



Sub Mk3P

Technical Manual

Commercial in Confidence

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Revision history

Date	Rev	By	DCN	Comments	CHKD	CHKD Date	Ext. APPD	Ext. APPD Ref	Ext. APPD Date
28/08/2024	09	PJO	2024-0111	Update to weight specification following redesign of battery housing	LG	28/08/2024	-	-	-
08/07/2024	08	MC	2024-0093	Updated the Declaration of Conformity to comply with RoHS Directive 2015-863.	PJO	15/07/2024	-	-	-
20/05/2024	07	PJO	2024-0063	Update spares table with new 7000 spare part numbers	CDo	07/06/2024	-	-	-
22/01/2024	06	MC	2024-0004	Updated UK DoC to read Analox Ltd not Analox Group Ltd	PJO	23/01/2024	-	-	-
14/08/2023	05	MC	2023-0115	Update specifications section to read real time batteries instead of backup batteries. Update address branding	PJO	14/08/2023	-	-	-

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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.

1 Safety warnings

1.1 Electrochemical sensors (Oxygen)

Electrochemical sensors contain toxic compounds. Under normal conditions the sensor will be safely sealed. To prevent leakage, the unit must not be exposed to temperatures outside the specified range, or be exposed to organic vapours, which may cause physical damage to the body of the sensor. The unit must not be stored in areas containing organic solvents or in flammable liquid stores.

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.

Oxygen cell contains caustic electrolyte (potassium hydroxide). In the event of an accident, use the following first aid procedures.

Table 1 *Electrochemical sensor first aid procedure*

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.

Should leakage of any electrolyte occur as a result of misuse, incorrect operation, manufacturing error, physical damage, etc. then wear protective gloves when cleaning any spills. Should electrolyte contact skin then the affected area should be washed thoroughly with copious water and medical advice sought if there has been any contact with the eyes or mouth. If connected to any electrical equipment, the sensor should be immediately removed.

2 Modification state control

Each instrument is fitted with a serial number label (internal), as shown below:

ANALOX		MODIFICATION MARKER LABEL		P0202-9017-00	
THIS LABEL MUST NOT BE REMOVED					
www.analoxgroup.com					
PART NO: ????????????????			NATO STOCK NO: ????????????????		
DATE MANUFACTURED: 07 September 2021			SERIAL NO: SUB3P????		
MODIFICATION RECORD					
1	2	3	4	5	6
7	8	9	10		

Figure 1 Modification State Label

The first units delivered will initially have no modification numbers crossed out, this is interpreted as "Modification State 0".

As design changes are made that affect the fit, form or function of the instrument, the *Modification Record* boxes will be used to track changes made to individual units. For example, as an instrument receives the first authorised modification it will have the '1' box crossed out, signifying that it is now at modification state 1.

Design changes that do not affect fit, form or function will be made using the Analox DCN process but the Mod State will not be changed.

Table 2 Modification State

Modification state	Date authorised/DCN No	Details
0	N/A	First article delivery

3 Packaging contents check

- Sub Mk3P main unit
- Calibration adapters and tubing
- Technical manual
- Test certificates
- Analox hyperbaric tested batteries (x4)

3.1 Accessories

See section 12 for part numbers of the below accessories.

- 24V DC power cable
- Comms cable

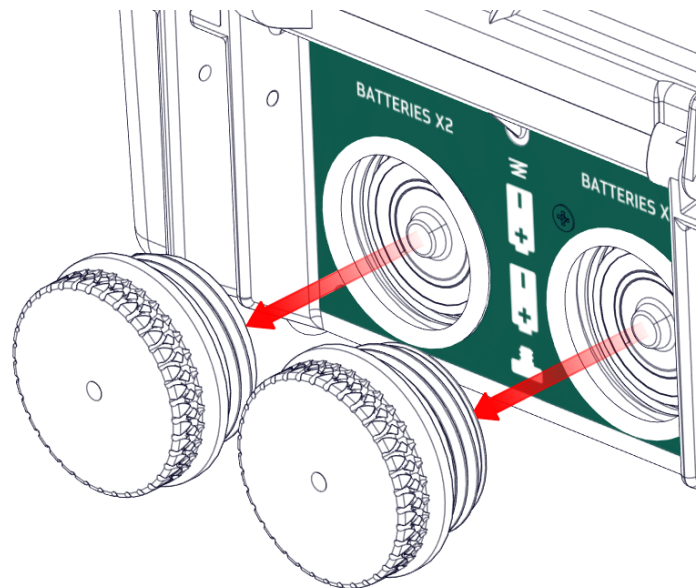
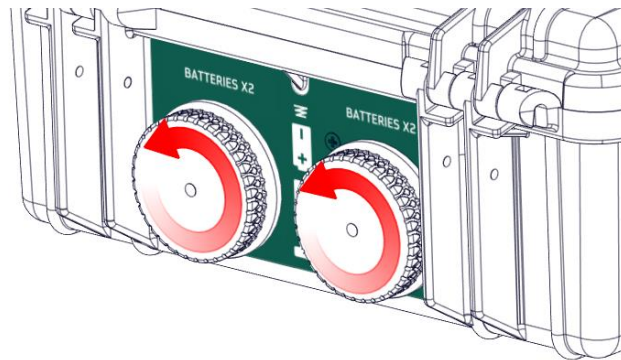
4 Prerequisites

4.1 Installing main batteries

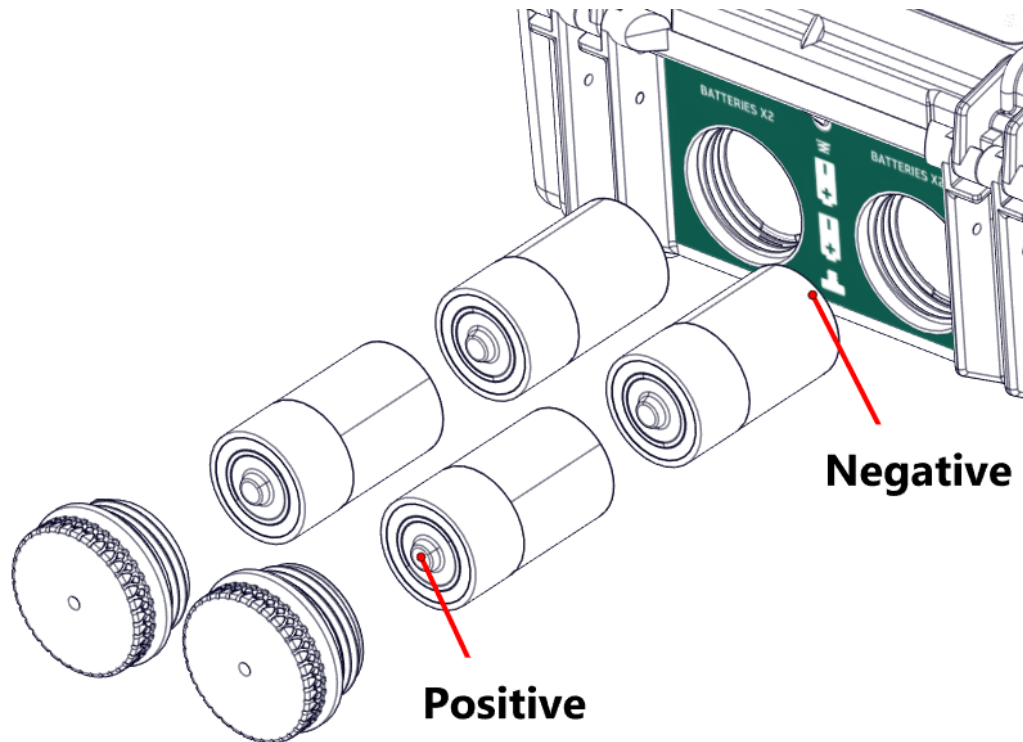


CAUTION: ALL D-TYPE BATTERIES SUPPLIED BY ANALOX FOR USE IN THE SUB Mk3P ARE HYPERBARICALLY TESTED. ONLY USE HYPERBARICALLY TESTED BATTERIES SUPPLIED BY ANALOX.

- 1] Unscrew and remove the battery cap



- 2] Insert the new batteries, taking care to observe the polarity markings on each battery then screw the battery cap in place.



CAUTION: FITTING THE BATTERIES INCORRECTLY COULD CAUSE THEM TO LEAK.

5 Introduction

The Sub Mk3P is a combined, oxygen (O₂), carbon dioxide (CO₂), temperature & humidity and pressure monitor. O₂ is monitored by an electrochemical cell and CO₂ is monitored by an infra-red absorption technique. Pressure and temperature compensation are applied to the CO₂ reading.

The unit can be powered internally by pressure tested alkaline batteries or by an external DC supply.

The unit is built in a water resistant 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 for maintenance purposes (e.g., replacing a sensor module). The battery life is long enough that during typical usage in a distressed or disabled submarine (DISSUB) incident, there should be no need to change the batteries.

Gas levels are monitored by diffusion across hydrophobic membranes built into the unit. The user should ensure the instrument's gas inlet ports remain as clean as possible to prevent the protective membranes from becoming blocked.

