

ANALOX SUB Mk II P-S  
OXYGEN AND CARBON DIOXIDE MONITOR  
WITH AUTOMATIC PRESSURE COMPENSATION

USER INSTRUCTION MANUAL

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## **1        PACKAGING CONTENTS CHECK**

- a)        Analox Sub Mk II P-S main unit.
- b)        External supply cable
- c)        Short length of 6mm OD Gas Sample Line
- d)        User Manual
- e)        Test Certificate

Optional:

- f)        Data Logging Software
- g)        Data output cable for data logging facility when fitted.

## 2 INTRODUCTION

The ANALOX SUB Mk II P is a combined oxygen and carbon dioxide (CO<sub>2</sub>) monitor. Oxygen is monitored by an electrochemical cell and CO<sub>2</sub> is monitored by an infra red absorption technique. Pressure compensation is automatically applied to the CO<sub>2</sub> data.

The unit can be powered internally by alkaline batteries or by an external d.c. supply.

In addition to the power switch, the standard instrument has four pushbuttons which permit calibration, and control of the backlight for the liquid crystal displays (LCD).

The unit is built in a waterproof enclosure which is vented to prevent collapse in hyperbaric environments. The lid of the unit should only be opened in clean, dry environments. This should only be necessary when changing batteries.

An internal sample pump draws sample gas into the instrument through a replaceable waterproof filter unit. The user should ensure that the instrument's gas inlet ports remain as clean as possible to prevent blockage of the filter. An internal flow switch alerts the user to lack of sample flow, and automatically stops the sample pump after a few seconds. The sample pump may be restarted from the front panel control switches. Sample flow exhausts from the instrument through a valve which prevents water entering the outlet. The outlet is also fitted with a special cap which reduces the possibility of accidentally blocking the exhaust.

The instrument is designed to withstand being totally submersed in water (to a depth of 1 foot for 15 minutes). The pump will automatically cut out. To reuse, simply restart the pump (by pressing ENTER push button). If the pump fails to continue running, unscrew the inlet port knurled fitting, and remove water from the filter inlet. The pump should now be able to restart. Refit the knurled fitting.

### 3 OPERATION

The external appearance of the instrument is as shown in Figure 1.

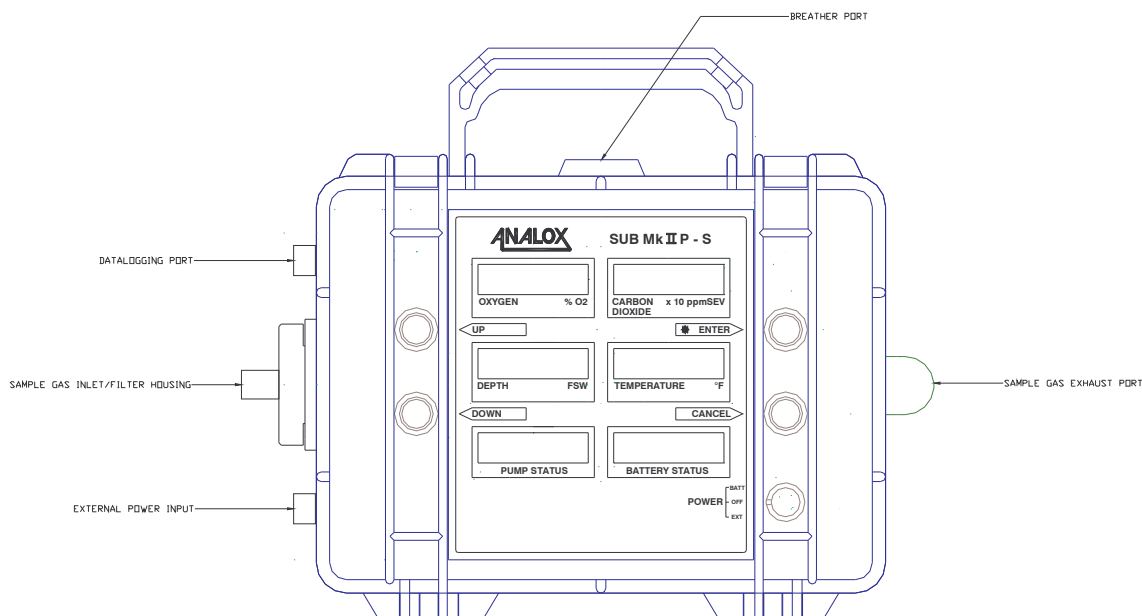


Figure 1: External View of Instrument

To switch the unit on, rotate the power switch to either the 'Battery' or 'External' position. Either an external supply or batteries must be installed in order for the unit to operate.

If the unit does not turn on, perform the following checks:

- a) check that either the external power supply or batteries are healthy
- b) check that the fuses in the external supply line or the battery circuit are not blown. (The fuses are located beside the batteries internally).

On powering up the instrument, the sensor readings may take a short time to settle, particularly the CO<sub>2</sub> sensor, which can take about 40 seconds to 'warm up'. During this period, it is quite normal to observe erroneous sensor readings.

Sensor readings are updated approximately every two seconds.

The choice of measurement units for each parameter are defined at the time of order and are factory set.

Oxygen readings are displayed in either ppATS (partial pressure in atmospheres), mBar.pp (millibar partial pressure) or as a percentage.

CO<sub>2</sub> readings are displayed in %SEV (percent surface equivalent) or ppmSEV (parts per million surface equivalent ).

Depth readings are displayed in either MSW (metres of sea water) or FSW (feet sea water)

Temperature readings are displayed in either °C (Centigrade) or °F (Fahrenheit).

The battery condition indicator provides an estimate of the number of hours battery life remaining. The actual battery life achieved can be heavily influenced by temperature. This is intended as an approximate guide only. When the reading reaches zero, the internal audible sounder will pulse to warn the user that the batteries are low.

