

OXYGEN CONTROL 0.1 - 19%

MiniGalaxy 'A' Model Option 050 - 031

Oxygen control is designed to cover the 0.1 - 19% range by adding Nitrogen to reduce the level below ambient.

1 Setting up for Oxygen Control

1.1 Remove the plastic protective cover from the Oxygen Sensor (keep in a safe place to use when cleaning the interior). Follow the installation routine as in Section 3. In addition connect up the Nitrogen cylinder via the regulator, set to 0.7 BAR (10 PSI) to the relevant 6mm PVC tubing on the back of the Incubator. Nitrogen is fed through a HEPA filter connected in the gas line. NB: If the programmed level is close to ambient O₂ it may be necessary to reduce the 1 BAR pressure to stop the O₂ level undershooting the programmed value.

Set the N₂ and CO₂ pressures according to the chart below, dependant on the programmed level of O₂ required.

O ₂ Prog. Level:	N ₂ Pressure:		CO ₂ Pressure:	
	Bar	psi	Bar	psi
CO ₂ and O ₂ Control combined	0.70	10	0.70	10
CO ₂ Control only	1.00	15	1.00	15

These values are guidelines only, they can be modified to speed up or slow down recovery. The programmed O₂ and CO₂ level should be achieved within 2 to 3 minutes of one another, otherwise the O₂ level may go too low because CO₂ is continuing to be added after the O₂ level has achieved the programmed value. (the addition of CO₂ also depletes the O₂ level)

IMPORTANT:- When working at 0.1% CO₂, the CO₂ pressure should be set to 0.2 BAR.

1.2 The Oxygen Sensor is automatically calibrated to atmospheric O₂ levels by selecting OXYGEN SENSOR - REF TO ATMOSPHERE in the USER Menu and following the on-screen instructions. The Oxygen reading is automatically adjusted to 19.7% which is the true reading taking into account the Relative Humidity level. This process should be carried out once the incubator is humidified and left overnight to stabilise.

1.3 To enable Oxygen Control, select USER and DISABLE and toggle the OXYGEN CONTROL to ON using the <> Keys. Programme the required Oxygen level in the PROG screen.

1.4 The Alarm levels are set automatically to +/- 0.2% above / below the programmed value, but these points can be altered in the ALARM screen. Also the re-arming of the Alarm can be delayed until the Programmed Value is achieved, by selecting the relevant option in the ALARM screen. It is possible at low Oxygen levels that the CO₂ and O₂ levels have not fully recovered

within the Alarm Limits after the 15 minutes 'DELAY IN ARMING AFTER DOOR OPENING'. This time can be increased to suit individual circumstances in the ALARM screen.

1.5 The Control of Oxygen is tailored such that both the Oxygen and the CO₂ levels are achieved at approximately the same time. This is done by controlling the duty cycle of the N₂ valve. This applies only when working in the range 1.0 – 19.0%. See later section for 0.1 – 0.9% control information.

2 Guidance Notes and Routine Checks When Using Oxygen Control

2.1 Carry out reference to atmosphere procedure monthly to ensure that long term drift in output from the sensor is corrected. It should be done at the required chamber temperature.

2.2 Care should be taken not to flood the oxygen or CO₂ sensor when cleaning. Do not use solvents on the sensor membrane.

Under normal humidity conditions (95-99% Rh) the sensor is unaffected. If for any reason liquid condenses around the sensor, restriction of gas flow may take place and a low signal will be given.

This could occur if there was a large spillage within the chamber or if the incubator is switched off whilst fully humidified. Both of these events would cause excess condensation to form on the chamber walls.

Normal operation can be restored by removing the humidity tray, drying the chamber completely and then running the incubator at 37°C for one hour. This will dry out the sensor, the Humidity Tray can then be replaced and the incubator re-humidified.

3 Referencing to Atmosphere Procedure.

3.1 The Oxygen Sensor is a self-powered electrochemical cell which has a finite life dependent on the ambient Oxygen level, typically 1-2 years at atmospheric levels. During the sensor's life span, the signal produced will become degraded until it is ultimately un-useable. For this reason, the sensor should be referenced to atmospheric Oxygen levels regularly – we recommend monthly intervals. The REF TO ATMOSPHERE procedure has three possible outcomes:-

NB: - When working at Oxygen levels below 1.0% prior to the REF TO ATMOSPHERE procedure being carried out, it is necessary to disable O₂ Control, degas the chamber by opening the door for 1 minute and leave the sensor in atmospheric Oxygen for approximately 90 minutes. This is to allow the sensor to fully recover to ambient Oxygen level.