6 Overview

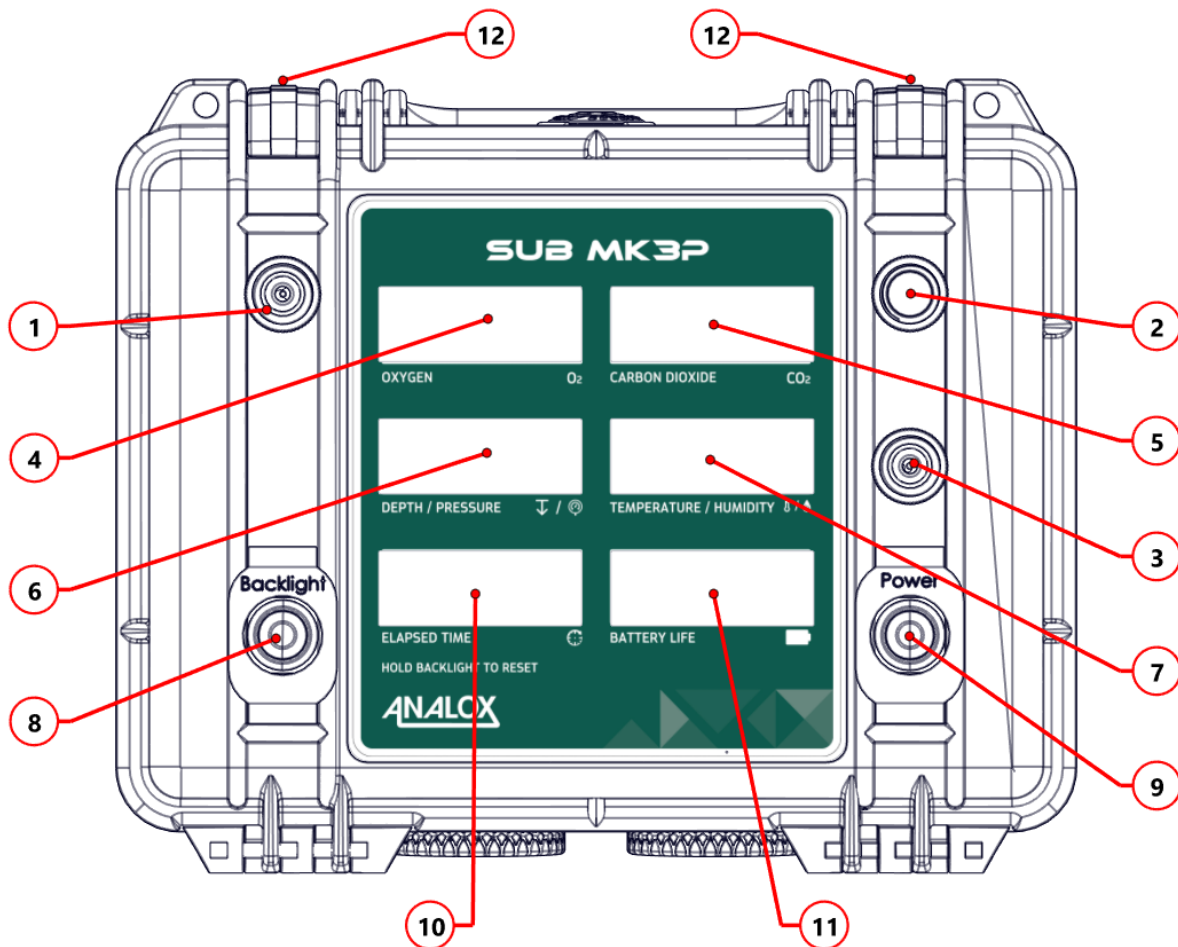


Figure 2 Sub Mk3P overview

Item #	Description
1	O ₂ sensor
2	CO ₂ sensor
3	Temperature & Humidity sensor
4	O ₂ display panel
5	CO ₂ display panel
6	Depth / Pressure display panel
7	Temperature & Humidity display panel
8	Backlight button
9	Power button
10	Elapsed Time display panel
11	Battery Life display panel
12	Lid securing latches

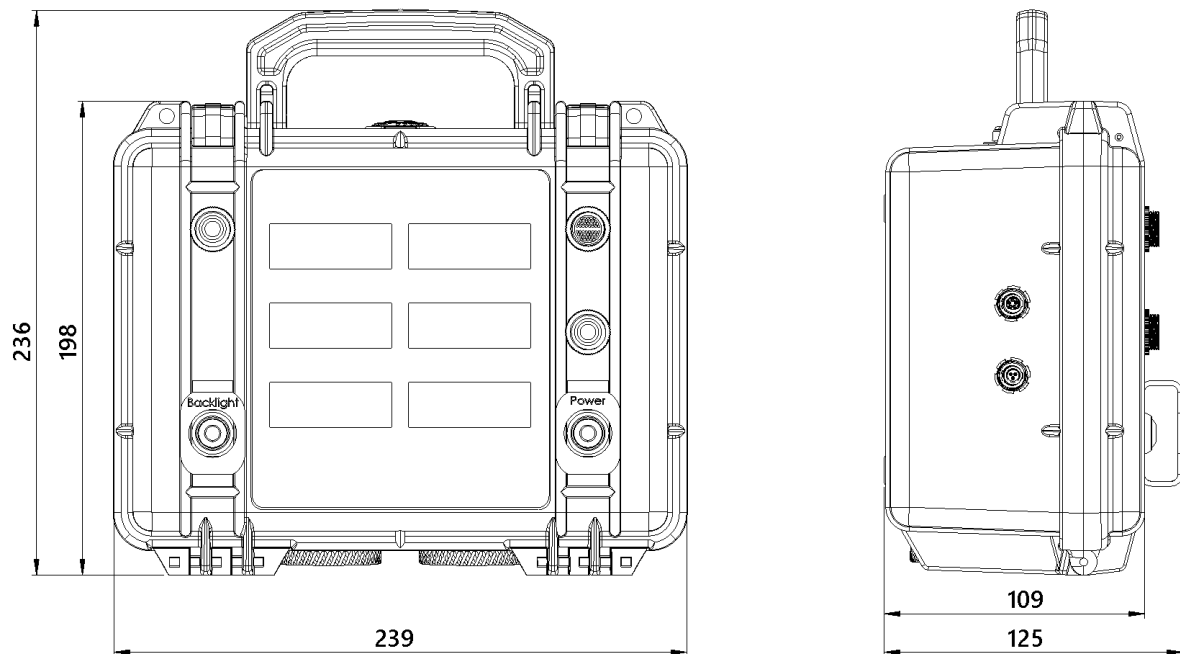


Figure 3 Sub Mk3P dimensions

7 Operation

7.1 Units of measurement

The following units of measurement are used in the displays.

Unit of measurement	Description
°C	Degree centigrade
°F	Degree fahrenheit
%SEV	Percent surface equivalent value
%VOL	Percent volume
%RH	Percent relative humidity
MSW	Metre's sea water
FSW	Feet sea water
ATA	Atmospheres absolute
ATS	Atmospheres partial pressure
mbar	Millibar
bara	Bar absolute
DD:HH	Days:hours



NOTE: %SEV USES 1000MBAR FOR THE CONVERSION TO A SURFACE EQUIVALENT PRESSURE. ATA AND ATS USE A CONVERSION OF 1013.25MBAR.

7.2 Turning the unit on and off

- 1] To turn the unit on, momentarily press the Power button
- 2] To turn the unit off, press and hold down the Power button.



- 3] The unit will display OFF in the Elapsed Time window and will count down from 05 to 0 seconds in the Battery Life window.
- 4] When the backlight turns off, release the Power button. The unit will now be switched off.



NOTE: INCASE OF AN ACCIDENTAL POWER ON, THE DEVICE WILL POWER OFF AFTER 15 MINUTES IF THERE HAS BEEN NO USER INTERACTION. A SINGLE PRESS OF THE BACKLIGHT BUTTON WILL KEEP THE DEVICE ON (UNTIL THE BATTERIES DEplete OR THE DEVICE IS POWERED OFF).

8 Connecting an external supply

A 9-36V DC external power cable can be supplied as an accessory (see Section 12 Spares and Accessories). A protective dust cap must be pulled out prior to attaching the external supply lead.

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

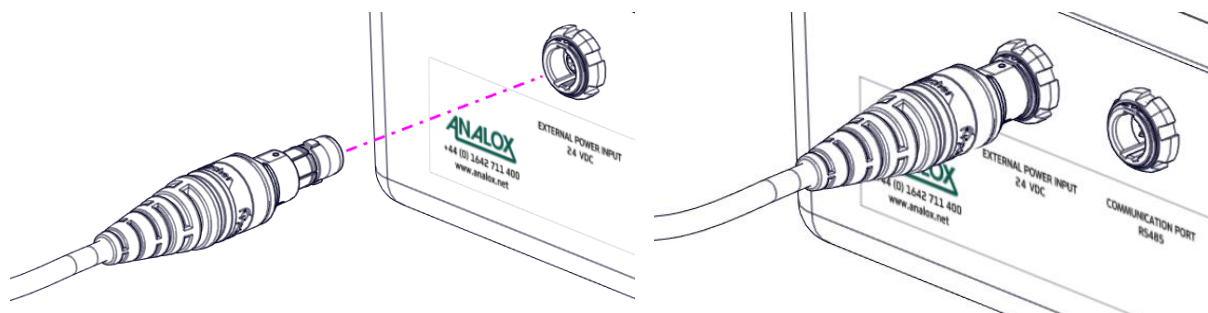
Table 3 Core colour coding

Core Colour	Description	Connect to
Red	Positive (+ve) Supply	Nominal 24V DC +9 to +36 V DC
Blue	Negative (-ve) Supply	0V

Table 4 Typical current consumption figures

Input Voltage (V DC)	Load Current without backlight (mA)	Load Current with backlight (mA)
9.0	30	150
12.0	23	105
24.0	15	50
30.0	14	42

When the unit is connected to an external power supply the battery life display will show:



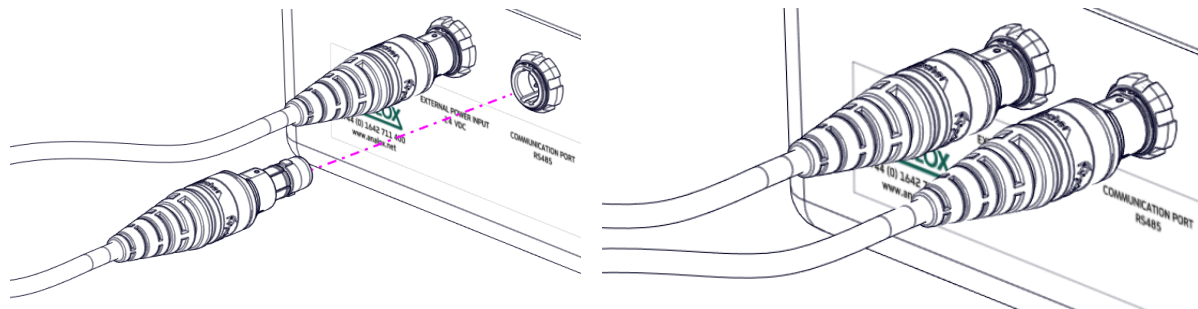
9 MODBUS RTU connection

The comms cable can be supplied as an optional accessory (see Section 12 Spares and Accessories).

Core Colour	Description	Connect to
Red	RS485 A	RS485 A
Blue	RS485 B	RS485 B
White	RS485 Reference	0V

The table below lists the port settings and communications protocol required to interface to the unit.

Parameter	Setting
Baud rate	9600
Data length	8 bits
Parity	None
Stop bits	One
Protocol	Modbus RTU
Transfer	Half-duplex
Hardware	RS485



The table below lists the variables that can be obtained via a MODBUS interface. The Sub Mk3P will be a slave only device with a fixed address of 1.

Function	Register	Length	Type
O ₂ reading	30001	2	float
All sensors	30001	18	float and integer
O ₂ display unit	30003	1	integer
O ₂ decimal places	30004	1	integer
CO ₂ reading	30005	2	float
CO ₂ display unit	30007	1	integer
CO ₂ decimal places	30008	1	integer
Pressure reading	30009	2	float
Pressure display unit	30011	1	integer
Pressure decimal places	30012	1	integer
Temperature reading	30013	2	float
Temperature unit	30015	1	integer
Temperature decimal places	30016	1	integer
Humidity reading	30017	2	float
Humidity decimal places	30019	1	integer
Elapsed time	30020	1	integer
Elapsed time state	30021	1	integer
Battery life	30022	1	integer
Active faults	30023	2	integer
Voltage (V)	30060	2	float
Current (mA)	30062	2	float

10 Datalogging



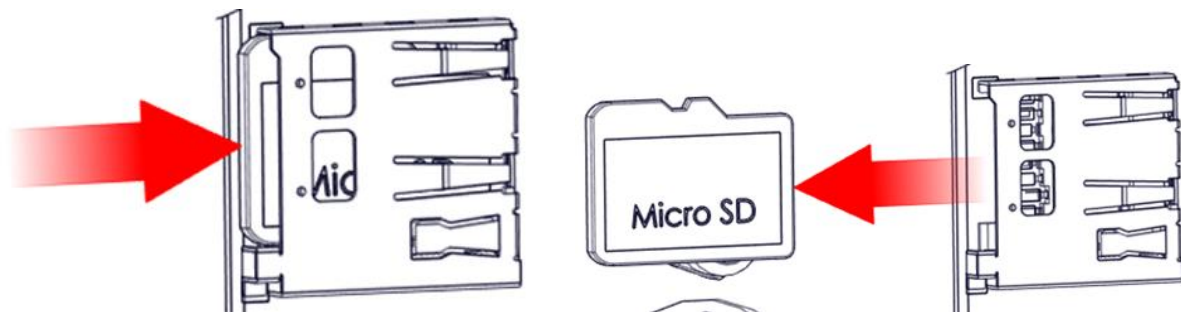
CAUTION: THE SD CARD IS PRECONFIGURED BY ANALOX. ONLY REPLACE WITH AN ANALOX SD CARD.