The instrument readings will remain accurate until the batteries are exhausted (Battery State =0). The brightness of the backlights will fade as the batteries discharge. When the Battery Status indicator reaches 0 hours, new batteries should be inserted at the earliest opportunity.

The battery condition indicator will show 'E-pr' to indicate that the instrument is operating from the External Power input.

The backlight is turned on by momentarily pressing the ENTER pushbutton on the front of the instrument. The backlight will turn off automatically after a short period. A flashing indicator is built into the backlight switch to show that the instrument is operating. This can also be used to locate the backlight switch in dark conditions.

A small sample pump is fitted inside the instrument to pull samples of gas through the gas inlet port. An internal flow switch indicates to the instrument that a sample is being obtained. The Pump Status indicator will show the following

- a) 'on' indicates the pump is running and there is a sample flow detected
- b) 'noFL' indicates that the pump is running, but that no flow has been detected
- c) 'off' indicates that the pump has been turned off because no sample flow could be detected for a short time period.

To restart the pump, simply press the ENTER switch. The pump will start up, and run for a few seconds. If sample flow is obtained, the pump will continue to run. If no sample flow is detected, the pump will switch off again.

Whenever the pump is in the 'off' state, the internal audible sounder will bleep to warn the user to investigate the problem.

## 4 INSTALLING BATTERIES

### 4.1 Main Batteries

The instrument is fitted with four 'D' size 1.5v alkaline cells. Although the instrument will operate from other types of D size battery, their use is not recommended. The operating life using batteries such as zinc chloride or nickel cadmium will be significantly less than with alkaline. Batteries with cell voltages in excess of 1.5v must not be fitted.

With new batteries fitted, the Battery Status will indicate 50, representing an estimated endurance of 50 hours. The life of the batteries will be influenced by how often the backlight is used. With frequent use of the backlight, the instrument may operate for less time than estimated.

To replace the batteries:

- a) in dry conditions (to prevent damage) open the lid of the instrument using the two catches beside the handle
- b) undo the two velcro retaining straps around the batteries
- c) ease each battery from its clips - use one hand to grip the battery and the other hand to apply a little pressure to release the clips.
- d) Insert the new batteries, taking care to observe the polarity markings on each of the battery holders, and ensuring that the battery is retained by the clips in the holder.
- e) refasten the velcro retaining straps to prevent the batteries becoming dislodged from their holders inadvertently.
- f) close the lid of the instrument, and secure in place with the two catches.

### 4.2 Backup Batteries

The instrument is also fitted with 2 additional LR43 Alkaline Manganese cells to maintain the Real Time Clock within the instrument. The Real Time Clock is used to calculate the elapsed time and for instruments with the datalogging option.

These cells are mounted on the main printed circuit board on the underside of the lid. The batteries should be replaced at 5 year intervals. Observe the polarity markings on the cell holders, positive uppermost.

The instrument will operate without these batteries fitted, although the Datalogging function will cease to operate.

## 5 CONNECTING AN EXTERNAL SUPPLY

The external power lead supplied with the instrument terminates in a female screw-locking connector that attaches to the mating connector on the left-hand side of the unit (this connector is protected by a dust cap that must be unscrewed prior to attaching the external supply lead).

The other end of the cable is presented as stripped ends for the customer to connect a suitable plug of their choice. The colour coding is as follows:

Core Colour	Signal Name	Connect to
Red	Positive (+ve) Supply	+9 to +40 V DC
Blue	Negative (-ve) Supply	0v

The external supply must be a stable DC supply in the range 9-40V. Typical current consumption figures are shown below

Input Voltage (V DC)	Load Current (without backlight) (mA)	Load Current (with backlight) (mA)
9.0	200	420
12.0	160	430
24.0	150	410
40.0	140	400

## 6 CALIBRATION

Calibration should be performed at 6 month intervals.

Calibration should only be performed by suitably trained personnel familiar with handling and use of calibration gas. Any abuse of the calibration features may render the instrument inaccurate and unusable, although there is a facility to restore the instrument to its original factory configuration if this should occur.

The pushbuttons alongside the instrument displays are labelled ENTER, CANCEL, UP and DOWN.

Momentarily pressing the four push buttons at the same time instructs the instrument to display a calibration menu in place of the Pump Status and Battery Status displays.

Initially, the lower displays will show the message CAL O2 L. Pressing UP or DOWN will cycle through all of the available menu options as shown below

Press Up/Down to select appropriate option

CAL	O2 L	Calibrate Oxygen Sensor Low Point
CAL	O2 H	Calibrate Oxygen Sensor High Point
CAL	CO2 0	Calibrate Carbon Dioxide Sensor Zero
CAL	CO2 S	Calibrate Carbon Dioxide Sensor Span
CAL	Pr L	Calibrate Pressure Sensor Low Point
CAL	Pr H	Calibrate Pressure Sensor High Point
CAL	EP L	Calibrate Temperature Sensor Low Point
CAL	EP H	Calibrate Temperature Sensor High Point
CAL	FACT	Select Factory Default Settings

When the desired option has been selected press ENTER. Alternatively press CANCEL to return to normal operation.

Pressing ENTER will cause the instrument to request the user to specify calibration data. Refer to the appropriate section below for further details. The battery condition display will then show the value of the calibration parameter, and the user can adjust the value using the UP and DOWN keys. Pressing CANCEL will abort the calibration, and pressing ENTER will request the calibration to be performed. Before performing the calibration, the instrument will require confirmation. Initially the word 'no' will appear on the Battery Condition display. This must be changed to 'yes' by pressing UP or DOWN, and then confirmed by pressing ENTER. This instructs the calibration to be performed. Pressing ENTER while the display shows 'no', or pressing CANCEL at any time, will prevent the calibration from taking place.

Once entering the calibration menu feature, if no switches are pressed for a period of approximately 2 minutes, the instrument will return automatically to normal operation.

