore the value to that before making any changes. Press BACK to return to the previous menu without making any changes.

To effectively disable an alarm, adjust it's set-point to a value that the sensor is unlikely to measure. For instance, an absolute pressure sensor could be set to 0.5 BarA in a system that was never expected to be less than 0.8 BarA.

8.4 Calibration Menu

WARNING: INCORRECT USE OF THE CALIBRATION SYSTEM AFFECTS THE ACCURACY OF GAS /PRESSURE MEASUREMENTS. ONLY TRAINED PERSONNEL SHOULD USE THESE FEATURES.

The calibration menu provides the user with the facility to calibrate each of the sensors. The figures that follow show the calibration options available. The use of these functions will be further discussed in the Calibration section (Section 10).

Within this section, all that needs to be noted for now is that the calibration data is adjusted in a very similar way to the alarm set-points, using the UP/DOWN/SET and RESET keys. In order to avoid accidental calibration, when SET is pressed, a confirmation is required that the user does indeed intend to calibrate the sensor. A command is then sent to the appropriate sensor to calibrate.

Note that CO2 is a slightly special case. When performing a zero, there is no screen to define the calibration value. It is assumed to be zero always. Therefore the user is only asked to confirm that the calibration should be performed.

Quick calibration is a facility to make calibration of oxygen and carbon dioxide a little easier. It is usual to carry two gases – oxygen (Gas1) to both span O_2 and zero CO_2, and a CO_2 gas in N_2 or Helium (Gas 2) to zero oxygen and span CO_2. Quick Calibration allows the O_2 and CO_2 sensors to be calibrated at the same time, requiring far fewer button presses than doing the two tasks individually. However, the gas calibration data must have been entered once previously for this to happen. Do this whenever changing from one supply of calibration gas to another with a different concentration.

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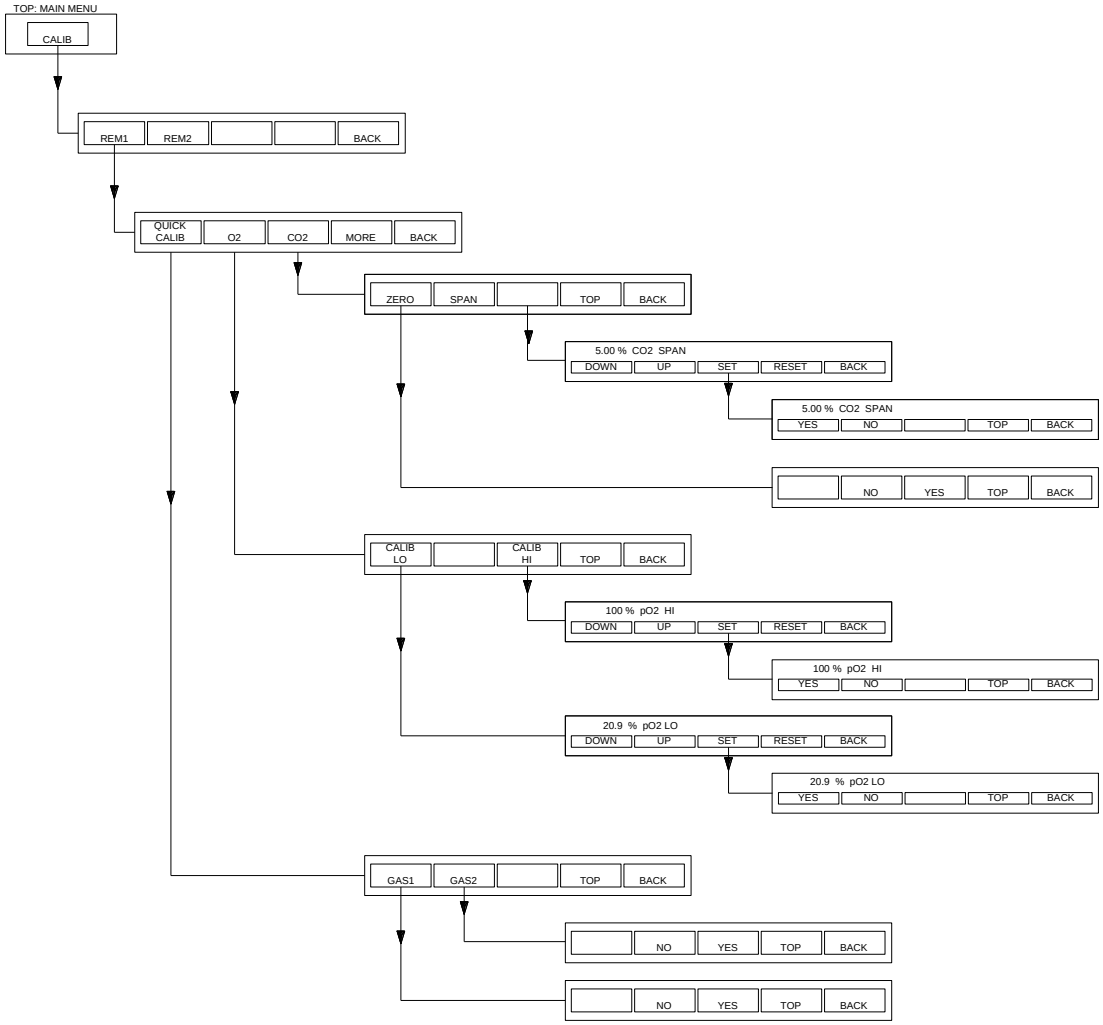
8.4.1 CO2 and O2 Calibration Menus

Note the labels REM1, REM2. in the following diagrams may be replaced in specific versions with more appropriate text, as per the comments above for the alarm set-points

Also, gas ranges shown may differ to specific models.