NOTE: DATALOGGING ONLY OCCURS DURING A DISSUB EVENT. EVENTS ARE WRITTEN TO THE EVENT LOG AS THEY OCCUR.

The Sub Mk3P is supplied with a pre-fitted and formatted Micro SD card for datalogging.

To view the datalogs, power down the unit, remove the micro SD card from the SD card socket, and then insert it into a suitable computer device (e.g., PC or tablet) then download the data.



Files will be held in folders named DS20YYMMDD, where YY is the year, MM is the month and DD is the day.

A new folder is created per DISSUB event.

Name	Date modified	Type	Size
DS20210313	17/03/2021 11:15	File folder	
DS20210315	17/03/2021 11:15	File folder	
DS20210316	17/03/2021 11:15	File folder	
DS20210317	17/03/2021 11:15	File folder	

Each DISSUB folder holds all sample files created within that DISSUB event.

A new samples file is created per day and is named HL20YYMMDD.csv, where YY is the year, MM is the month and DD is the day.

Name	Date modified	Type	Size
 HL20210313.csv	13/03/2021 23:58	Microsoft Excel C...	60 KB
 HL20210314.csv	14/03/2021 23:58	Microsoft Excel C...	92 KB
 HL20210315.csv	15/03/2021 08:18	Microsoft Excel C...	32 KB

The SD card is formatted as a FAT16 which means it can be read by most operating systems.

Logs are in csv format, so can be opened using suitable spreadsheet software, for instance Microsoft Excel.



NOTE:

AFTER A DISSUB EVENT IT IS ONLY NECESSARY TO RETRIEVE THE SD CARD. IT IS NOT NECESSARY TO RETAIN THE UNIT.

10.1 Datalog output file

An example of the datalog output is shown below.

27/02/2020	06:36:26	209.75	0.6	987.31	22.44	31.55
27/02/2020	06:37:26	209.56	0.76	987.44	22.46	31.4
27/02/2020	06:38:26	209.28	0.58	987.66	22.48	31.28
27/02/2020	06:39:26	209	0.64	987.48	22.49	31.28
27/02/2020	06:40:25	208.79	0.62	987.83	22.49	31.24
27/02/2020	06:41:25	208.57	0.52	986.92	22.49	31.2
27/02/2020	06:42:25	208.39	0.67	987.18	22.49	31.12
27/02/2020	06:43:25	208.3	0.6	987.51	22.49	31.2
27/02/2020	06:44:20	208.14	0.54	987.23	22.49	31.2
27/02/2020	06:45:20	208.06	0.52	987.89	22.49	31.12
27/02/2020	06:46:20	207.98	0.57	987.56	22.49	31.16
27/02/2020	06:47:20	207.96	0.6	987.67	22.49	31.16
27/02/2020	06:48:20	207.91	0.6	987.21	22.49	31.16
27/02/2020	06:49:20	207.85	0.66	987.04	22.49	31.16
27/02/2020	06:50:20	207.96	0.55	987.96	22.49	31.12

10.2 Event log output files

An example of the event log output is shown below.

Date	Time	Event code	Optional parameter
28/02/2020	14:44:59	22	00000000
28/02/2020	14:44:59	18	01000000
28/02/2020	14:44:59	18	00080000
28/02/2020	14:44:59	19	00080000
28/02/2020	14:44:59	19	01000000
28/02/2020	14:44:59	18	00080000
28/02/2020	14:44:59	19	00080000

10.2.1 Event log codes

..	Meaning	Parameter?
1	The unit was powered up	N/A
2	The unit was powered down	N/A
3	The RAM test failed	N/A
4	Internal watchdog reset	N/A
5	Calibration start	N/A
6	O2 calibration started	N/A
7	CO2 calibration started	N/A
8	Calibration successful	N/A
9	Calibration failed	Returned sensor reason
10	O2 sensor replaced	N/A
11	CO2 sensor replaced	N/A
12	T&H sensor replaced	N/A
13	O2 sensor comms fault	N/A
14	CO2 sensor comms fault	N/A
15	Elapsed time started	N/A

“	Meaning	Parameter?
16	Read configuration file	N/A
17	Menus entered	N/A
18	Fault set	32-bit fault ID
19	Fault cleared	32-bit fault ID
20	All tasks timed out	Task bit mask
21	Factory reset	N/A
22	Backlight on	N/A

10.2.2 Event log parameters

“	Meaning	Comment
80000000	FIRMWARE_CRC_BIT	Does not clear
40000000	CONFIGURATION_BIT	Does not clear
20000000	RAM_CHECK_BIT	Does not clear
10000000	O2_SENSOR_COMMS_BIT	Self clearing
08000000	CO2_SENSOR_COMMS_BIT	Self clearing
04000000	TEMP_HUMIDITY_SENSOR_COMMS_BIT	Self clearing
02000000	O2_SENSOR_INTERNAL_BIT	Self clearing
01000000	CO2_SENSOR_INTERNAL_BIT	Self clearing
00800000	TEMP_HUMIDITY_SENSOR_BIT	Self clearing
00400000	PRESSURE_SENSOR_BIT	Self clearing
00200000	BATTERY_ADC_BIT	Self clearing
00100000	NO_SD_CARD_BIT	Self clearing
00008000	BATTERY_LIFE_LOW_BIT	Self clearing
00004000	SD_CARD_WRITE_BIT	Self clearing
00002000	SD_CARD_OPEN_BIT	Self clearing
00001000 to 00000001	Not used	

11 Maintenance

11.1 Technician menus

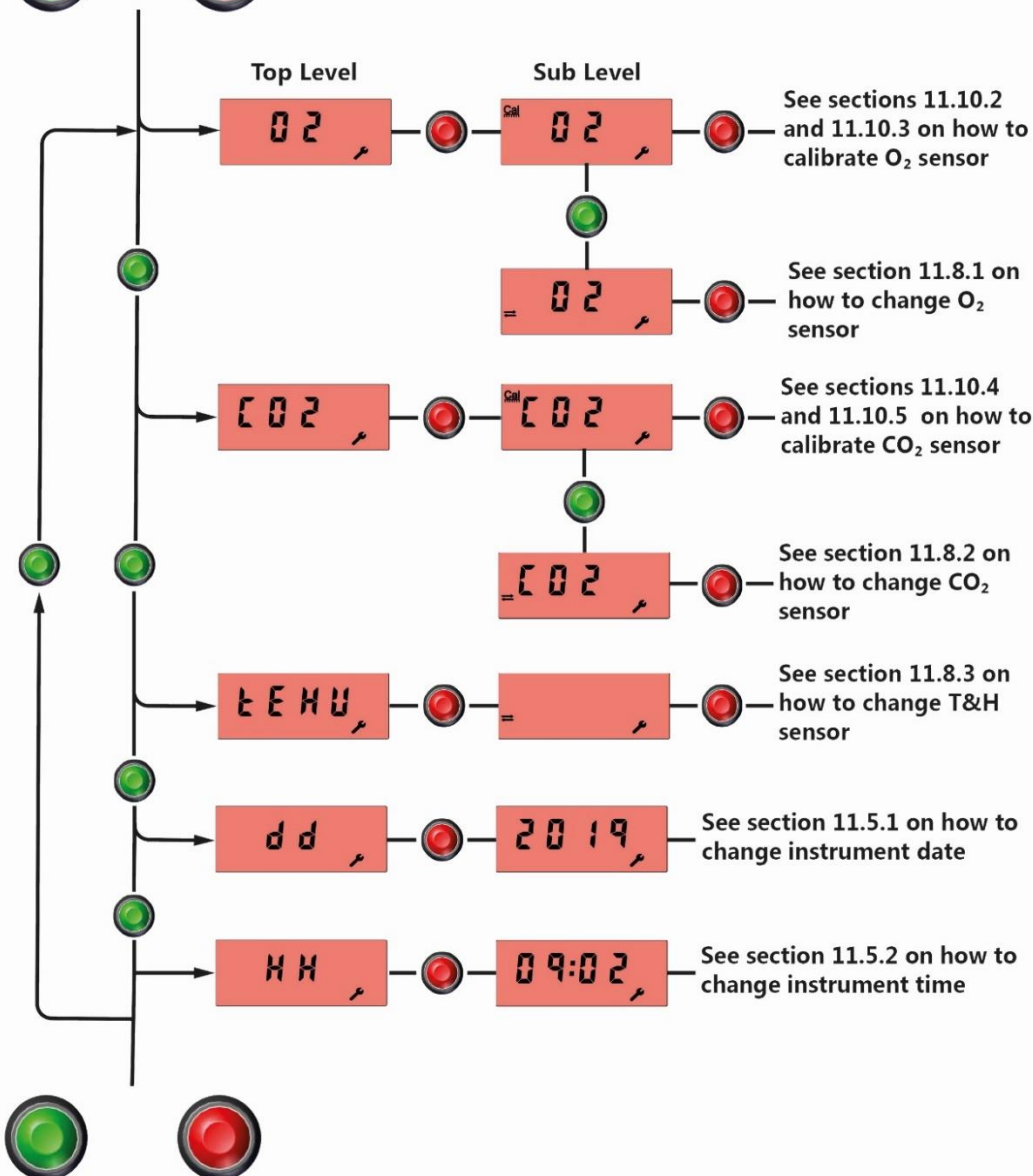
Press both the backlight and power buttons for 5 seconds to enter technician mode



Key:

 Cycle menu option

 Accept menu option



NOTE:

PRESS BOTH THE BACKLIGHT AND POWER BUTTONS AT ANY TIME FOR 5 SECONDS TO RETURN TO THE TOP LEVEL MENU. WHEN IN THE TOP LEVEL MENU PRESSING BOTH BUTTONS FOR 5 SECONDS WILL EXIT THE MENUS (OR WAIT FOR THE INSTRUMENT TO EXIT AUTOMATICALLY AFTER 60 SECONDS).

11.2 General care

The Sub Mk3P is designed to be water resistant to a depth of 1 metre. However, it should be noted that the instrument is not designed to operate when submerged and should not be intentionally immersed in liquid or left outside unprotected.

In the event of submersion in water the unit should be dried with a soft cloth. Care should be taken to ensure that all water is removed from the three gas ports on the front face of the unit.