The description above is illustrated in Figure 3.

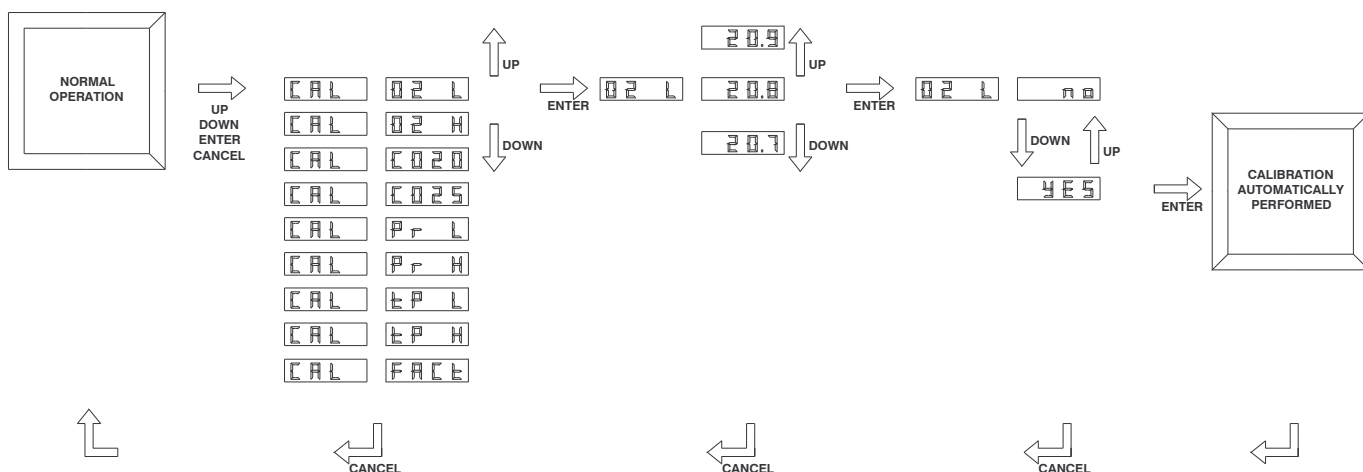


Figure 3 : Operation of Pushbuttons during Calibration

### 6.1 Use Of Calibration Gas

The following sections require the use of calibration gas to calibrate the sensor. The instrument has been designed to allow the use of a wide range of calibration gases from various suppliers.

The instrument is designed to pump a sample from the ambient atmosphere. A breather port ensures that the instrument is at the same pressure as ambient.

Under no circumstances connect pressurised gas to the sensor inlet without an external regulation device.

For calibration purposes, use calibration gas bottles with either a flow regulator, or a pressure regulator and an external in-line flow meter.

Sample flow rates of 0.2-1.0 litres per minute are ideal for calibration.

## 6.2 Oxygen Sensor Calibration

The oxygen sensor provides a varying millivolt output proportional to the partial pressure of oxygen. Two calibration points are provided. The instrument calculates the oxygen concentration by linear interpolation between the calibration points. The calibration parameters are defined as the Percentage of oxygen in the calibration gas. (eg 20.9 or 100.0% for instance). The instrument determines from the present value of depth, what the expected partial pressure of oxygen should be. It is important that the accuracy of the depth measurement is correct before performing oxygen calibration.

Similarly, for instruments displaying oxygen as a percentage value, the pressure sensor reading is used to calculate the percentage value from the measured partial pressure.

Ideally the calibration points should be near to the lower and upper ends of the oxygen range. The actual range of the oxygen sensor is 0- 2000mBar ppO<sub>2</sub>. The Low point calibration is expected to be performed using either nitrogen or calibration air. With nitrogen, the calibration can be performed at any depth, whereas with air, the calibration would be best at around 1 Bar Absolute.

The High point calibration is expected to be performed using 100% Oxygen at between 1 and 2 Bar Absolute. An alternative arrangement would be to use the calibration air used for the Low point, but subjected to a higher pressure ( eg air at between 5 and 10 Bar Absolute).

EXAMPLE 1 : CALIBRATION OF OXYGEN SENSOR AT NORMAL ATMOSPHERIC PRESSURE AND USE OF 2 GASES (Calibration Air =20.9%O <sub>2</sub> and 100% O <sub>2</sub> )	
1	Prior to proceeding, ensure that the depth (pressure) readout of the instrument is within specification)
2	At atmospheric pressure subject the oxygen sensor to calibration air.
3	Wait for the instrument reading to settle (allow approximately one minute)
4	Enter calibration mode by pressing all 4 push buttons momentarily
5	Select Cal O <sub>2</sub> -L by pressing UP/DOWN
6	Press ENTER
7	Press UP/DOWN until the display reads 20.9 (or appropriate value for the calibration air - this is the percentage concentration of oxygen in the calibration gas)
8	Press ENTER
9	Press UP to change 'no' to 'yes'
10	Press ENTER
11	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
12	At atmospheric pressure subject the oxygen sensor to 100% oxygen.
13	Wait for the instrument reading to settle (allow approximately one minute)
14	Enter calibration mode by pressing all 4 push buttons momentarily
15	Select Cal O <sub>2</sub> -H by pressing UP/DOWN
16	Press ENTER
17	Press UP/DOWN until the display reads 100.0 (or as appropriate for the gas used- this is the percentage concentration of oxygen in the calibration gas)
18	Press ENTER
19	Press UP to change 'no' to 'yes'
20	Press ENTER
21	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
22	Re-subject the sensor to each of the test gases in turn to confirm that the sensor is working correctly