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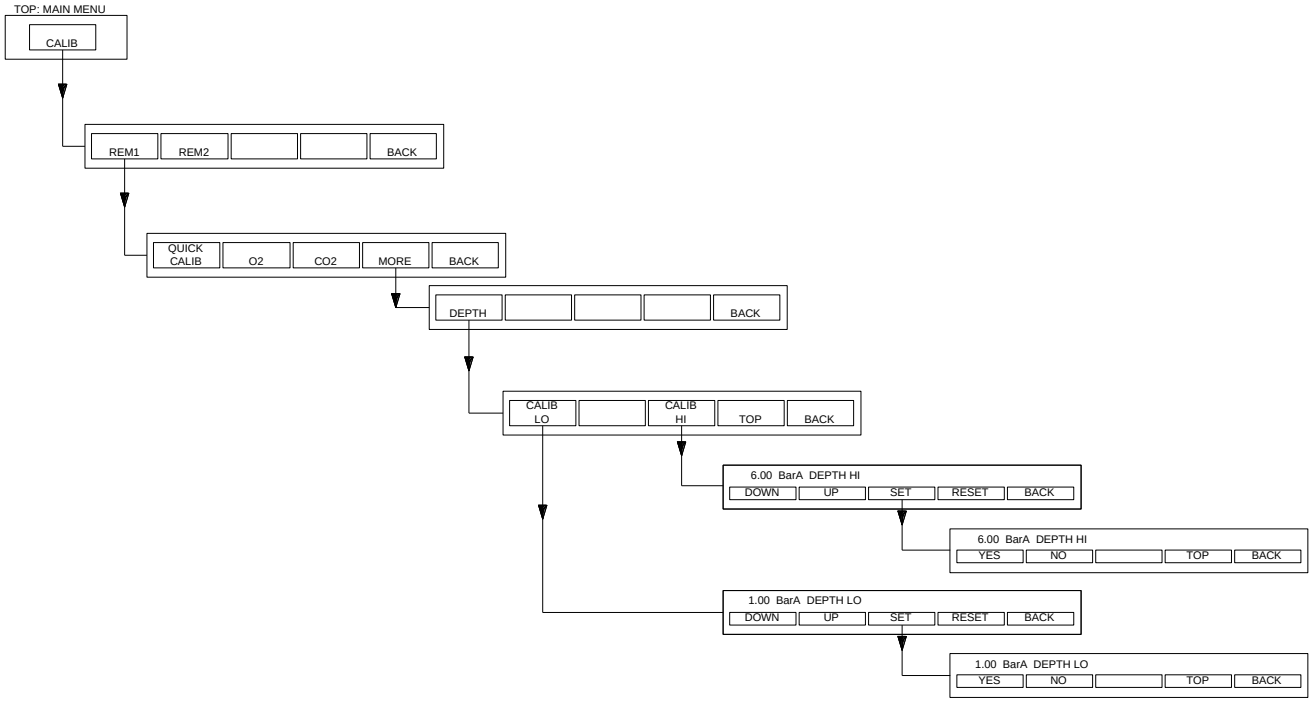
8.4.2 Pressure Sensor (Depth) Calibration Menus

The depth / pressure sensor calibration functions are accessed by pressing CALIB, then selecting the appropriate remote sensor module, then pressing MORE, and then selecting the DEPTH sensor.



8.5 Control Menu

The functions provided on the control menu depend on the actual application. Not all of the following sections will apply to a particular instrument type.

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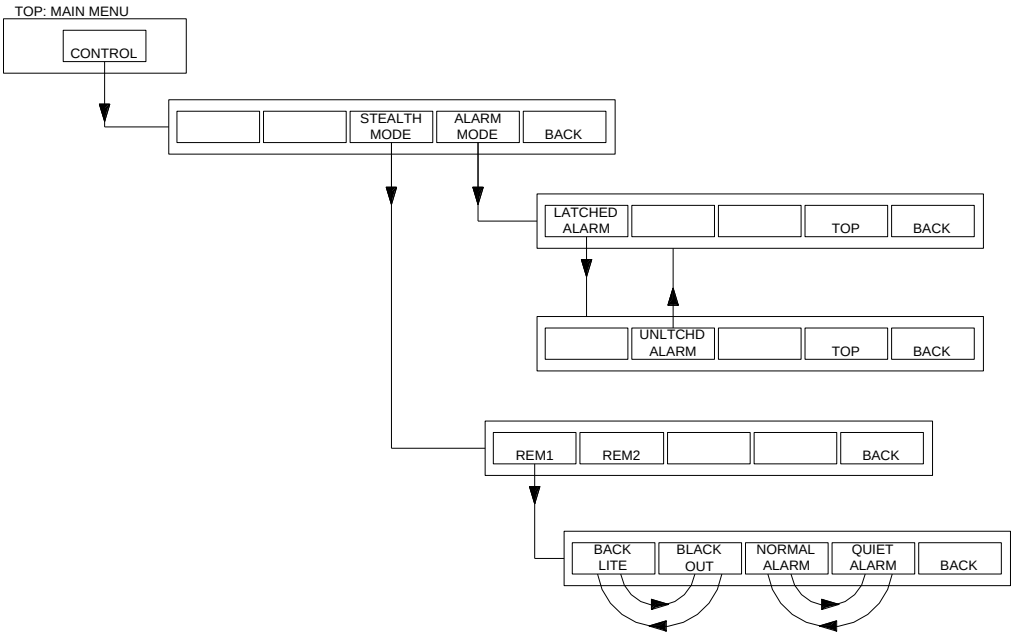
8.5.1 Control Menu – Standard Features



8.5.1.1 Stealth Mode

F3, Stealth Mode provides two options regarding operation of the remote sensors.

The changes may be applied to any of the sensor modules connected to the system.

When 'BLACK OUT' appears on the menu, pressing this key will cause the remote sensor to operate in Black Out mode. The display backlights and the LED alarm/fault indicators will be turned off, such that occupants of the chamber are less aware of the sensors presence. Under such circumstances, the external chamber operator must take appropriate actions on each and every alarm/fault occurrence.

When 'BACKLITE' is pressed, this will restore the system to its normal state in which the remote sensor backlights and alarm indicators operate normally.

Pressing 'QUIET ALARM' causes the audible sounder in the remote sensor to be disabled. This may reduce anxiety levels amongst chamber occupants.

Pressing 'NORMAL ALARM' causes the audible sounder in the remote sensor to be enabled. It will then operate whenever the remote sensor detects an alarm or fault condition.