11.3 Maintenance schedule

Regular maintenance consists of the following tasks:

11.3.1 Periodic maintenance

Table 5 *Periodic maintenance schedule*

Frequency	Task
Monthly	Check that the instrument is maintained in a clean state. In particular ensure that the gas inlet ports and breather port are unobstructed. When necessary, clean the instrument with a damp cloth.
	Power on the unit and check the battery life display. Ensure there are enough hours remaining for a DISSUB event. Replace the batteries if necessary.
	Check any Sub Mk3P readings in a verified atmosphere
Six Monthly	Recalibrate the O ₂ and CO ₂ sensor (see section 11.11).
Annually	Replace the O ₂ and Pressure Sensor module (See section 11.9).
	Replace the batteries (see section 4.1)
Five Yearly	Replace the O ₂ and Pressure Sensor module (See section 11.9).
	Replace the batteries (see section 4.1)
	Change the RTC batteries (See section 11.6)
	Replace the T&H sensor module (See section 11.10.3)
	Replace the CO ₂ sensor module (See section 11.10.2)



NOTE:

ANALOX RECOMMEND THE CALIBRATION SCHEDULE IS ADHERED TO, HOWEVER SOME CUSTOMERS WILL ONLY PERFORM CALIBRATION ONCE EVERY 12 MONTHS. BASED ON THE SENSOR DRIFT DATA AVAILABLE; THE EFFECT OF THIS IS THAT THE CO₂ SENSOR HAS AN 89% CHANCE OF REMAINING WITHIN SPECIFICATION (SEE SECTION 13). THE O₂ SENSOR HAS MORE VARIATION IN DRIFT OVER TIME. AFTER 12 MONTHS THE O₂ SENSOR HAS A LESS THAN 50% CHANCE OF REMAINING WITHIN SPECIFICATION (SEE SECTION 13).

11.3.2 Non-periodic maintenance

Table 6 *Non-periodic maintenance schedule*

Frequency	Task
As required	Check condition of sensor O-ring seals
	Check condition of front panel label and battery housing label
	Check the gaskets on the battery caps

11.4 Battery life

Assuming the equipment is powered for 1 hour every month for testing purposes, in the event of a DISSUB incident, a new set of alkaline batteries will power the instrument for a minimum of ten days. A DISSUB incident is believed to be no longer than seven days, therefore under these conditions there will be no need to replace the batteries during the incident. It is assumed that the backlight would only be used on an occasional basis (i.e., every 15 minutes) during this period.



NOTE:

EXCESSIVE USE OF THE BACKLIGHT WILL REDUCE THE BATTERY LIFE.

11.5 RTC batteries

The instrument is also fitted with 2 LR43 Alkaline Manganese cells to maintain the Real Time Clock (RTC) within the instrument. The Real Time Clock is used for data-logging.

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.

If the RTC batteries are replaced, the date and time will need to be reset (see section 11.7 for the procedure).

See section 11.6 for the fitting and replacement procedure.

11.6 Replacing the RTC batteries



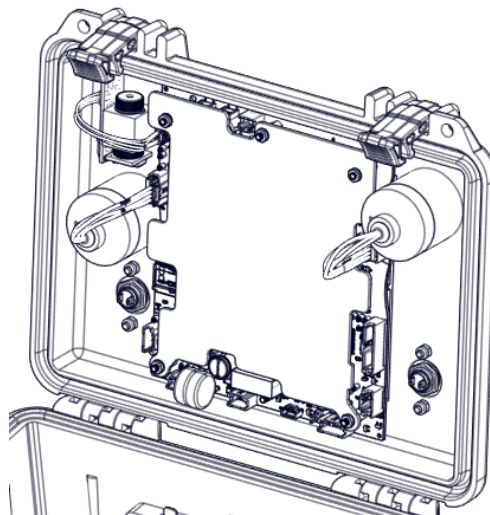
CAUTION: PRIOR TO REPLACING THE RTC BATTERIES THE UNIT SHOULD BE POWERED DOWN, SEE SECTION 7.2



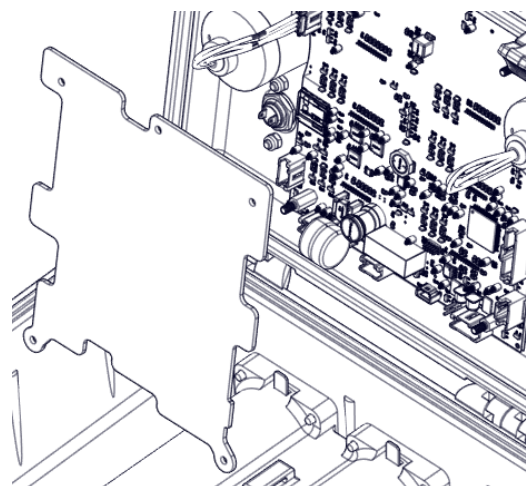
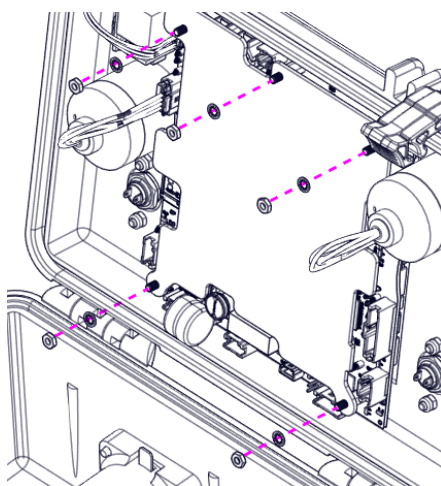
NOTE: RESET THE DATE AND TIME AS PER SECTION 11.7

Follow the procedure below to replace the RTC batteries.

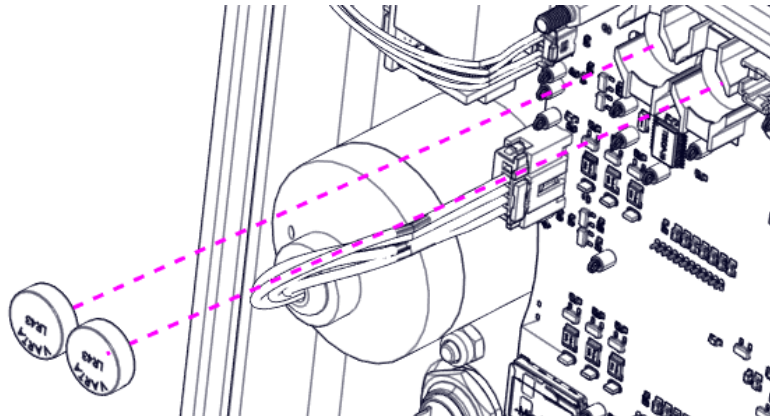
- 1] Power down the device.
- 2] Open the lid.



- 3] Remove the shroud PCB by removing the 4 M3 nuts and M3 shakeproof washers.



- 4] Use a suitable non-metal tool (Such as a spudger) to prise out both LR43 coin cells from their holders found in the top left corner.



- 5] Push in the 2 new LR43 coin cells with the markings facing up.
- 6] Reverse steps 1 to 3 to refit the shroud and power up the device.
- 7] Enter the maintenance menu to reset the date and time.

11.7 Setting the date and time

11.7.1 Setting the date



NOTE: THE UNIT IS FACTORY PRE-SET WITH THE CURRENT DATE AND TIME. IF IT IS NECESSARY TO RESET THE DATE AND TIME FOLLOW THE PROCEDURE DESCRIBED BELOW.

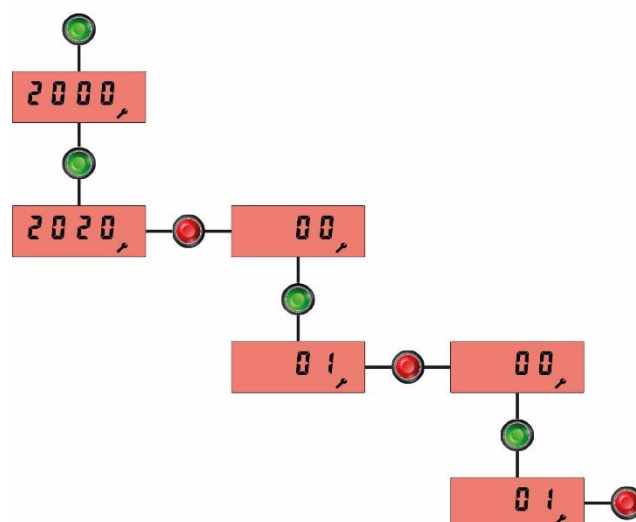


NOTE: WHEN SETTING THE YEAR, ONLY THE THIRD AND FOURTH DIGIT (I.E., 19) CAN BE CHANGED. THE MILENNIUM DATE ALWAYS STAYS THE SAME AT 20.

Follow the procedure below to set the date.

- 1] Press and hold down the backlight button and power button simultaneously until the red backlight appears.
- 2] Use the green backlight button to navigate to the date display panel then press the red button.
- 3] The first digit of the year entry will flash. Use the green backlight button to increment to the desired number. Once the display is showing the correct number press the red 'Power' button to accept the selection.
- 4] The display will automatically move to the next flashing number.
- 5] Repeat step 3 until the correct year is showing. Once the red 'Power' button has been pressed to accept the selection the month will automatically display.
- 6] Repeat the above steps to enter the correct month.
- 7] Once the month has been selected the day display will show. Repeat the above steps to enter the correct day. Press the red 'Power' button to accept.

Example: Changing the date from 00/00/2000 to 01/01/2020

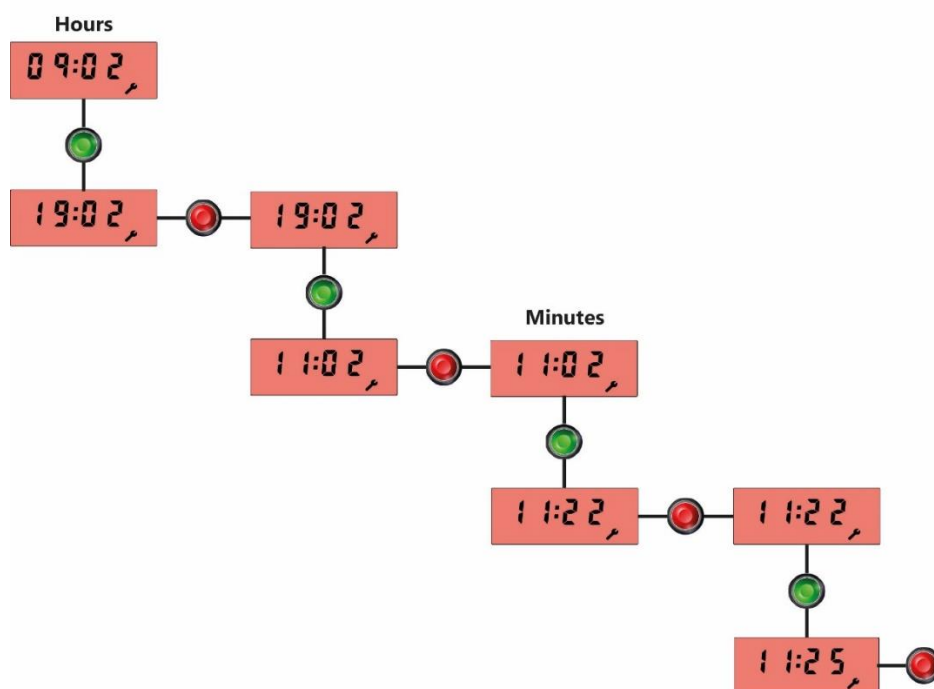


11.7.2 Setting the time

Follow the procedure below to set the time.