EXAMPLE 2 : CALIBRATION OF OXYGEN SENSOR USING CALIBRATION AIR AND VARYING THE DEPTH	
1	Prior to proceeding, ensure that the depth (pressure) readout of the instrument is within specification)
2	At atmospheric pressure subject the oxygen sensor to calibration air.
3	Wait for the instrument reading to settle (allow approximately one minute)
4	Enter calibration mode by pressing all 4 push buttons momentarily
5	Select Cal O2-L by pressing UP/DOWN
6	Press ENTER
7	Press UP/DOWN until the display reads 20.9 (or appropriate value for the calibration air - this is the percentage concentration of oxygen in the calibration gas)
8	Press ENTER
9	Press UP to change 'no' to 'yes'
10	Press ENTER
11	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
12	Now alter the depth experienced by the instrument to between 5 and 9 BarAbs. (ie take the instrument into a pressure environment). Subject the oxygen sensor to calibration air.
13	Wait for the instrument reading to settle (allow approximately one minute)
14	Enter calibration mode by pressing all 4 push buttons momentarily
15	Select Cal O2-H by pressing UP/DOWN
16	Press ENTER
17	Press UP/DOWN until the display reads 20.9 (or as appropriate for the gas used- this is the percentage concentration of oxygen in the calibration gas)
18	Press ENTER
19	Press UP to change 'no' to 'yes'
20	Press ENTER
21	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
22	Monitor the oxygen readout as the pressure is reduced back to atmospheric pressure and confirm that the sensor is working correctly

### 6.3 Carbon Dioxide Sensor Calibration

The carbon dioxide sensor works using an infra red absorption technique. It generates maximum signal when exposed to zero CO<sub>2</sub>, and minimum signal when exposed to span CO<sub>2</sub>. The microprocessor analyses this signal and applies temperature compensation, linearisation and depth compensation as required. Two calibration points are provided. The first point must always be at zero CO<sub>2</sub>. The second point should be at around half of the instruments full scale. (ie for a 25000ppmSEV instrument, use of 1.5% CO<sub>2</sub> at atmospheric pressure is ideal). The calibration parameter is defined as the Percentage of CO<sub>2</sub> in the calibration gas. (eg 1.50% for instance). CO<sub>2</sub> calibration should always be performed at atmospheric pressure.

EXAMPLE 1 : CALIBRATION OF CO <sub>2</sub> SENSOR AT NORMAL ATMOSPHERIC PRESSURE USING ZERO GAS AND SPAN GAS (typically 1.50% CO <sub>2</sub> )	
1	Prior to proceeding, ensure that the depth (pressure) readout of the instrument is within specification)
2	At atmospheric pressure subject the CO <sub>2</sub> sensor to zero CO <sub>2</sub> gas. (100% nitrogen, or 100% oxygen or calibration air with CO <sub>2</sub> removed).
3	Wait for the instrument reading to settle (allow five minutes)
4	Enter calibration mode by pressing all 4 push buttons momentarily
5	Select Cal CO20 (CO <sub>2</sub> Zero) by pressing UP/DOWN
6	Press ENTER
7	Press UP to change 'no' to 'yes'
8	Press ENTER
9	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
10	At atmospheric pressure subject the CO <sub>2</sub> sensor to 1.50% CO <sub>2</sub> in nitrogen.
11	Wait for the instrument reading to settle (allow five minutes)
12	Enter calibration mode by pressing all 4 push buttons momentarily
13	Select Cal CO2S (CO <sub>2</sub> Span) by pressing UP/DOWN
14	Press ENTER
15	Press UP/DOWN until the display reads 1.50 (or as appropriate for the gas used- this is the percentage concentration of in the calibration gas)
16	Press ENTER
17	Press UP to change 'no' to 'yes'
18	Press ENTER
19	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
20	Re-subject the sensor to each of the test gases in turn to confirm that the sensor is working correctly

#### Special CO<sub>2</sub> calibration mode

Note that the Sub MkIIP-S has been specially adapted to allow span calibration at very low CO<sub>2</sub> concentrations. The span gas can be reduced to a minimum value of 0.05%. This is to facilitate testing of very low levels of CO<sub>2</sub>, such as when monitoring breathing gas supplies. It is intended that the instrument can be calibrated, if necessary, from typically 1000ppm CO<sub>2</sub>, so the span gas would be defined as 0.10%.

Note that after using this feature, the sensor should be recalibrated on 1.50% CO<sub>2</sub> prior to monitoring higher gas concentrations.

#### 6.4 Pressure Sensor Calibration

The Pressure sensor provides a varying millivolt output proportional to the absolute pressure experienced by the instrument. The pressure sensor is mounted inside the instrument, but there is a Breather Port that allows the pressure inside the instrument to equalise with the external pressure.

Two calibration points are provided. The instrument calculates the pressure by linear interpolation between the calibration points. It then converts the depth to the units used on the display which are typically Metres of Sea Water (MSW) or Feet Sea Water (FSW). The calibration parameters are defined as the Absolute Pressure in BarA at the time of calibration. (eg 1.00 and 10.00 BarA for instance).

Ideally the calibration points should be near to the lower and upper ends of the pressure range. The actual range of the sensor is 0- 10.00 Bar Abs. The Low point calibration is expected to be performed between 0 and 1.5 BarAbs. The most convenient point will typically be atmospheric pressure.

The High point calibration is expected to be performed in the upper half of the pressure sensor range (ie 5-10 Bar Absolute)

The conversion factors used for converting pressure in Bar Absolute to depth in MSW or FSW are as follows:

Pressure in Bar Absolute is first converted to Bar Gauge by subtracting 1.00 Bar Absolute from the sensor reading.

This results in a Bar Gauge sensor reading in the range -1.00 to +9.00 BarG.

The Bar Gauge reading is then either multiplied by 10.0 to arrive at a reading of -10.0 to +90.0 MSW, or multiplied by 32.8083 to arrive at a reading of -30.0 to 300.0 FSW.