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8.5.1.2 Alarm Mode

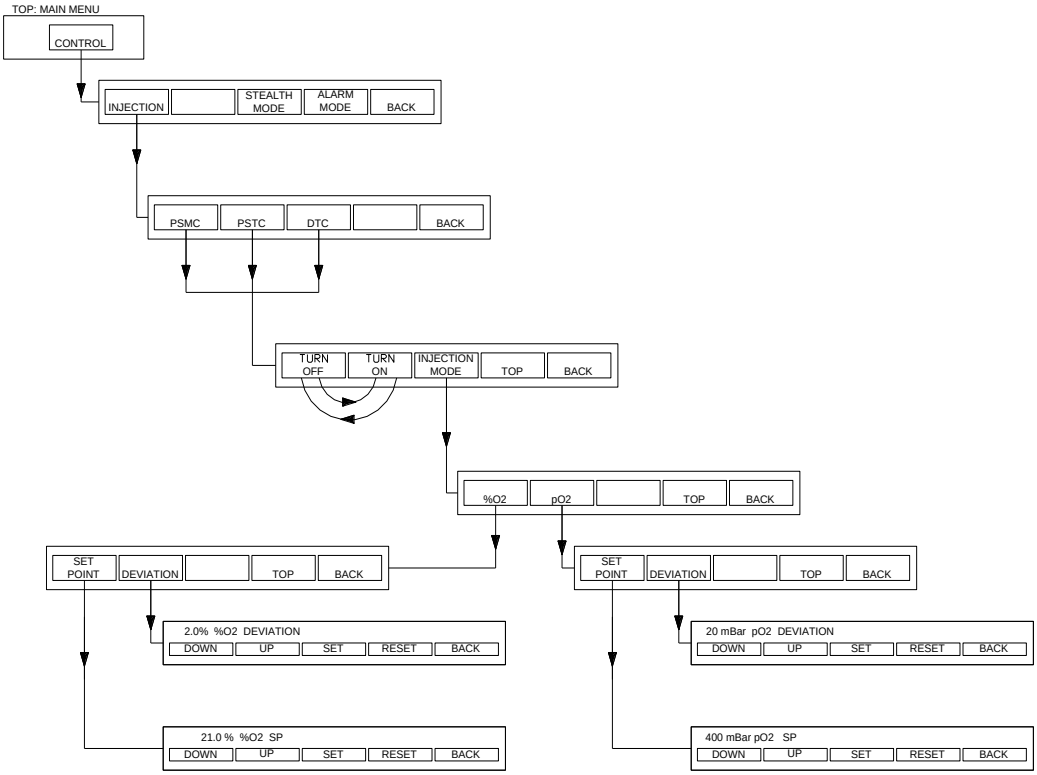
F4, Alarm Mode, allows the user to control whether alarms should operate in latched or unlatched mode. A latched alarm must be acknowledged by the user before it can be revert to normal. An unlatched alarm will revert to normal as soon as the condition that caused it ceases to exist.

When in Latched Mode, F2 will appear to offer the option to swap to Unlatched Mode.

When in Unlatched Mode, F1 will appear to offer the option to swap to Latched Mode.

8.5.2 Control Menu – Injection Option

These options are fitted to all systems performing an Oxygen Injection function. The example below is taken from a 3 chamber controller in which one operator console controls three remote sensor units. In this case they are given labels PSMC, PSTC and DTC. They may be given alternative names. In a Submarine Rescue Vehicle they are usually referred to as PC (Pilot Compartment) and RC (Rescue Compartment)



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9 Data Communications Output

Two 9 way Female D-type connectors are fitted to the rear of the Operator Console. These are intended for Diagnostic purposes, or for providing 'real-time' data from the system during use.

The Diagnostic Connector details are shown below.

Connector PL1 (COMM 0)

Pin Number	Signal
1	NC
2	RS232 Transmit Output
3	RS232 Receive Input
4	DTR
5	RS232 Signal Ground
6	NC
7	RTS
8	NC
9	NC

Connector PL2 (COMM 1) – generally not used

9.1 Data Interface to External Systems

PL1 COMM0 on each Operator Console provides an RS232 data output connection if it is required to capture and log the instrument status. No data connection should be made back to the Analox system to avoid interference from unexpected data sources.

Data messages will typically be sent at least once every 5 seconds for each chamber, although this can be set to be 1s, 5s, 15s, 30s, 60s, 120s, 300s.

All transmitted data is in ASCII printable characters, communicated at 9600 baud, 1 start bit, 8 data bits, no parity, 1 stop bit, no hardware handshaking, with a terminating carriage return character (ASCII #13). A comma (#44) and a space character (#32) delimit each field within the message.

Each message is preceded by a start character (>) and a date and time stamp. There is no comma between the date and time, as this allows the date and time field to be imported to an Excel spreadsheet as a combined date and time field.

Each message contains a checksum to validate the data within the message. A 4 digit ASCII checksum (0000-FFFF hex) is intended as a straight summation of each of the characters in the message (excluding the checksum itself).

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9.1.1 Typical Monitoring System Operator Console Outputs

>13-OCT-2006 12:21:37, ID=REM 1, pO2=1.024, CO2=0.001, P= 0.2, ST=Af, CK=xxxx

>13-OCT-2006 12:21:37, ID=REM 2, T= 24.8, H1=   9, ST=Af, CK=xxxx

Red section denotes checksummed characters

>	Start character followed by date/time stamp
ID	ID=REM1 or ID=REM2 to indicate the source of the data.
%O2	Oxygen reading in %O2 (when enabled)
pO2	Oxygen reading in partial pressure (mBar pO2)
CO2	CO2 reading (mBar pCO2)
P	Pressure in MSW
T	Chamber Ambient Temperature in ºC (REM2)
H	Humidity in %RH
ST	Alarm Status – A/a=Alarm/no alarm, F/f=Fault/no fault
CK	Checksum
CR	ASCII Carriage Return terminator

9.1.2 Code Example

Assuming strData is the received data and u16Length is the data length, the following example will calculate the checksum for the data string:

```
uint16_t u16Loop;
uint16_t u16Checksum = 0;

for(u16Loop = 1; u16Loop < (u16Length - 9); u16Loop++ )
{
      u16Checksum += strData[u16Loop];
}
```