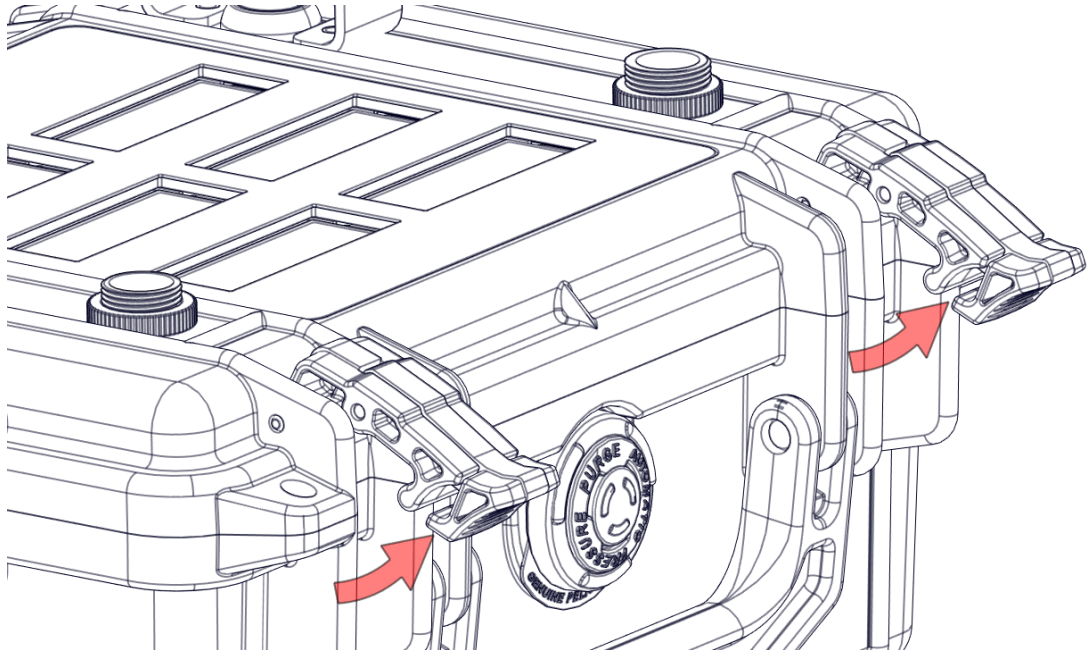
- 1] Press and hold down the backlight button and power button simultaneously until the orange backlight appears.
- 2] Use the green backlight button to navigate to the time display panel then press the red button.
- 3] The first digit of the time entry will flash. Use the green backlight button to increment to the desired number. Once the display is showing the correct number press the red 'Power' button to accept the selection.
- 4] The display will automatically move to the next flashing number.
- 5] Repeat step 3 until the correct hour is showing. Once the red 'Power' button has been pressed to accept the selection the minute will automatically display.
- 6] Repeat the above steps to enter the correct minutes.
- 7] Once the minutes have been selected press the red 'Power' button to accept.

Example: Changing the time from 09:02 to 11:25



11.8 Opening the lid

- 1]** Power down the unit.
- 2]** Unclip the latches at the top of the lid to open.



11.9 Sensor replacement



CAUTION: PRIOR TO SENSOR REPLACEMENT THE UNIT SHOULD BE POWERED DOWN, SEE SECTION 7.2

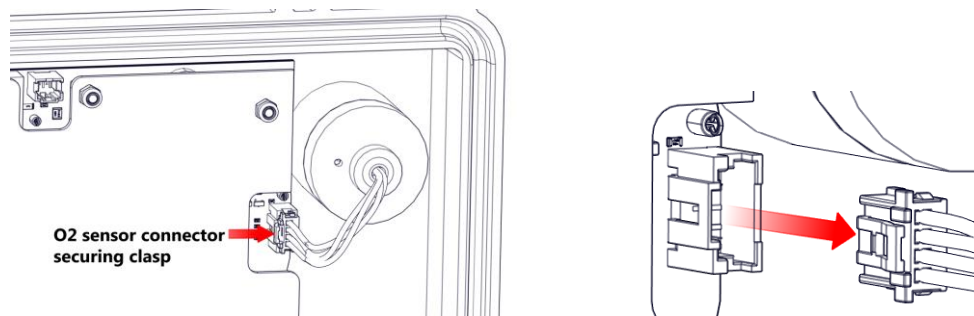


NOTE: THE SENSOR MUST BE CHANGED IN THE MENU AFTER REPLACEMENT (SEE SECTION 11.11) THEN CALIBRATE THE SENSOR.

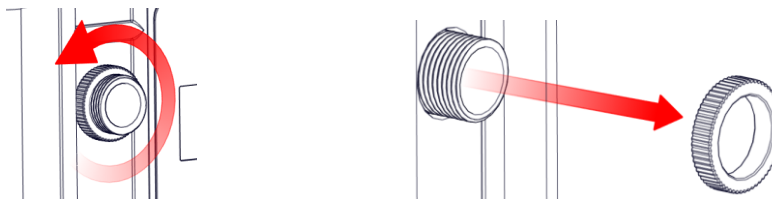
11.10 Changing the sensors in the unit

11.10.1 Removing and replacing the O₂ sensor

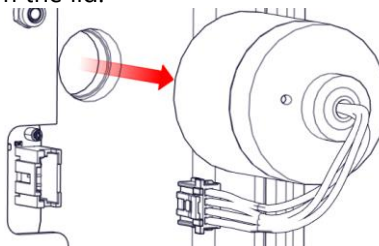
- 1] Power down the unit.
- 2] Open the lid.
- 3] Press in the connector securing clasp to release the wiring. Remove the wiring by withdrawing it from the housing.



- 4] Hold the sensor and unscrew the sensor locking nut by turning anti-clockwise.



- 5] Remove the O₂ sensor from the lid.

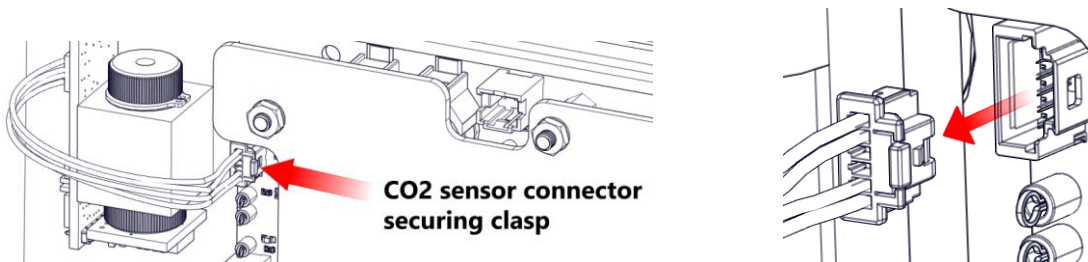


- 6] Follow steps 1 to 5 in reverse to fit the new sensor.
- 7] Change the sensor in the menu for it to be recorded.

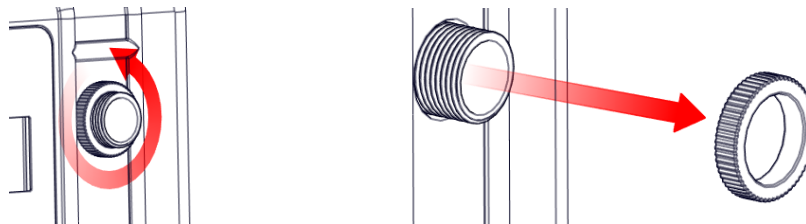
11.10.2 Removing and replacing the CO₂ sensor

The following procedure describes how to replace the CO₂ sensor:

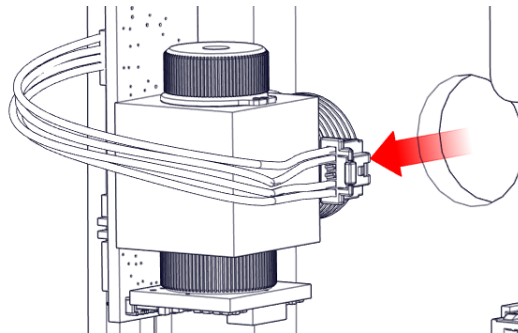
- 1] Power down the unit.
- 2] Open the lid.
- 3] Press in the connector securing clasp to release the wiring. Remove the wiring by withdrawing it from the housing.



- 4] Hold the sensor and unscrew the sensor locking nut by turning anti-clockwise.



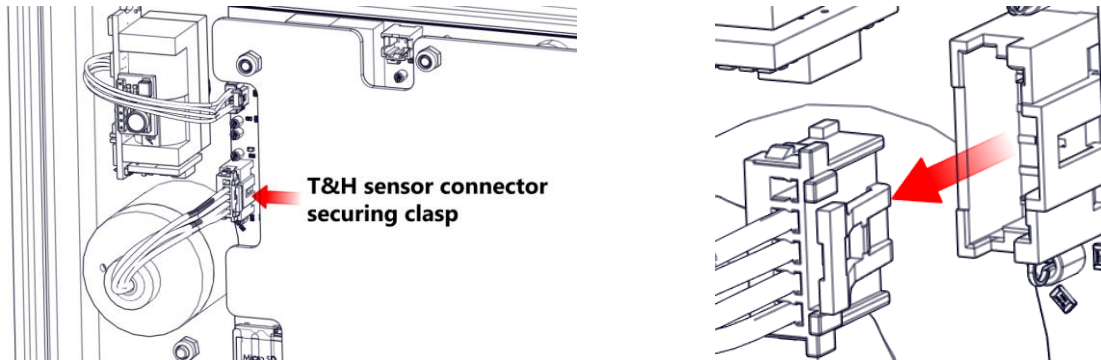
- 5] Remove the CO₂ sensor from the lid.



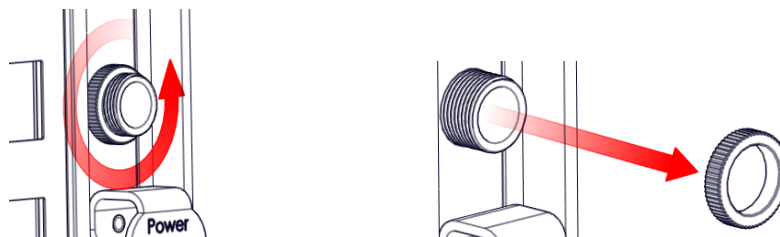
- 6] Follow steps 1 to 5 in reverse to fit the new sensor.
- 7] Change the sensor in the menu for it to be recorded.

11.10.3 Removing and replacing the temperature & humidity sensor

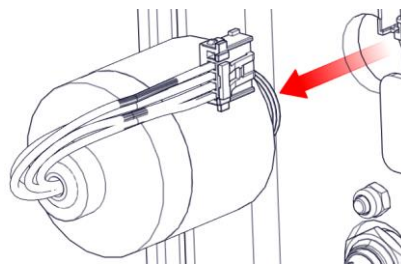
- 1] Power down the unit.
- 2] Open the lid.
- 3] Press in the connector securing clasp to release the wiring. Remove the wiring by withdrawing it from the housing.