EXAMPLE 1 : CALIBRATION OF DEPTH SENSOR AT NORMAL ATMOSPHERIC PRESSURE AND AT 5.0 Bar Absolute	
1	With the instrument at normal atmospheric pressure, determine from a reference standard the actual atmospheric pressure in Bar Absolute (for example let us assume it is 1.02 Bar Absolute (1020 mBar))
2	Ensure that the instrument reading is steady
3	Enter calibration mode by pressing all 4 push buttons momentarily
4	Select Cal Pr-L (Calibrate Pressure Low) by pressing UP/DOWN
5	Press ENTER
6	Press UP/DOWN until the display reads 1.02 (or appropriate value for actual atmospheric pressure) Note this number is assumed to be Bar Absolute.
7	Press ENTER
8	Press UP to change 'no' to 'yes'
9	Press ENTER
10	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
11	Now subject the instrument to a known pressure of between 5 and 10 Bar Abs in a pressure chamber
12	Ensure that the instrument reading is steady
13	Enter calibration mode by pressing all 4 push buttons momentarily
14	Select Cal Pr-H by pressing UP/DOWN
15	Press ENTER
16	Press UP/DOWN until the display reads 5.00 (or as appropriate for the pressure attained). Note this number is assumed to be Bar Absolute.
17	Press ENTER
18	Press UP to change 'no' to 'yes'
19	Press ENTER
20	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
21	Subject the instrument to varying pressures and confirm the correct depth reading (in either MSW or FSW depending on instrument version)

## 6.5 Temperature Sensor Calibration

The Temperature sensor is a thermistor which changes its resistance with temperature. The sensor is mounted in the gas entry port to the CO<sub>2</sub> sensor.

Two calibration points are provided. The instrument calculates the temperature by linear interpolation between the calibration points. It then converts the depth to the units used on the display which are either Degrees Centigrade or Fahrenheit. The calibration parameters are defined as the temperature in Centigrade or Fahrenheit at the time of calibration. (eg 10.0 and 30.0 °C or 50.0 and 90.0 F for instance).

Ideally the calibration points should be near to the lower and upper ends of the normal operating temperature range. The actual range of the sensor is 0- 60°C or 32-140.0 F . The Low point calibration is expected to be performed between 0 and 70 (Centigrade or Fahrenheit). The High point calibration is expected to be performed between 25 and 140 (Centigrade or Fahrenheit). These ranges allow the user to convert the range from Centigrade to Fahrenheit if necessary. The preferred ranges for each calibration points are given in the examples below.

EXAMPLE 1 : CALIBRATION OF TEMPERATURE SENSOR IN DEGREES CENTIGRADE	
1	Subject the entire instrument to a steady known temperature of between 0 and 20°C. (for example let us assume it is 15°C)
2	Ensure that the instrument reading is steady
3	Enter calibration mode by pressing all 4 push buttons momentarily
4	Select Cal Tp-L (Calibrate Temperature Low) by pressing UP/DOWN
5	Press ENTER
6	Press UP/DOWN until the display reads 15.0 (or as appropriate value for actual temperature)
7	Press ENTER
8	Press UP to change 'no' to 'yes'
9	Press ENTER
10	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
11	Now subject the entire instrument to a steady known temperature of between 25 and 60°C (for example let us assume it is 30°C)
12	Ensure that the instrument reading is steady
13	Enter calibration mode by pressing all 4 push buttons momentarily
14	Select Cal Tp-H by pressing UP/DOWN
15	Press ENTER
16	Press UP/DOWN until the display reads 30.0 (or as appropriate for actual temperature).
17	Press ENTER
18	Press UP to change 'no' to 'yes'
19	Press ENTER
20	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
21	Subject the instrument to varying temperatures and confirm the correct temperature reading

EXAMPLE 2 : CALIBRATION OF TEMPERATURE SENSOR IN DEGREES FAHRENHEIT	
1	Subject the entire instrument to a steady known temperature of between 32 and 70°F. (for example let us assume it is 60°F)
2	Ensure that the instrument reading is steady
3	Enter calibration mode by pressing all 4 push buttons momentarily
4	Select Cal Tp-L (Calibrate Temperature Low) by pressing UP/DOWN
5	Press ENTER
6	Press UP/DOWN until the display reads 60.0 (or as appropriate value for actual temperature)
7	Press ENTER
8	Press UP to change 'no' to 'yes'
9	Press ENTER
10	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
11	Now subject the entire instrument to a steady known temperature of between 75 and 140°F (for example let us assume it is 85°F)
12	Ensure that the instrument reading is steady
13	Enter calibration mode by pressing all 4 push buttons momentarily
14	Select Cal Tp-H by pressing UP/DOWN
15	Press ENTER
16	Press UP/DOWN until the display reads 85.0 (or as appropriate for actual temperature).
17	Press ENTER
18	Press UP to change 'no' to 'yes'
19	Press ENTER
20	Observe after a few seconds that the instrument readout changes to the correct value (it may not have been wrong before)
21	Subject the instrument to varying temperatures and confirm the correct temperature reading

## 6.6 Select Factory Default Settings

It is possible by the incorrect usage of the calibration features to render the instrument virtually unusable. The situation can be recovered by exercising the calibration options correctly.

It may be beneficial to a technician who is experiencing problems to be able to switch to the original factory default configuration. Each of the sensors may then also require calibration, but the readings displayed by the instrument should make sense.

To select Factory Default settings, proceed as follows:

EXAMPLE 1 : RESTORING FACTORY DEFAULT SETTINGS	
1	Enter calibration mode by pressing all 4 push buttons momentarily
2	Select Cal Fact (Cal Factory Defaults) by pressing UP/DOWN
3	Press ENTER
4	Press UP to change 'no' to 'yes'
5	Press ENTER
6	Test the performance of each sensor and recalibrate as required

## 7 DATA LOGGING

The data logging option allows the ANALOX SUB Mk II P to record up to approximately 3500 sensor readings and to output the stored data to a computer for analysis purposes.