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10 Calibration

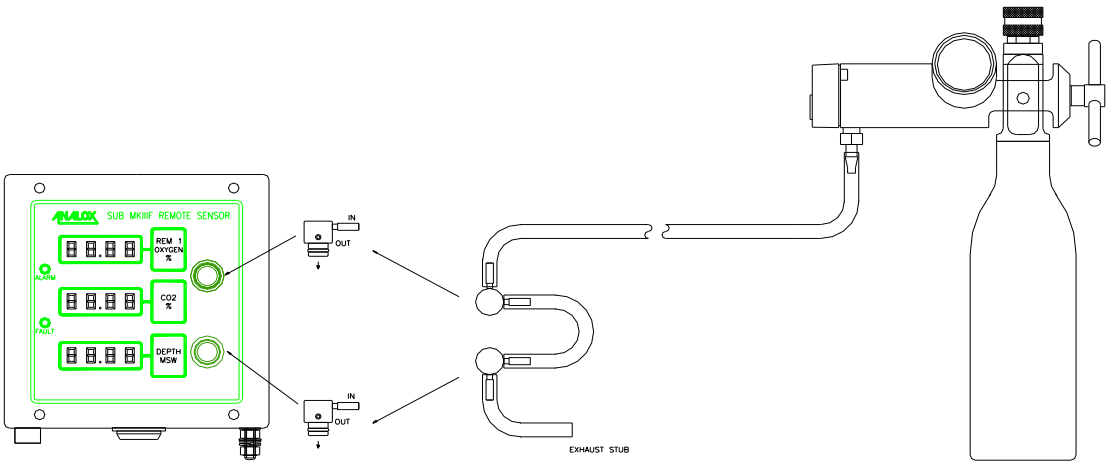
Calibration should only be performed by personnel with the necessary skills. Abuse of the calibration controls may render the instrument inaccurate and unusable.

For calibrating the oxygen and carbon dioxide sensors, the supplied calibration adaptors and tubing should be used as shown in the drawing below. Remove the adaptors from the sensors after calibration. The drawing also shows a calibration gas bottle and flow regulator. These can be purchased from Analox if necessary. Alternatively the user may opt to use their own calibration gas, perhaps with a conventional pressure regulator and an in-line sample flow meter. Take care not to over-pressurise the sensors, or they may be damaged.

The drawing below shows a calibration gas bottle with a flow regulator fitted providing sample gas flow within the recommended range of between 0.3 and 1.0 litres per minute. The flow adaptors simply push in to the oxygen and CO2 sensor inlet ports.

After calibration, the flow adaptors MUST be removed from the sensor inlets.

Note that a REM3 controller with only one gas sensor is supplied with a calibration kit with only one flow adaptor. The two- flow adaptor kit will still work with only one sensor, but always make sure that the flow adaptor first in line from the regulator is pushed into the sensor being calibrated.



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10.1 User Calibration

The system features a semi-automatic calibration feature for zero and span of each of the sensors (oxygen, carbon dioxide, pressure, temperature and humidity).

These adjustments are possible without internal access to the sensor unit, provided that the sensors are near to their ideal outputs.

Correct calibration of the gas sensors is dependent on the correct operation of the depth sensor. Therefore always ensure that the depth sensor is operating satisfactorily before calibrating the gas sensors.

To ensure the most accurate performance, ensure that settling time is allowed for all gas readings. Typically 2-5 minutes is required for adequate settling time.

10.2 Background to Calibration

The calibration operates by assuming that each sensor has a linear output. Two calibration points are defined. Each point relates an 'x' value (the actual output of the sensor) to a 'y' value (the value defined by the user). By having two points (x_1,y_1) and (y_1,y_2), the system then translates any measured value x to the corresponding value y.

y is always measured in the engineering units. These are mBar for O2 and CO2, Bar Absolute for pressure, °C for temperature and %RH for humidity. For gases, y is entered as a percentage (corresponding to the certified content of the calibration gas), and the system converts this to mBar by accounting for the pressure at the time of the calibration.

The value 'y' is further processed into 'customer units' to account for different units of measurement – for instance MSW or FSW for pressure, or volumetric % for gases. The customer units are defined at the time of ordering from the factory.

The further apart the two calibration points, the more accurate the system will be over the full range of measurement. If the points are too close together, then any errors in the original calibration will be further accentuated the further we move away from the calibration points. This leads to the concept of having a low point calibration Cal-L and a high point calibration Cal-H.

When a user performs a Cal-L, the system re-defines the stored values of (x_1,y_1).

When a user performs a Cal-H, the system re-defines the stored values of (x_2,y_2).

The system is also programmed with the ideal or intended characteristic, and hence when a user attempts to re-define a calibration point, the system will first check that the measured value of x corresponds within a reasonable accuracy to what is expected. If it does, then the calibration will proceed correctly. If it disagrees, then a calibration fault is raised – leading to either a Cal-L fault or a Cal-H fault. In the event of such a fault, the system protects itself by not accepting the new settings. It is possible to clear the fault simply by cycling the power to the remote sensor (or to the system). Or alternatively, the system can be correctly calibrated to clear the fault – for instance if an incorrect value is entered for a calibration gas for example.

The CO2 sensor works in a similar manner, except the Cal-L point is always defined at zero. For this reason, the CO2 calibrations are refered to as Cal-Z and Cal-Span.

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10.3 Pressure Sensor Calibration

Typical hyperbaric pressure sensors are ranged nominally over 0.8 to 36BarA. It is intended to be calibrated at two points. Atmospheric Pressure (Cal-L) and a test pressure between 20 and 35 BarA (Cal-H) are ideal for most applications.

The unit requests the two calibration points in the units of measurement used by the instrument. So for an instrument displaying depth in MSW, the calibration points will be entered as MSW.