- 4] Hold the sensor and unscrew the sensor locking nut by turning anti-clockwise.



- 5] Remove the Temperature & humidity sensor from the lid.



- 6] Follow steps 1 to 5 in reverse to fit the new sensor.
- 7] Change the sensor in the menu for it to be recorded.

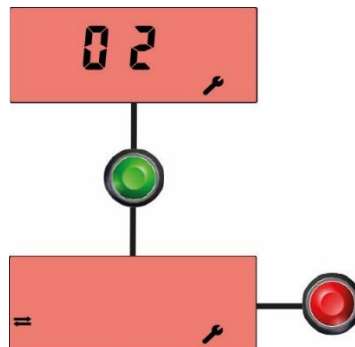
11.11 Changing the sensor in the menu



NOTE: EACH SENSOR REPLACEMENT MUST BE RECORDED.

The following procedure describes how to record a change of sensor.

- 1] Navigate to the sensor display that has been changed.
- 2] Toggle to the change sensor symbol.
- 3] Press the accept button.



NOTE: THE SENSOR MUST BE CALIBRATED AFTER REPLACEMENT.

11.12 Calibration

11.12.1 Calibration gas

The below table lists the recommended calibration gases required to LO and HI calibrate the Sub Mk3P O₂ and CO₂ sensors. A specific O₂ cleaned flow regulator is required for the 100% O₂ HI calibration gas.

Table 7 Sub Mk3P calibration gases

Item	Image of item	Description	Part no.
1.	N/A	Calibration gas, O ₂ & CO ₂ LO – 100% nitrogen	Source locally
2.	N/A	Calibration gas, O ₂ HI – 100% oxygen	Source locally
3.	N/A	Calibration gas, CO ₂ HI – 20% carbon dioxide, balance nitrogen	Source locally
4.	N/A	Regulator, for O ₂ HI calibration gas bottle (O ₂ cleaned)	Source locally
5.	N/A	Regulator, for O ₂ & CO ₂ LO and CO ₂ HI calibration gas bottles	Source locally

11.12.2 Connecting the calibration gas



NOTE: ONLY O₂ AND CO₂ SENSORS CAN BE CALIBRATED.



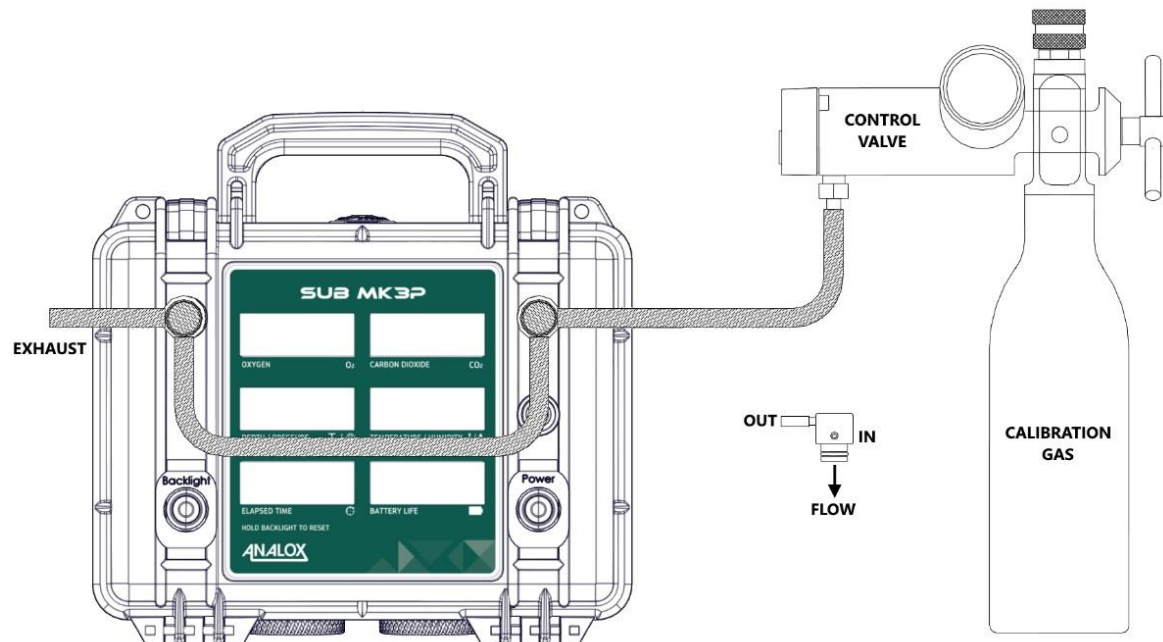
WARNING: CALIBRATION SHOULD ONLY BE PERFORMED BY SUITABLY TRAINED PERSONNEL FAMILIAR WITH THE HANDLING AND USE OF CALIBRATION GAS AND SHOULD BE PERFORMED IN A WELL-VENTILATED AREA.



NOTE: THE INSTRUMENT HAS BEEN DESIGNED TO ALLOW THE USE OF A WIDE RANGE OF CALIBRATION GASES FROM VARIOUS SUPPLIERS.

The calibration adapters and tubing supplied with the instrument will be required during calibration and should be fitted as shown below.

- 1] The longer free pipe is connected to the outlet of a calibration gas bottle flow regulator.
- 2] The calibration adapters in the chain are then firmly inserted into the O₂ and CO₂ sensor inlets.
- 3] The shorter free pipe is merely an exhaust which prevents atmospheric contamination of the gas in the last sensor and should not be blocked.
- 4] The gas flow from the regulator should be set to between 0.2 and 1.0 ltr/min (0.05 to 0.26 US gal/min).



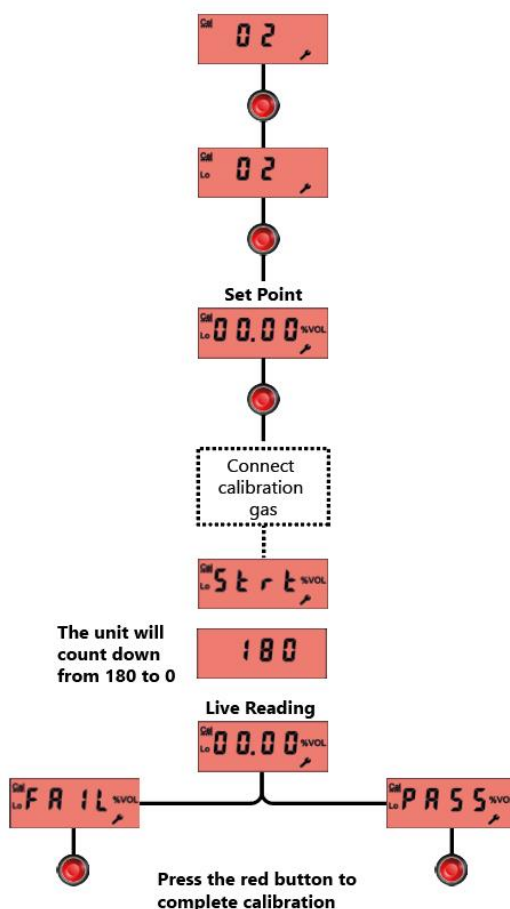
11.12.3 Calibrating the oxygen sensor (LO)



NOTE: ALWAYS LO CAL BEFORE HI CAL.

The following procedure describes how to LO calibrate the oxygen sensor:

- 1] Navigate to the O₂ display panel then press the red button to confirm.
- 2] The display will show the Cal Lo icon. Press the red button to confirm.
- 3] The display will show 00.00 %VOL. This %VOL is fixed when performing a LO calibration.
- 4] Press the red button to move to the next screen. The display will show 'Strt' (flashing).
- 5] The 'Strt' display will be flashing indicating a user action is required.
- 6] Connect the appropriate calibration gas.
- 7] Press the red button to start calibration.
- 8] After starting, a countdown period is shown in the Elapsed Time display. Calibration cannot be stopped after starting.
- 9] The sensor display will show a live reading while the unit is calibrating. No user action is required.
- 10] The unit will indicate if the calibration has passed or failed.
- 11] Press the red button to confirm the result.



11.12.4 Calibrating the oxygen sensor (HI)



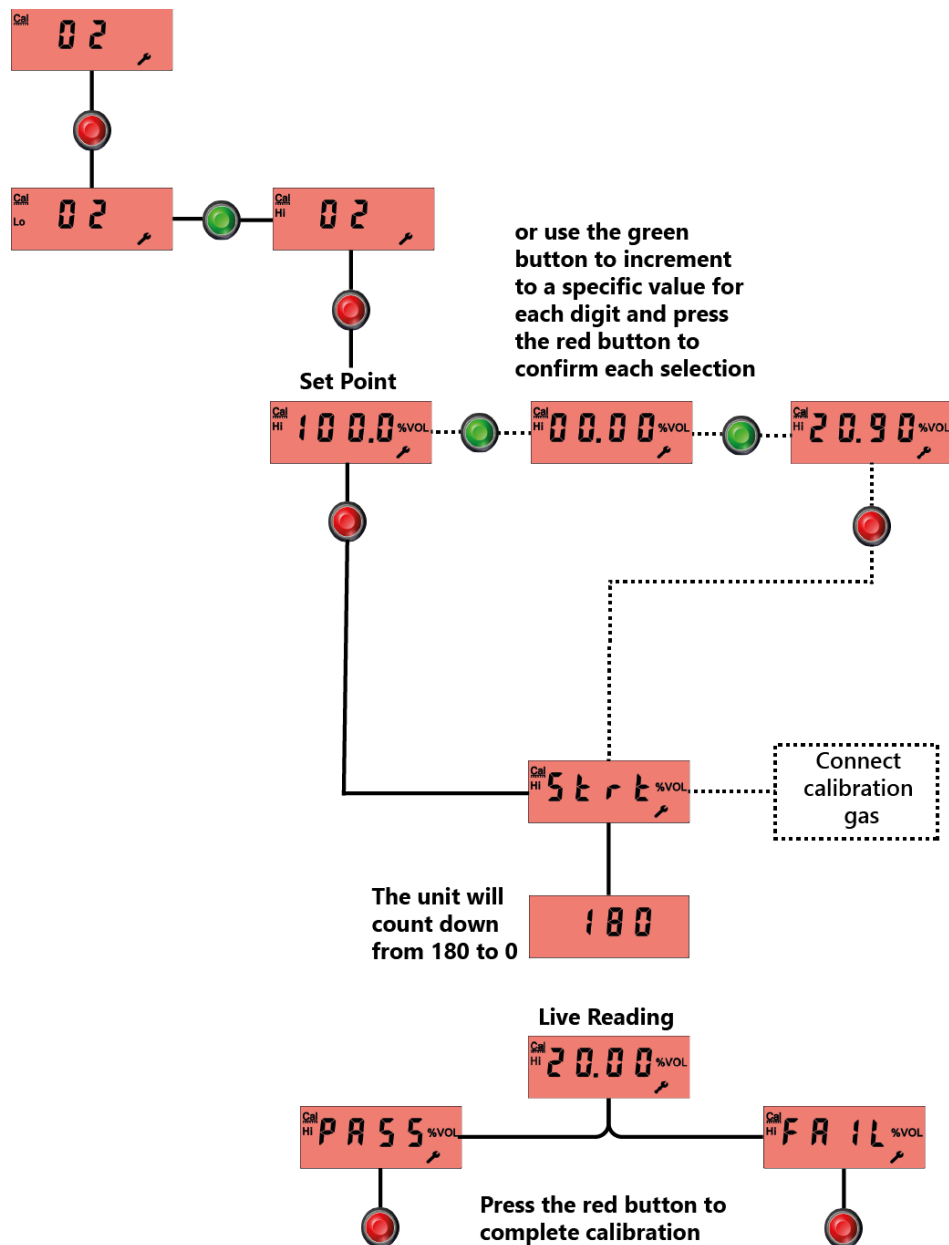
NOTE: ALWAYS LO CAL BEFORE HI CAL.