An Analox utility installed on the computer allows the instrument to be configured to store any combination of oxygen, carbon dioxide, depth or temperature at selected time intervals varying from 10 seconds to 30 minutes.

The user could for instance opt to record just the carbon dioxide reading at 30 minute intervals. In this case 3500 readings will provide an endurance of approximately 70 days. Alternatively, the user could opt to record all four parameters at 10 second intervals, in which case the endurance would be approximately 2.5 hours.

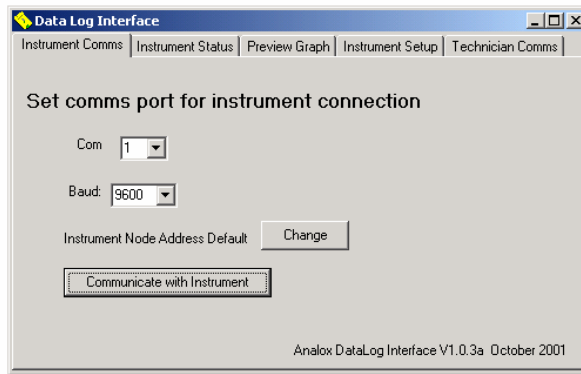
By choosing an appropriate interval, the user can store the maximum amount of information over a chosen time period.

A cable is supplied to connect the Analox Sub to the serial port on a PC. The cable is fitted with a 9 way female D-type connector. An adaptor will also be required if using a PC with a 25 way D-type connector.

### 7.1 Installation of Data Logging Software on a PC

The datalogging software is compatible with IBM Personal Computers and compatibles running Windows 95, 98 or 2000 software.

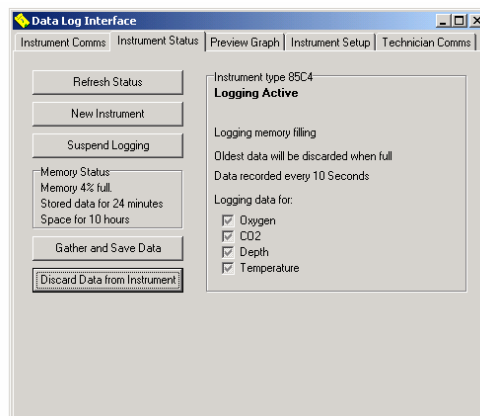
- 1 Insert the floppy disk provided into the floppy disk drive on your computer
- 2 From the Start Menu on your desktop select RUN.
- 3 Type A:INSTALL.BAT or use the Browse feature to locate the file INSTALL.BAT on the Floppy Disk Drive (assumed to be A:). Whilst the file is installing an MSDos type screen will appear, this will disappear when installation is complete.
- 4 Install.Bat simply transfers the file DataLogInterface.exe to the directory C:\Analox
- 5 Now create a shortcut to the programme on your desktop
  - a. On your desktop, click with the right hand mouse button and select New, and then Shortcut
  - b. Navigate using the Browse button to select the file C:\Analox\DataLogInterface. Click OK to select this programme.
  - c. Press NEXT
  - d. Enter a name by which you would like to refer to the Shortcut, or just leave it as the default name
  - e. Click Finish
- 6 From your desktop now double click on the new shortcut Icon that you have just created
- 7 The following screen will appear.



- 8 Now connect the PC to the Analox Sub using the data lead provided and ensure that the Sub is switched on. Note whether it is connected into COM1, COM2, COM3 or COM4 on the PC. (Note if you have one of the older 25 way D-type ports on your PC, you will also need a 25 way to 9 way D-type adaptor).
- 9 Ensure that the correct 'COM' port is selected – press the Selection arrow adjacent to 'Com' and select 1 to 4 as appropriate. This setting will be remembered the next time you start the programme.
- 10 Always ensure that the Baud rate is set to 9600, to which it will default.
- 11 Click on the 'Communicate with Instrument' button. You will see a message 'Please wait' and if successful, the 'Instrument Status' tab will be selected.
- 12 If you get a message 'No Reply from Instrument' check the following:
  - a. The Analox Sub is switched on
  - b. The D-type connector is connected between the Analox Sub and PC
  - c. The correct COM port is selected.
  - d. No other devices are attempting to use the COM port (eg mouse drivers)

Now click 'OK' to the No Reply from instrument message and retry communications.

- 13 When you successfully establish communications, the following screen will appear. You are now ready to use the programme.



## 7.2 Data Logging Programme Overview

The datalogging programme is split into a number of pages or tabs. These are Instrument Comms, Instrument Status, Preview Graph, Instrument Setup and Technician Comms as shown in the diagram below. Additional pages may also be accessed through the Technician Comms page.

Instrument Comms appears during the installation process, the Instrument Status, Preview Graph and Instrument Setup pages are used during datalogging set up, activation and data retrieval. The 'Preview Graph' is a small utility, allowing you an overview of the data that has been logged. It is not intended to replace the need for a spreadsheet. To use the graph select the variable that you wish to view and a graph will be automatically generated. This process will suspend logging; you will therefore need to click on the 'Restart logging' button on the Instrument Status page.

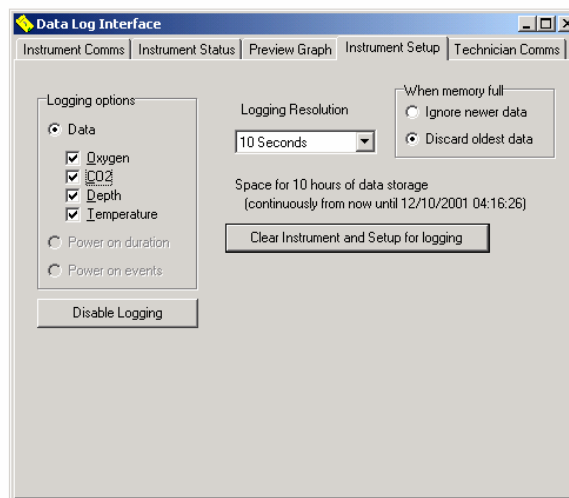
The Technician Comms page should not be used, it is to be used only under guidance from an Analox technician.