Note that the system uses the conversion factors

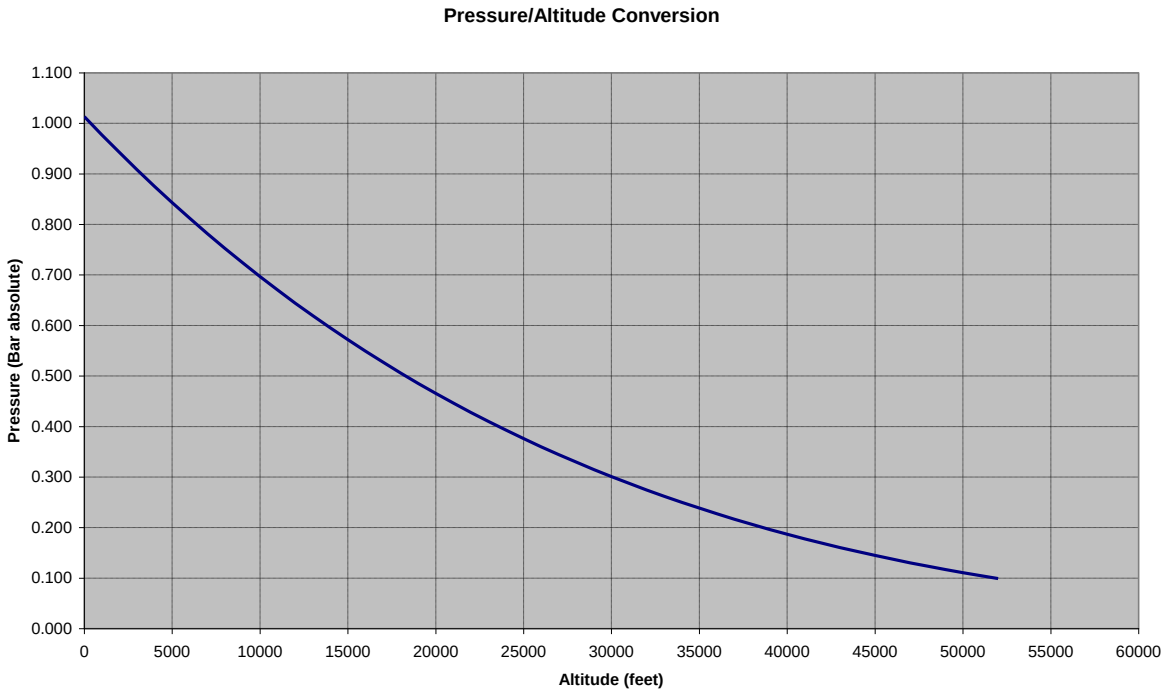
10MSW = 1 Bar

32.8083 FSW = 1Bar

So 1.00 Bar Absolute is displayed as 0 MSW or 0FSW, and 2.00 BarAbsolute is displayed as either 10MSW or 32.8FSW.

If Cal-L is performed at atmospheric pressure of say 1020mBar, then the Cal-L value should be specified as 0.20 MSW. Similarly if the atmospheric pressure were 980 mBar, then the Cal-L value should be defined as -0.2MSW

Typical hypobaric pressure sensors are ranged nominally over 0.1 to 2.0 BarA. Note there is no conversion available within the system to display in feet altitude, therefore Bar Absolute is the usual range with such systems. The chart below may assist with calibration of such systems.



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1	Subject the remote sensor to a known pressure For hyperbaric systems this will typically be atmospheric pressure For hypobaric systems it should be a pressure in the range 0.1 to 0.8 bar absolute
2	Ensure that the reading on the display is steady
3	From Main menu, press CALIB, REM1, MORE DEPTH , CAL-L and adjust the setting to the actual pressure in the units of measurement
4	Press SET to inform the remote sensor of the calibration pressure
5	Now confirm the action by pressing YES
6	Observe after a few seconds that the pressure reading on the display adjusts to the new calibration value.
7	Now subject the remote sensor to a known pressure For hyperbaric systems this will typically be slightly less than the range of the instrument (eg 35 BarA (340 MSW). For hypobaric systems it will typically be atmospheric pressure, or if use up to 2 bar absolute is required, a higher pressure can be used.
8	Ensure that the reading on the display is steady
9	From Main menu, press CALIB, REM1, MORE, DEPTH, CAL-H and adjust the setting to the actual pressure in the units of measurement
10	Press SET to inform the remote sensor of the calibration pressure
11	Now confirm the action by pressing YES
12	Observe after a few seconds that the pressure reading on the display adjusts to the new calibration value
13	Reduce the pressure to a mid scale value and confirm that the reading on the instrument is correct

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10.4 Oxygen Sensor Calibration

Hyperbaric oxygen sensors are usually ranged over 0 to 1500mBar pO2. Typically the sensor should be calibrated using air and pure oxygen, or alternatively nitrogen and pure oxygen.

Hypobaric oxygen sensors are usually ranged over 0 to 600mBar pO2. Typically the sensor should be calibrated using nitrogen and air.

1	Fit the supplied calibration adaptors to the sensor inlets and pass calibration gas of a certified concentration (typically calibrated air 20.9% or pure nitrogen, or pure helium) across the sensors at a flow rate of approximately 20-60 litres per hour (0.3-1.0 litres per minute)
2	Wait for the sensor reading to stabilise
3	From the MAIN menu press CALIB, REM1, O2, CAL-L and adjust the gas concentration to the desired value (eg 0.0 for nitrogen, or 20.9% for air etc)
4	Press SET to inform the remote sensor of the calibration gas value.
5	Now confirm the action by pressing YES
6	Observe after a few seconds that the oxygen reading adjusts to the new calibration value (taking the absolute pressure into account
7	Now pass a higher concentration certified calibration gas (typically 100% O2 for hyperbaric systems or 21% O2 for hypobaric systems) across the sensors at a flow rate of approximately 20-60 litres per hour (0.3-1.0 litres per minute)
8	Wait for the sensor reading to stabilise
9	From the MAIN menu press CALIB, REM1, O2, CAL-H and adjust the gas concentration to the desired value (eg 100.0 % or as appropriate)
10	Press SET to inform the remote sensor of the calibration gas value.
11	Now confirm the action by pressing YES
12	Observe after a few seconds that the oxygen reading adjusts to the new calibration value (taking the absolute pressure into account)
13	Remove the calibration flow adaptors after use and confirm that the sensor readings are sensible for the atmosphere in which they are exposed.

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10.5 Carbon Dioxide Sensor Calibration

The CO2 range will depend on the application. Calibration is best performed at atmospheric pressure using 0% CO2 (eg air or oxygen or nitrogen, or helium) and typically CO2 concentration equivalent to around 50%-90% of the scale eg 1.0- 1.8% CO2 for a 20mBar pCO2 sensor.

In saturation diving applications, it is best to use helium based gases for CO2 calibration.

1	Fit the supplied calibration adaptors to the sensor inlets and pass calibration gas containing no carbon dioxide (typically calibrated air 20.9% or nitrogen or 100% oxygen, or pure helium) across the sensors at a flow rate of approximately 20-60 litres per hour (0.3-1.0 litres per minute)
2	Wait for the sensor reading to stabilise
3	From the Main menu press CALIB, REM1, CO2, ZERO
4	Confirm calibration by pressing YES.
5	Observe after a few seconds that the carbon dioxide reading adjusts to zero.
6	Now pass a certified calibration gas (see note above regarding scale of sensor) across the sensors at a flow rate of approximately 20-60 litres per hour (0.3-1.0 litres per minute)
7	Wait for the sensor reading to stabilise
8	From the MAIN menu press CALIB, REM1, CO2, SPAN and adjust the gas concentration to the desired value (e.g. 1.80%) The actual gas can be in the range 0.10-2.00% (depending on range)
9	Press SET to inform the remote sensor of the calibration gas value.
10	Confirm the action by pressing YES
11	Observe after a few seconds that the carbon dioxide reading adjusts to the new calibration value (taking the pressure into account).
12	Remove the calibration flow adaptors after use and confirm that the sensor readings are sensible for the atmosphere in which they are exposed.