NOTE: WHEN PERFORMING AN OXYGEN HI CALIBRATION, IT IS POSSIBLE TO EITHER PERFORM A 100% CALIBRATION OR ENTER THE REQUIRED GAS VALUE.

The following procedure describes how to Hi calibrate the oxygen sensor:

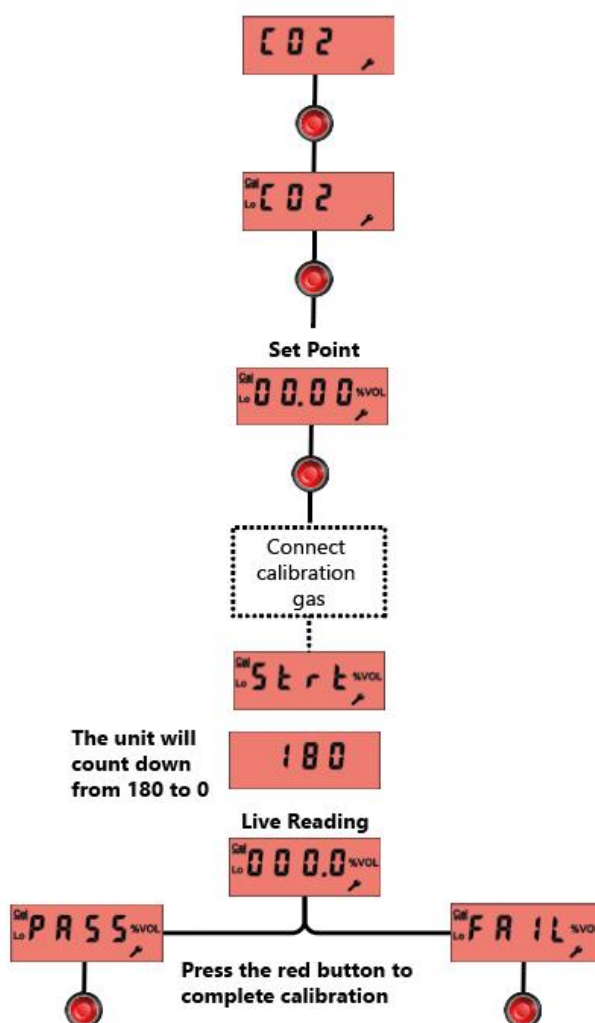
- 1] Navigate to the O₂ display panel then press the red button to confirm.
- 2] The display will automatically show the Cal Lo icon. Toggle using the green button to Cal Hi. Press the red button to confirm.
- 3] The display will automatically show a Set Point of 100.0 %VOL. Press the red button to move to the next screen or enter a specific value using the green button.
- 4] If wanting to change the %VOL calibration, press the green button, then repeatedly press the green button to change the value of the first digit (flashing). Press the red button to confirm the selection. The display will automatically move to the next digit. Repeat the process until the desired %VOL has been entered then press the red button to confirm.
- 5] The display will show 'Strt' and will be flashing.
- 6] Connect the appropriate calibration gas.
- 7] Press the red button to start calibration.
- 8] After starting, a countdown period is shown in the Elapsed Time display. Calibration cannot be stopped after starting.
- 9] The sensor display will show a live reading while the unit is calibrating. No user action is required.
- 10] The unit will indicate if the calibration has passed or failed.
- 11] Press the red button to confirm the result.



11.12.5 Calibrating the carbon dioxide sensor (LO)

The following procedure describes how to LO calibrate the oxygen sensor:

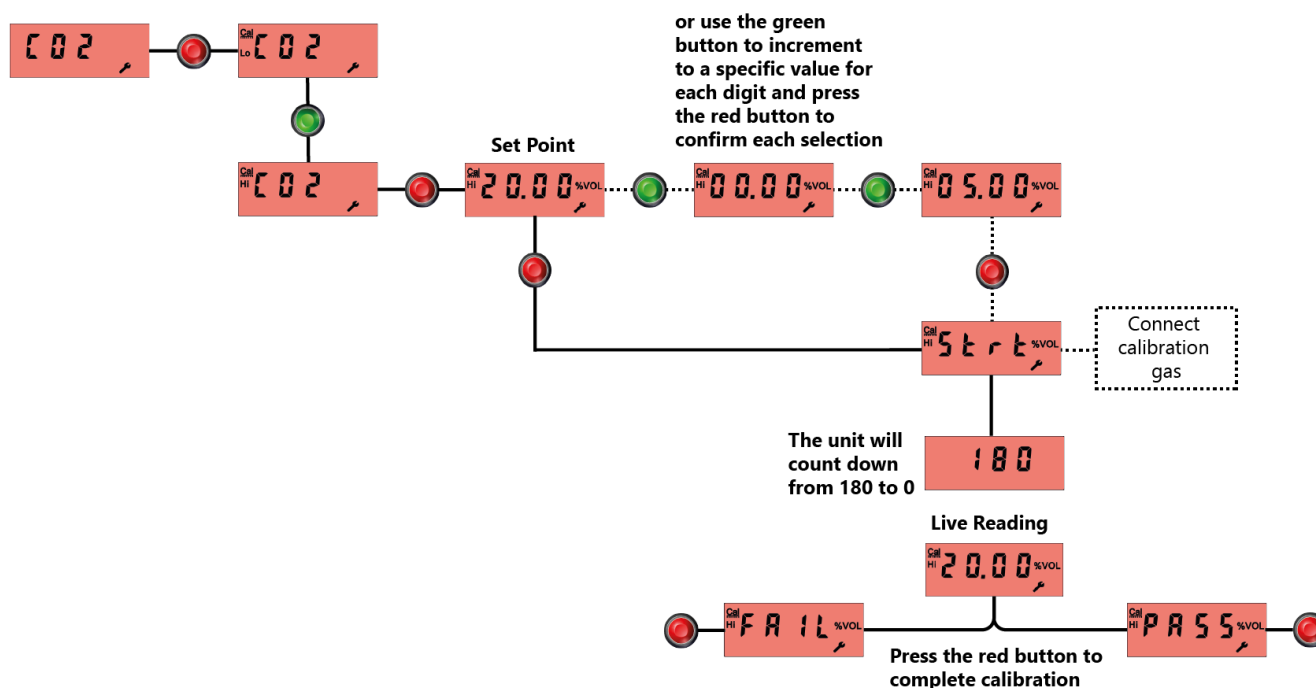
- 1] Navigate to the CO₂ display panel then press the red button to confirm.
- 2] The display will show the Cal Lo icon. Press the red button to confirm.
- 3] The display will show 000.0 %VOL. %VOL is fixed when performing a LO calibration.
- 4] Press the red button to move to the next screen. The display will show 'Strt' and will be flashing.
- 5] Connect the appropriate calibration gas.
- 6] Press the red button to start calibration.
- 7] After starting, a countdown period is shown in the Elapsed Time display. Calibration cannot be stopped after starting.
- 8] The sensor display will show a live reading while the unit is calibrating. No user action is required.
- 9] The sensor unit will indicate if the calibration has passed or failed.
- 10] Press the red button to confirm the result.



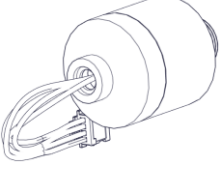
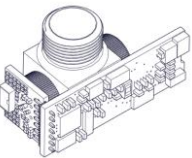
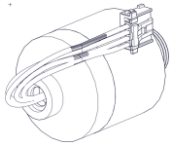
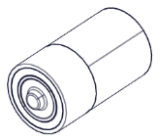
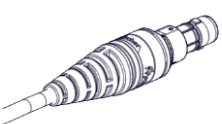
11.12.6 Calibrating the carbon dioxide sensor (HI)

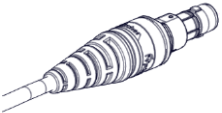
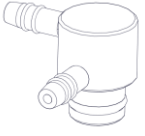
The following procedure describes how to HI calibrate the carbon dioxide sensor:

- 1] Navigate to the CO₂ display panel then press the red button to confirm.
- 2] The display will show the Cal Lo icon. Toggle using the green button to Cal Hi. Press the red button to confirm.
- 3] The display will show the last performed calibration setpoint (~20%).
- 4] To change the %VOL calibration, press the green button, then repeatedly press the green button to change the value of the first digit (flashing). Press the red button to confirm the selection. The display will automatically move to the next digit. Repeat the process until the desired %VOL has been entered then press the red button to confirm, on subsequent calibrations the previously entered value will show.
- 5] The display will show 'Strt' and will be flashing.
- 6] Connect the appropriate calibration gas.
- 7] Press the red button to start calibration.
- 8] The countdown period is shown in the Elapsed Time display. Calibration cannot be stopped after starting.
- 9] The sensor display will show a live reading while the unit is calibrating. No user action is required.
- 10] The unit will indicate if the calibration has passed or failed.
- 11] Press the red button to confirm the result.