The Instrument status page provides a summary of the instruments datalogging status and is shown in the diagram above. This page shows the Memory status of the Analox Sub. The Information Panel to the right of the screen shows us that logging is Active, i.e. the instrument is currently logging. The instrument has been configured to discard the oldest stored data when the memory is full. The instrument is recording all parameters (Oxygen, carbon dioxide, depth and temperature) at 10 second intervals. All of these features are configurable on the Instrument Setup page. The 5 command buttons will be explained in Section 7.4.

## 7.3 Data Logging Configuration

Click on the 'Instrument Setup' tab.

The following screen will appear



**Disable Logging:**

If you do not want datalogging to take place at all, press the 'Disable Logging' button. 'Logging disabled' will be shown on the Instrument Status page.

**Logging Options:**

Select the data items that you wish to record from O<sub>2</sub>, CO<sub>2</sub>, Depth and Temperature, by clicking on the box next to the parameter you require, if the box has been successfully selected a ✓ will appear.

**Logging Resolution:**

Select the Logging Resolution you require by clicking on the ▼ arrow, and then clicking on the time interval you want. This is the time interval between logged readings, which can be set to one of various values between 10 seconds and 30 minutes. Please be aware that the shorter the time interval, the shorter the data storage period. For example logging just CO<sub>2</sub> at 2 minute intervals will give approximately 5 days of continuous data storage, whereas logging O<sub>2</sub>, CO<sub>2</sub>, Depth and Temperature at 10 second intervals will result in approximately 2.5 hours of continuous data storage. The wording 'continuous' refers to the unit logging whilst left permanently switched on. If the instrument is switched off, e.g. overnight, this time period will be extended.

*Note there is a slight overhead every time the instrument is switched on and off, so the number of data points recorded will be slightly reduced each time the instrument is switched off and on. In normal daily use this reduction will not be apparent.*

**Full Memory:**

This option enables you to specify what the instrument should do when its datalogging memory is full.

You may choose to 'Ignore newer data' if for example you are conducting a specific test run, using a short logging resolution, and you only require data from that test. By ignoring new data you will ensure that you retain your test data until you have been able to download it to a PC.

You may choose to 'Discard older data' if you want the instrument to essentially keep on logging for ever, and you only intend to download the data following an incident you want to investigate.

Once you have set each of the 3 options described above (Logging Data, Logging Resolution and Memory Full options), press 'Clear Instrument and Setup for Logging'. This transfers the selected options to the instrument. It also transfers the date and time from your PC to the instrument. Make sure the Date and Time on your PC are correct!

You will be asked to confirm whether logging should 'Start Immediately', or the next time the instrument is switched on ('Start at next Power-Up'). This enables you to optimise the data storage time by leaving the instrument switched off until it is required.

## 7.4 Data Logging Retrieval of Data

1. Start up the Datalogging programme by clicking on the shortcut on your desktop.
2. Click on the 'Communicate with Instrument' button. This will automatically take you to the Instrument Status page.
3. The Memory Status will show the Status of the instrument at the present moment in time. If you wish to refresh this status simply click the 'Refresh Status' button.
4. Press the 'Suspend Logging' button if you wish to stop the Analox Sub storing data temporarily. The Analox Sub will automatically resume the next time it is switched on, or when the Restart Logging 'button' is pressed.
5. Press the 'Gather and Save Data' button to transfer data from the Analox Sub to the PC. Note this will automatically Suspend logging if you have not already done so.
6. Please wait patiently while the instrument transfers data to the PC. An estimate is provided of the time required for the data transfer to complete. If no problems occur in the transfer process, a screen will appear inviting you to save the log file.
7. In the Save as type box, select the type of file that you wish to save. Let us assume that we are trying to create a Microsoft Excel spreadsheet. Therefore select an Excel compatible .csv file. (CSV stands for a Comma Separated Variable file, and is a format that most spreadsheet programmes will recognise).
8. Now select the folder and enter the filename that you wish to use for the file. The programme will remember the filenames that you have used previously. Initially the default will be c:\My Documents\0Analox00. If you choose to retain this format, the programme will automatically suggest the next number 0Analox01, 0Analox02 etc for future files. The 0 at the start is meant to signify which instrument you are transferring data from if using multiple instruments.
9. You will then be asked if you want to delete the data already in the instrument. Answer Yes or No as appropriate. Answering 'Yes' will avoid retrieving the same data again at a future date. You will then be asked when you want logging to commence, click 'Start Immediately' or 'Start at next Power-Up' as appropriate.

*You may choose not to discard the data until you have inspected the data for correctness and click No. This will leave the data shown in the Memory Status. You can then use the 'Discard the Data From the Instrument' button to delete the data at your own discretion. You will need to reactivate the logging by clicking the 'Restart logging' button.*

10. If you are retrieving data from a number of instruments, connect the PC to the next instrument and press the 'New Instrument' button. Retrieve the data as explained in steps 5 to 9.