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11 Troubleshooting

SYMPTOM	REASON	SOLUTION
Operator Console does not switch on	No power connected Front panel DC fuse blown	Ensure power is connected correctly Switch it to ON Replace fuse if necessary. If replacement blows, seek assistance
Remote unit does not switch on	Operator Console is switched OFF Fuse on Operator Console blown Wiring incorrect Fuse on remote sensor blown	Switch main unit ON Replace fuse. If replacement blows see note 2 in section 7.2 otherwise seek assistance Check wiring correct Replace fuse. If replacement blows, seek assistance

Refer also to Section 7.4.2 detailing fault indications

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12 Maintenance

It is essential to calibrate the gas sensors regularly to ensure their correct operation. It is recommended that the system is calibrated prior to use.

Pressure, temperature and humidity sensors require less frequent calibration than the gas sensors. Simple comparison checks with the Master Gauges during use will reveal faults with the pressure sensors. In the event of a discrepancy, the sensors should be re-calibrated. It is expected that a pressure calibration may only be required on an annual basis, but it is important to perform the regular checks (e.g. on each use) to identify faults.

12.1 Replacement Parts

Item	Description	Part No	Suggested Frequency of Replacement
1.	Analox MIR CO2 Bench 100mbar	MIRDJNX4S	5 years
2.	Analox MIR CO2 Bench 20mbar	MIRAGNX4S	5 years
3.	Analox MIR SS CO2 Bench 20mbar in Helium	MIRASHX4S	5 years
4.	Analox Hyperbaric/Hypobaric Oxygen Sensor 0 to 600mbar pO2 (hypobaric), 0 to 1500 or 2000mbar pO2 (hyperbaric) ranges	9100-9212-9HSUBA	2 years
5.	Analox Hyperbaric Oxygen Sensor 0 to 3000mbar pO2 ranges	9100-9212-9H3	2 years
6.	Analox REM2 Replacement Temperature/ Humidity Sensor	SA1HAT690	5 years
7.	Immersible breather Vent	SA2 XMRCBL/D6693	5 years
8.	MkIII Operator Console LCD display module*	2553-9200S	5 years
9.	Replacement battery – Operator Console Real Time Clock (2 required per console)	9430-4794	5 years

* The Console must be returned to Analox for replacement

12.2 Accessories

Item	Description	Part No
1.	Calibration Gas	Contact Analox for exact requirements
2.	Flow or pressure regulators and flow meters	Contact Analox for exact requirements
3.	Humidity Calibrator 0% RH and 75%	SA1P16RH
4.	Push in flow adaptor	8000-0069A
5.	Calibration tubing – neoprene (Qty of 1m)	1817-5000

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12.3 Fitting Replacement Oxygen Sensor to Rem1 (Or Rem3)

NOTE: **PRIOR TO INSTALLATION OF THE OXYGEN SENSOR, ALLOW EXPOSURE TO FRESH AIR BY OPENING THE SEALED PACKAGING, SENSOR SHOULD BE EXPOSED FOR A MINIMUM OF 2 HOURS, ANALOX RECOMMEND 24 HOURS EXPOSURE PRIOR TO INSTALLATION.**

The oxygen sensor is a consumable item with an expected life of up to 3 years in an air environment at standard temperature and pressure. Use at pressure or at elevated oxygen levels will shorten the life of the sensor. For instance a sensor exposed to 100% oxygen at atmospheric pressure would be expected to expire within approximately 6 months. Similarly a sensor exposed to air at 10 Bar, would be expected to expire within approximately 3 months. These examples are fairly untypical of expected usage. Normally, hyperbaric customers will opt to change out their sensors at either 1 or 2 year intervals, depending on their usage patterns.

To replace the sensor, first ensure that you have the correct replacement oxygen sensor for your system. Refer Section 12.1

Read the safety instructions regarding oxygen sensors (Section 13.1) and ensure that neither the old nor the new oxygen sensor shows any sign of electrolyte leakage. If the old sensor is leaking, use protective clothing whilst removing and disposing of the sensor. If the new sensor is leaking, return it to Analox.

Replacing the oxygen sensor will require access to the remote sensor enclosure. Ensure the sensor is switched off before removing the cover.

Identify the oxygen sensor already fitted within the enclosure (refer Photos in Section 12.8). Use a small screwdriver to remove the red and black wires that connect the oxygen sensor to terminals marked O2-1 (+VE and –VE). After disconnecting the wiring, unscrew the green locking ring retaining the oxygen sensor in place. Remove the oxygen sensor from the enclosure.

Mount the replacement sensor and secure in place with its locking ring. Note the o-ring fitted to the oxygen sensor provides a seal to prevent water ingress to the enclosure.

Connect the sensors wires to the O2-1 terminals. Wires should be fitted to terminals as shown in the table below.

Wire Colour	Function	Terminal
Red	Positive output from sensor	O2-1 +VE
Black	Negative output from sensor	O2-1 -VE

Ensure the wiring for the sensor is neat and tidy, and does not become trapped when refitting the enclosure cover.

After fitting a new oxygen sensor, always calibrate the new sensor (refer Section 10.4).

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12.4 Fitting Replacement Co_2 Sensor

First ensure that you have the correct replacement CO2 sensor for your system. Refer Section 12.1

Note that the CO2 sensor electronics is static sensitive. Apply standard procedures for the handling of sensitive electronic components to avoid the risk of damage to the CO2 sensor.

Replacing the CO2 sensor will require access to the remote sensor enclosure. Ensure the sensor is switched off before removing the cover.

Identify the CO2 sensor already fitted within the enclosure. Unplug the connector at the CO2 sensor.

Unscrew the green locking ring retaining the CO2 sensor in place. Remove the CO2 sensor from the enclosure.

Mount the replacement sensor and secure in place with its locking ring.

Reconnect the plug to the new CO2 sensor.

Ensure the wiring for the sensor is neat and tidy, and does not become trapped when refitting the enclosure cover.