12 Spares and accessories

Item	Image of item	Description	Part no.	Life	Planned maintenance periodicity
6.		O ₂ sensor	7000-0202-0005 NSN: UNKNOWN	LIFE TO INSPECTION (CALIBRATION) AUTHORISED LIFE	6 months 1 years
7.		CO ₂ sensor	7000-0202-0006 NSN: UNKNOWN	LIFE TO INSPECTION (CALIBRATION) AUTHORISED LIFE	6 months 5 years
8.		Temperature & Humidity sensor	7000-0202-0007 NSN: UNKNOWN	AUTHORISED LIFE	5 years
9.		4 X D size 1.5v hyperbaric tested alkaline batteries	7000-0202-0008 NSN: 6135-00-835-7210	LIFE TO INSPECTION AUTHORISED LIFE	Monthly 1 year
10.		2 x LR43 coin cell batteries	7000-0202-0009 NSN: UNKNOWN	AUTHORISED LIFE	5 years
11.		External DC power cable	7000-0202-0010 NSN: 6150-99-846-6786	N/A	N/A

Item	Image of item	Description	Part no.	Life	Planned maintenance periodicity
12.		External communications cable	7000-0202-0011 NSN: 5995-99-378-5591	N/A	N/A
13.		Calibration adaptor	7000-0000-0001 NSN: UNKNOWN	LIFE TO INSPECTION AUTHORISED LIFE	As required As required
14.	N/A	Calibration adapter tubing	7000-0000-0002 NSN: UNKNOWN	LIFE TO INSPECTION AUTHORISED LIFE	As required As required
15.	N/A	1-year service kit	7000-0202-0001	N/A	N/A
16.	N/A	5-year service kit	7000-0202-0003	N/A	N/A
17.	N/A	Annual return to factory service	7000-0202-0002	N/A	N/A
18.	N/A	5 yearly return to factory service	7000-0202-0004	N/A	N/A
19.	N/A	Calibration gas, O ₂ & CO ₂ LO – 100% nitrogen	Source locally	N/A	N/A
20.	N/A	Calibration gas, O ₂ HI – 100% oxygen	Source locally	N/A	N/A
21.	N/A	Calibration gas, CO ₂ HI – 20% carbon dioxide, balance nitrogen	Source locally	N/A	N/A
22.	N/A	Regulator, for O ₂ HI calibration gas bottle (O ₂ cleaned)	Source locally	N/A	N/A
23.	N/A	Regulator, for O ₂ & CO ₂ LO and CO ₂ HI calibration gas bottles	Source locally	N/A	N/A

13 Specifications



NOTE:

SENSOR PERFORMANCE APPLIES OVER THE FULL OPERATING TEMPERATURE AND PRESSURE RANGE AND ASSUMES MAINTENANCE ACTIVITIES HAVE BEEN COMPLETED CORRECTLY.

General	
Battery power	4 x 'D' alkaline cells (Hyperbaric)
External power	24V dc (9-36V dc), <0.5A
Real time clock batteries	2 x LR43 alkaline manganese cells
Displays	6 x 4 character LCD, with symbols and LED backlights.
Operating temperature	-5 to 50°C
Storage temperature	-5 to 50°C
Operating pressure	0.7 to 10bara
Operating humidity	0 to 100%RH (Non-condensing)
Standards/compliance	NATO STANAG 1476:2014 ANEP/MNEP 85 & 86 (2014) DEF STAN 59-411:2014 (EMC) IACs E10:2014 (MarED) type tested IP65 CE marked (RoHS)
Dimensions (W, H, D)	240mm x 198mm x 127mm
Weight	2.2kg with batteries installed
Oxygen (O ₂) sensor specification	
Range	0 to 2000mbar pO ₂
Accuracy	±10mbar (0 to 300mbar pO ₂) ±50mbar (300 to 2000mbar pO ₂)
Response time (t90)	20s
Detection mode	Electro-chemical
Shelf life (in sealed packaging)	6 months
Expected life (in air)	12 months
Carbon dioxide (CO ₂) sensor specification	
Range	0 to 100mbar pCO ₂
Accuracy	±10mbar
Response time (t90)	60s
Detection mode	Infrared
Expected life	5 years

Pressure sensor specification	
Range	0.1 to 14barA (-3 to 90MSW or -10 to 300FSW)
Accuracy (including annual drift)	-0.07bar +0.04bar
Response time (t90)	<1s
Detection mode	Piezoresistive
Expected life	>12 months (Replaced as a part of the O ₂ sensor)
Temperature and humidity sensor specification	
Temperature range	-40 to 125°C
Accuracy	±1°C
Response time (t63)	30s
Humidity range	0 to 100%RH (Non-condensing)
Accuracy	±10%RH
Response time (t63)	8s
Detection mode	Digital IC, capacitive RH and band gap temperature
Expected life	5 years

14 Troubleshooting

14.1 Faults

The following table lists the fault codes and corrective solutions.

Table 8 *Fault codes.*

Fault code	Meaning	Associated LCD	Solution
F099	Assert (Program bug)	Elapsed Time	Contact Analox
F101	The firmware CRC is incorrect	Elapsed Time	Contact Analox
F111	The configuration data is corrupt	Elapsed Time	Check configuration file for out-of-range, contact Analox
F121	The RAM check has failed	Elapsed Time	Contact Analox
F002	O ₂ sensor comms fault	O ₂	Check connections, replace sensor, power cycle, contact Analox
F003	CO ₂ sensor comms fault	CO ₂	Check connections, replace sensor, power cycle, contact Analox
F004	T&H sensor comms fault	Temperature	Check connections, replace sensor, power cycle, contact Analox
F022	O ₂ internal sensor fault	O ₂	Calibrate, power cycle, contact Analox
F023	CO ₂ internal sensor fault	CO ₂	Calibrate, power cycle, contact Analox
F024	T&H sensor fault	Temperature	Power cycle, contact Analox
F005	Pressure sensor fault	Depth	Power cycle, contact Analox
F321	Battery ADC fault	Battery	Power cycle, contact Analox
F221	SD card fault / not inserted	Elapsed Time	Check for card, insert new card, power cycle, contact Analox
F301	Battery life low indication	Battery	Replace batteries
F201	SD card write error	Elapsed Time	Check SD card, Contact Analox
F202	SD card open fault	Elapsed Time	Check SD card, Contact Analox
F203	SD card close fault	Elapsed Time	Check SD card, Contact Analox
F204	SD card folder fault	Elapsed Time	Check SD card, Contact Analox
F205	FRAM write error	Elapsed Time	Check SD card, Contact Analox

14.2 Warnings

Table 9 *Warnings*

Warning symbol	Meaning	Solution
	When a sensor has reached end of life and requires replacement a sensor replacement warning will flash on the display for that sensor	Replace the sensor (section 11.9). The warning will stop once a sensor has been replaced in the menu (section 11.11), the countdown is reset.

14.3 Reprogramming

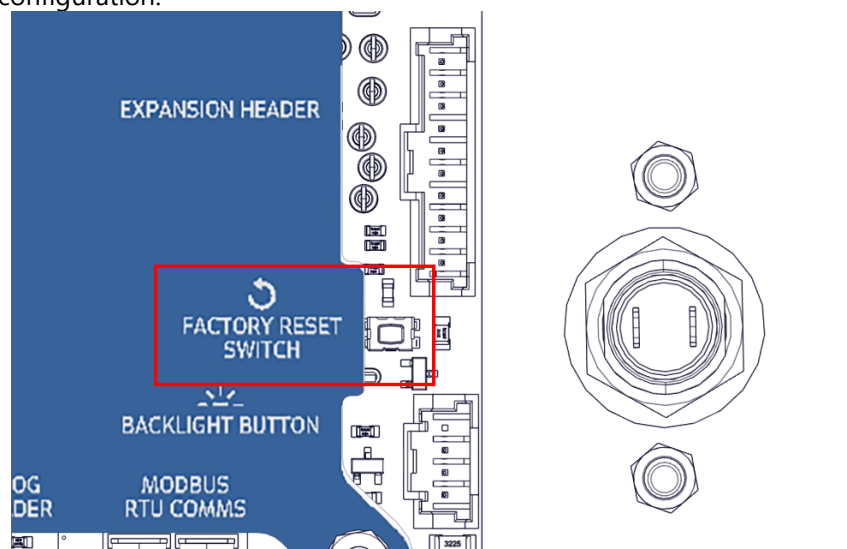
14.3.1 Firmware reprogramming

When a new version of the firmware is stored on an SD card the unit will update the firmware on power up.

14.3.2 Configuration file reprogramming

The Sub Mk3P comes with a factory configuration (units of measurement etc.) this can be updated in the same way as the firmware (through the SD card). The new configuration file will be stored as a 'user configuration', it does not overwrite the factory configuration.

If you need to restore the unit to the factory configuration press and hold the factory reset switch for 10 seconds. Ensure that there is not a configuration file on the SD card otherwise the unit will re-install that as a user configuration.



15 Warranty information

We provide the following warranties for the Sub Mk3P:

- A 3-month O₂ and pressure sensor module warranty
- A 2-year CO₂ sensor module warranty
- A 2-year T&H sensor module warranty
- A 1-year electronics warranty

The warranty period is from the day when the goods arrive at the works of the buyer. The warranty period for non-installed systems starts when the systems have been received at the purchaser's premises.

The warranty period applies to all maintainable parts (excluding consumables such as fixings etc.) provided that the purchaser replaces relevant parts according to the replacement schedule advised in the technical documentation delivered with the system.



NOTE:

**WHERE THE BUYER/END USER FAILS TO FOLLOW THE SELLERS
REGULAR MAINTENANCE INSTRUCTIONS, THE WARRANTY WILL
BE VOID.**

16 Fault reporting

In the event of a fault arising, the following table may be of use when reporting the fault to Analox. Please complete all sections which are believed to be relevant to the fault and return a copy to Analox. Contact details can be found on the front page of this manual.

Sub Mk3P	
Customer details	
Company/institution name	
Customer contact	
Address	
Country	
Telephone number	
Mobile telephone number	
Email address	
Equipment details (where applicable)	
Sub Mk3P serial no.	
Sub Mk3P part number	
MOD State	
System Operating Voltage	
Description of fault	

17 Disposal



WEEE statement

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.



Analox will provide a disposal service if this is beneficial to the customer. Analox are registered for the disposal of WEEE in the UK through the Environment Agency (2013 Registration number WEE/KE0043SY).

18 Declaration of conformity

Declaration of conformity

Declaration number: P0202-C001-02

Manufacturer's name: Analox Limited

Manufacturer's address: 15 Ellerbeck Court
Stokesley Business Park
Stokesley
North Yorkshire
TS9 5PT

It is declared that the following product:

Product name: Sub Mk3P

Product code: 4000-0202-xxxx
(xxxx replaced by variant number)

Conforms to all applicable requirements of: DEFSTAN 59-411*
*Except DRS02.B >1GHz restricted to 8V/m
field strength due to the CO2 sensor.
ANEP/MNEP-85
IACS E10:2014 (Environmental & IP65)

- Complies with the requirements of the EMC Directive 2014/30/EU
- Complies with the requirements of the RoHS Directive 2015/863
- Complies with the requirements of the WEEE Directive 2012/19/EU

CE The above product is CE-marked and satisfies the
relevant legislative requirements of the European
Economic Area (EEA)



Signed on behalf of: Analox Limited

Date: 11th July 2024

Signed: 

Name: Paul Branton
Position: Technical Director

19 UK declaration of conformity

UK Declaration of Conformity

Declaration number: P0202-C004-03

Manufacturer's name: Analox Limited

Manufacturer's address: 15 Ellerbeck Court
Stokesley Business Park
Stokesley
North Yorkshire
TS9 5PT

It is declared that the following product:

Product name: Sub Mk3P

Product code: 4000-0202-xxxx
(xxxx = configuration number)

Conforms to all applicable requirements of: DEFSTAN 59-411*
*Except DRS02.B >1GHz restricted to
8V/m field strength due to the CO2
sensor.
ANEP/MNEP-85
IACS E10:2014 (Environmental & IP65)

- Complies with the Electromagnetic Compatibility Regulations 2016
- Complies with the requirements of the RoHS Directive 2015/863
- Complies with the requirements of the WEEE Directive 2012/19/EU

The above product is UKCA-marked and satisfies the
relevant legislative requirements of the UK



Signed on behalf of: Analox Limited

Date: 11th July 2024

Signed: 

Name: Paul Branton

Position: Technical Director