## 7.5 Data Logging Data Analysis

*Microsoft Excel is not provided with the Analox system. If you do not have a copy of Microsoft Excel, other spreadsheets will also allow access to the data. These instructions are limited however to the use of Excel. You may choose to access the data in a variety of ways, either via Excel or Windows Explorer. These instructions are based on loading the file from Excel.*

1. Start Microsoft Excel from your Start Menu or from your desktop.
2. Select File, Open and then navigate to the folder in which you chose to store the data file (e.g. in c:\My Documents).
3. Select files of Type 'Text Files'. All of the CSV files in the chosen folder will appear. Click on the file that you wish to inspect, and then click on 'Open'
4. The data from the file will then appear in a standard Excel Worksheet.
5. Note that the first column of data is the date and time of the reading. This field is too wide to fit in the standard width of the cell. Click on the 'A' at the top of the column, and then select Format, Column, and Autofit Selection. Or simply drag the column separator between 'A' and 'B' to achieve the right width.
6. Select the right format for the Date and Time. Click on 'A' at the top of Column A, then press Format, Cells. On the 'Number' tab, under category, select 'Date', and then under 'Type' select 03-04-97 13:30 or similar.
7. Now to graph the CO<sub>2</sub> reading, click on the 'A' at the top of Column A, then press and hold the CTRL key on the keyboard, and click on the 'C' at the top of the CO<sub>2</sub> column. Then click on Insert, Chart (or press the small Chart Icon on the toolbar if you have one).
8. Under 'Chart Type' choose XY scatter, and under 'Chart Sub Type' choose the type of lines that you wish on the chart. (Hint – Use Scatter with data points connected by lines).
9. Now press 'Finish' or choose 'Next' if you wish to refine the appearance of the graph.
10. A graph will appear on the screen with the x-axis showing the date and time, and the y-axis showing the CO<sub>2</sub> reading.
11. The basic appearance of the graph can now be edited, but to do so requires familiarity with Microsoft Excel. There are several books available at almost any computer store on this subject.

## 8 MAINTENANCE

Maintenance consists of the following tasks:

FREQUENCY	
Daily	Check that the instrument is maintained in a clean state. In particular ensure that the gas inlet port, gas outlet port and the breather port are unobstructed. When necessary, clean the instrument with a dampened cloth.
	Check the battery condition indicator. Change the batteries when the indicator is near to zero
Six Monthly	Replace the inlet filter
	Check the accuracy of the readings by subjecting the instrument to calibration gas, a known pressure reference, and a known temperature reference. If necessary, recalibrate the instrument as detailed in Section 6
Annually	Where the instrument is used as a standby for use in emergencies, replace the main batteries as detailed in Section 4.1
	Replace the internal filter
Bi-annually	Replace O-rings and gaskets
	Replace oxygen sensor (or more frequently if used in oxygen enriched atmospheres)
Five Yearly	Change the Backup batteries as detailed in Section 4.2
	Replace the sample pump
	Replace CO2 sensor (factory fitted)
	Replace the flow switch
	Replace the outlet valve

### Inlet Filter Replacement

1	Unscrew the knurled inlet fitting
2	Extract the filter unit from the inlet filter housing, taking care not to damage the two gaskets fitted either side of the filter unit
3	Fit one gasket into the housing
4	Push the replacement filter unit into the housing (either way around)
5	Fit the second gasket over the top of the filter unit
6	Refit the knurled inlet fitting

### Internal In-line filter replacement

1	Open the instrument enclosure lid
2	Identify the filter mounted between the pump and the batteries
3	Disconnect the 'Leur' fittings from the filter
4	Insert the replacement filter, and reconnect the Leur fittings

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## Oxygen Sensor Replacement

1	Open the instrument enclosure lid
2	Identify the oxygen sensor which is mounted in the base of the enclosure, physically underneath the external power switch on the front panel.
3	Pull the flow adaptor (and the inlet and outlet sample lines) from the oxygen sensor inlet
4	Ensure the instrument is switched off. Disconnect the ribbon cable from the enclosure base connector.
5	Unscrew the knurled ring retaining the oxygen sensor.
6	Remove the old oxygen sensor
7	Disconnect the oxygen sensor from it's printed circuit board connector
8	Insert the new oxygen sensor, and refit the knurled retaining ring
9	Connect the oxygen sensor to the printed circuit board connector marked 'JP3 – Oxygen Sensor'
10	Connect the ribbon cable connector
11	Refit the flow adaptor
12	Close the lid and switch back on
13	Calibrate the oxygen sensor (refer Section 6.2)

## 9 SPECIFICATION

Power Source	External DC supply. 9-40V DC, with regulation of better than +/- 300mV.	
Batteries	4 x 'D' size alkaline cells for power 2 x LR43 Alkaline Manganese cells for real time clock backup	
Fuses	Individual fuses for the two supply sources, fuses 1A-T.	
Display Panel	6 x 4 character LCD displays, character size 8mm x 5mm Oxygen, carbon dioxide, depth, temperature, pump status and battery condition	
Operator controls	4x Pushbuttons for calibration and display backlight control Backlight times out after 15 seconds when turned on.	
Oxygen Sensors	Analox 9100-9212-9HSUB oxygen sensor with 2-3 year life at 0.21 Bar ppO <sub>2</sub> .	
	Range	0-2000 mBar ppO <sub>2</sub> or 0-2.000 ppATS
	Accuracy	< 1% of reading
Pressure Sensor	Analox solid state bridge sensor	
	Range	0-90 MSW or 0-300 FSW
	Accuracy	< 0.5% of range
CO <sub>2</sub> Sensor	Analox BL5 low power, long life infra red sensor with microprocessor applied pressure compensation	
	Range	0-25000 ppmSEV (displayed as 2500 x10ppmSEV
	Accuracy	5% of range (i.e. +/- 1250ppmSEVCO <sub>2</sub> ) when 0.8 < ambient pressure < 4 Bar Absolute and 0 < ambient ppCO <sub>2</sub> < 20mbar Otherwise: 10% of range (i.e. +/- 2500ppmSEVCO <sub>2</sub> )
Inlet Port	6mm OD push fit connection	
Outlet Port	Analox waterproof valve and anti-blockage device	
Operating Temperature	0°C to 40°C compensated	
Storage Temperature	-5°C to 50°C	
Dimensions	235 x 190 x 110 mm	
Weight	2.2kg (with batteries installed)	