After fitting a new CO2 sensor, always calibrate the new sensor (refer Section 10.5).

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12.5 Fitting Replacement Rem2 Temperature/Humidity Sensor

Note that the Temperature/Humidity sensor module electronics is static sensitive. Apply standard procedures for the handling of sensitive electronic components to avoid the risk of damage to the sensor.

Replacing the sensor requires access to the REM2 remote sensor enclosure. Ensure the sensor is switched off before removing the cover.

Identify the sensor already fitted within the enclosure (refer Photos in Section 12.8). Unplug the in-line connector to the T/H sensor. Unscrew the locking ring on the inside of the enclosure – this allows the sensor to be pulled out of the enclosure. The in-line connector just fits through the locking ring, such that the old sensor can be completely removed.

Insert the connector of the new sensor through the aperture in the enclosure. Slide the locking ring over the in-line connector, and then screw the locking ring onto the body of the replacement sensor. Reconnect the in-line connector.

Ensure the wiring for the sensor is neat and tidy, and does not become trapped when refitting the enclosure cover.

A new sensor should not require calibration – it is a factory calibrated item. However it is advised to at least check its performance after replacement.

12.6 Fitting Replacement LCD Module

Please return the Operator Console to the factory.

12.7 Fitting Replacement Batteries

The batteries are clearly visible on the rear connection board of the Operator Console. Please observe the correct polarity. There are two batteries and they stack on top of each other with the +ve terminals uppermost

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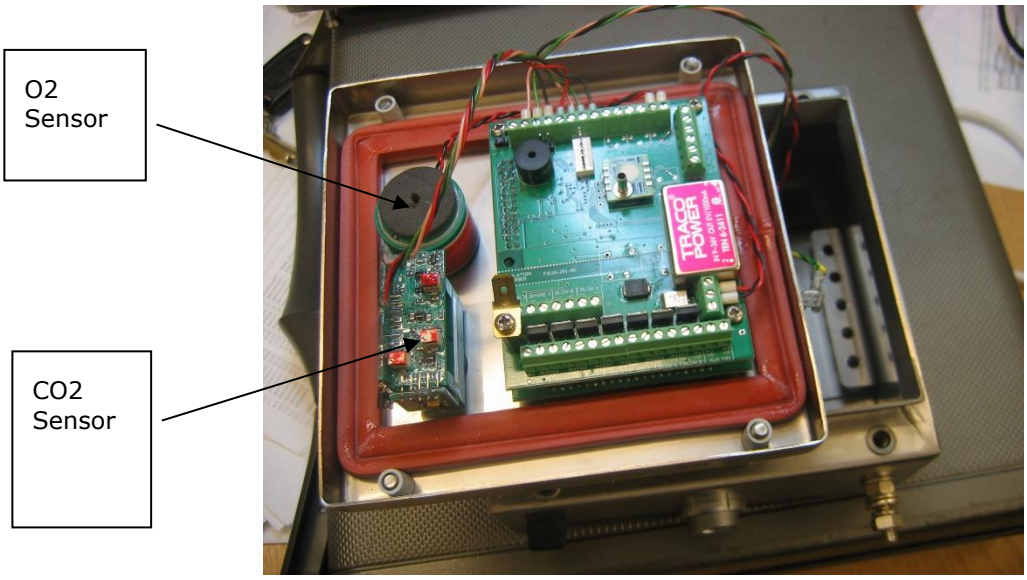
12.8 Internal Sensor Views

12.8.1 REM1



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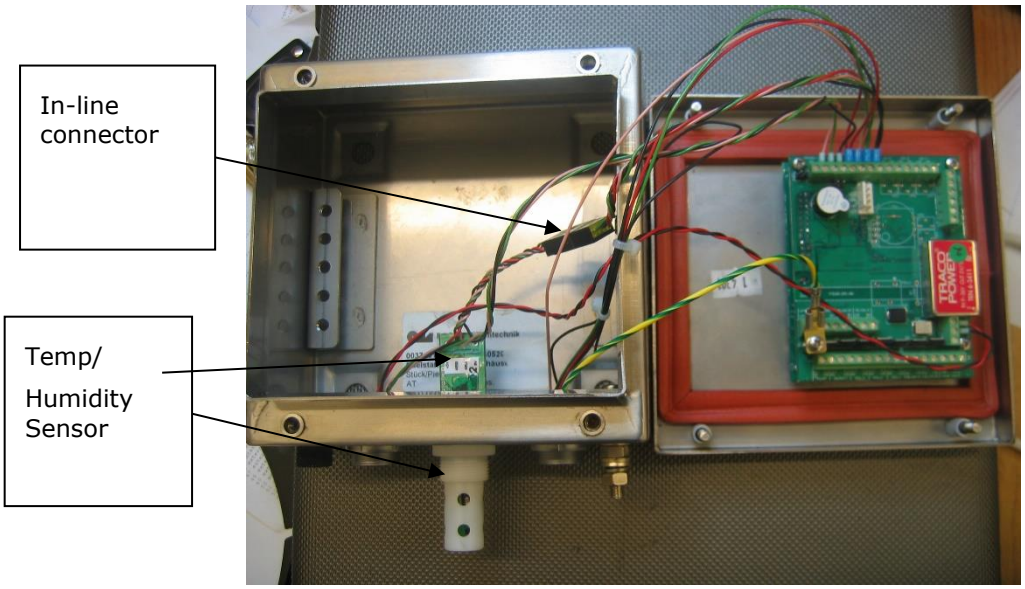
12.8.2 REM2



12.8.3 REM3

The inside of a REM3 essentially looks the same as a REM1. In standard versions there is no CO2 sensor fitted, but otherwise the units look the same.

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13 Safety Warnings

13.1 Oxygen Sensor – Caustic Electrolyte

The oxygen sensor is an electrochemical device and contains a caustic electrolyte. Always check to make sure that it is not leaking and do not allow it onto any part of your body or clothing.

When the life of the sensor has expired or it is leaking or otherwise damaged it must be disposed of safely in accordance with local regulations.

The sensor contains Potassium Hydroxide solution (KOH) which is hazardous.

In the event of an accident, use the following first aid procedures

Body Part	Effect	First Aid Procedures
Skin	Contact could result in a chemical burn. Persons with pre-existing skin disorders may be more susceptible to the effects of the substance.	Immediately flush the skin thoroughly with water for at least 15 minutes. Remove contaminated clothing and wash before re-use. Obtain medical advice if continued irritation.
Ingestion	Corrosive. May cause sore throat, abdominal pain, nausea, and severe burns of the mouth, throat, and stomach, and may be fatal.	If swallowed DO NOT INDUCE VOMITING. Wash out mouth thoroughly with water and give plenty of water to drink. Obtain medical advice immediately
Eye	Persons with pre-existing eye problems may be more susceptible to the effects of the substance. Corrosive. May cause redness, pain, blurred vision, and eye burns. Contact can result in the permanent loss of sight.	Irrigate thoroughly with water for at least 15 minutes. Obtain medical advice immediately.
Inhalation	Persons with pre-existing impaired respiratory function may be more susceptible to the effects of the substance. Inhalation is not an expected hazard unless heated to high temperatures. Mist or vapour inhalation can cause irritation to the nose, throat, and upper respiratory tract.	Remove to fresh air. Rest and keep warm. Obtain medical advice if applicable.

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13.2 Pressurised Gas

1) Do not exceed the specified maximum pressures. Failure to do so may result in damage to the equipment and to personnel.
2) Users of this equipment MUST be familiar with the handling of pressurised gas.
3) Take particular care when handling toxic or flammable gases. In such cases ensure that all exhaust is vented into well ventilated areas.
4) For systems with exhaust outlets, do not block the exhaust outlet.

13.3 Oxygen Systems

This document does not attempt to define a safe method of working with oxygen systems. It is assumed that all personnel working with this type of system are already competent in the use of oxygen, particularly in systems providing oxygen injection. If you have any concerns, please contact Analox for further advice.

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14 Fault Reporting to Analox

Date	

Customer Details

Customer Contact	
Address	
Country	
Telephone	
Fax	
Email	

Equipment Details (where applicable)

Operator Console Serial No	
Remote Sensor Serial No	
Remote Sensor Serial No	
Remote Sensor Serial No	
Others	

System Operating Voltage	

Customer's Description of Fault

To be completed by Analox

Date Manufactured	
Date Last Factory Calibration	
Operator Console SW Version	
Operator Console CPLD Version	
Remote Sensor SW Version	
Design Change Note Ref *(if applicable)*	
Comments	

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15 Specifications

Power Source	External Stabilised 12-30 VDC supply with regulation of better than +/- 300mV. External 110-230V AC supply (Option only)
Operating Current	Operator Console : Average 400mA at 24V DC supply REM1 : Average 130mA at 24V DC supply REM3 : Average 180mA at 24V DC supply (not including current drawn by customer's own injection solenoid on a REM3 – injection valves must consume less than 24W – ie 1A at 24 VDC)
Fuses	Front Panel Fuses F1 T1.0A in supply to Operator Console F2 T315mA in supply to REM1/REM2 F2/3/4 F1.5A in supply to REM3 (permits 1A for injection solenoid)
Display Panel	LCD graphic display, 240 x 128 pixels, with adjustable backlight and contrast controls Displays time in hours:minutes:seconds in 5mm high characters Displays current values of measured parameters using 10mm high large characters
Alarm Indicators	1 Alarm indicator for gas/environment alarms 1 Fault indicator for communications, calibration and general system faults. 1 Audible Buzzer operating on alarm/fault conditions.
Operator controls	1 Power Switch to switch instrument on and off 5 Pushbuttons used via Menu System 1 Pushbutton to mute alarms 1 Pushbutton to control display backlight
Oxygen Sensors	Analox oxygen sensor with up to 3 year life in air at NTP (type depends on range- refer Section 12.1) Ranges 0 to 600 mBar pO2 (hypobaric), 0 to 1500mBar pO2, 0 to 3000mBar pO2 (enquire regarding alternative ranges) Accuracy ±1% reading, ±2mBar pO2, ±0.1% reading /°C Choice of units from mBar, Bar, %, %SEV, kPa, mATA and ATA (define at time of order, please enquire regarding alternative units)
Pressure Sensor	Analox pressure transducer, with bridge output. Ranges 0.1 to 2.0 BarA (hypobaric), 0.80 to 10.00 BarA, 0.80 to 36.00 BarA, 0.80 to 60.00 BarA (hyperbaric) (enquire regarding alternative ranges) Accuracy ±0.3%FS, ±0.02%FS/°C Choice of units from BarA, BarG, MSW, FSW, ATA, kPaA, kPaG (define at time of order, please enquire regarding alternative units)

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CO_2 Sensor	Analox low power, long life infra-red sensor. CO2 reading is pressure compensated by microprocessor Ranges 0 to 20mBar, 0 to 100mBar (enquire regarding alternative ranges) Accuracy at atmospheric pressure and within 0-50%FS : ±2%FS, ±0.1%FS/°C at atm pressure and within 50-100%FS : ±3%FS, ±0.1%FS/°C 0.8< pressure < 6.0 BarA, CO2 < 50% FS : ±3%FS, ±0.1%FS/°C otherwise : ±5%FS, ±0.1%FS/°C Choice of units from mBar, %, %SEV, ppm, ppmSEV and mATA (define at time of order, please enquire regarding alternative units)
Temperature Sensor	Analox OEM HAT sensor Range -10 °C to +60°C Accuracy ±1°C ± 1display digit Choice of units in either °C or °F (define at time of order)
Humidity Sensor	Analox OEM HAT sensor Range 0-100% RH Accuracy ±10%RH
Analogue Outputs	8x 4-20mA output channels – (active outputs – generating current output) Voltage outputs (0-10V) also available by request.
Relay Outputs	8x Relay outputs assignable to any alarm or fault conditions. Changeover contacts on each relay, normally configured in Fail-Safe Mode. Contacts rated at load 1 Amp (24 VDC), Minimum load 1mA at 5V DC
Operating Temperature	-10°C to +40°C
Storage Temperature	-40°C to 66°C (remove oxygen sensor(s) for storage below -15°C)
Dimensions	Operator Console 240mm (w) x 133mm (h) x 80mm (d) Remote Sensor REM1/2/3 150 x 150 x 85mm (whd)
Weight	Operator Console 2.5kg REM1 1.8kg REM2 1.6kg REM3 1.6kg
Materials	Operator Console : SS Remote Sensors : SS

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16 Disposal

According to WEEE regulation this electronic product cannot be placed in household waste bins. Please check local regulations for information on the disposal of electronic products in your area

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