- a) The referencing procedure was completely successful no further action need be taken.
- b) The referencing procedure was successful, but the sensor is nearing the end of its working life and requires replacement in a month or so.

- c) The referencing procedure failed. Oxygen control will be disabled (incubator otherwise functions perfectly) until a new sensor is fitted and correctly re-referenced to atmosphere.

3.2 If the referencing procedure detects that the sensor is nearing the end of it's working life the following message will be displayed on the screen:-

O2 REFERENCE OK BUT SENSOR REQUIRES
REPLACEMENT SHORTLY

PRESS ENTER TO PROCEED.

Pressing ENTER will change the screen to:

O² SENSOR

THE RESULT OF THE O2 REFERENCE PROCESS
SHOWS THAT THE SIGNAL FROM THE O2 SENSOR
HAS REDUCED INDICATING IT IS APPROACHING
THE END OF ITS LIFE.

REPEAT THE REFERENCE PROCEDURE TO
CONFIRM THIS RESULT.

CONTACT YOUR DISTRIBUTOR FOR REPLACEMENT
INSTRUCTIONS.

PRESS ENTER TO PROCEED.

3.3 If the referencing procedure detects that the sensor has failed the following message will be displayed on the screen:-

O2 REFERENCE FAILED

PRESS ENTER TO PROCEED

Pressing ENTER will change the screen to:

O² SENSOR

THE RESULT OF THE O2 REFERENCE PROCESS
SHOWS THAT THE SIGNAL FROM THE O2 SENSOR
HAS REDUCED BELOW AN ACCEPTABLE LEVEL
AND HAS REACHED THE END OF ITS LIFE.

REPEAT THE REFERENCE PROCEDURE TO
CONFIRM THIS RESULT.

CONTACT YOUR DISTRIBUTOR FOR REPLACEMENT
INSTRUCTIONS.

PRESS NEXT TO PROCEED.

(continued on next page)

Pressing NEXT will change the screen to:

O₂ SENSOR

OXYGEN CONTROL HAS BEEN DISABLED AS A RESULT BUT THE INCUBATOR IS OTHERWISE FULLY OPERATIONAL.

PRESS PREV TO VIEW PREVIOUS SCREEN.
PRESS EXIT TO EXIT.

Pressing EXIT will return to the USER Screen and normal operation.

4 Important Note Regarding Humidity in the Chamber

An additional Hydrophobic Filter is factory fitted to help prevent condensation reaching the actual sensor. See diagram on page 7 for filter replacement instructions.

5 Oxygen Sensor Trouble-shooting

If the Oxygen sensor fails suddenly (within a period of a few hours), it is very likely that the sensor inlet membrane has become blocked by condensation. This can be seen on the Datalogger screen as a sudden drop from the programmed value to around zero.

To dry the membrane:-

- 1) Remove the Hydrophobic Filter Holder assembly by unscrewing anti-clockwise.
- 2) Program the incubator for a temperature of at least 37°C (or higher if being used at a higher temperature). Program 0.0% CO₂ and disable the Oxygen control in the USER menu.
- 3) Close the door and allow the temperature to recover. Re-open the door for 15 seconds to release any build up of humidity. Repeat approx every 30 minutes.
- 4) Observe on the Datalogger O₂ Graph that the Oxygen level should quite suddenly recover after a few hours.
- 5) Leave the incubator for a further few hours to ensure that the membrane has thoroughly dried out.
- 6) To replace the Hydrophobic Filter Membrane:-
 - 7.1) Gently push out the old Hydrophobic Filter Membrane & Filter Cap using a finger tip.
 - 7.2) Clean & dry the Hydrophobic Filter Holder and Hydrophobic Filter Cap.
 - 7.3) NB:- Gloves must be worn when handling a new Hydrophobic Filter Membrane to prevent contamination of the membrane!
Gently place a new Hydrophobic Filter Membrane in the recess of the Hydrophobic Filter Holder (membrane is bi-directional and will work equally well either way round).
 - 7.4) Gently press the Hydrophobic Filter Cap into the Hydrophobic Filter Holder to hold the membrane in position.
 - 7.5) Replace the Hydrophobic Filter Holder assembly by screwing in clockwise. Finger tighten only – do not use any tools! Refer to page 7 for a diagrammatic explanation of this procedure.
- 8) Re-humidify the incubator and leave it for 2 or 3 hours, then carry out an OXYGEN SENSOR – REF TO ATMOSPHERE in the USER Screen.
When the referencing has been completed the incubator is ready to use.

6 Technical Specification

Sensor Type:	Self-powered, diffusion-limited, electrochemical cell with temperature compensation.
Zero Signal in Nitrogen:	<50 μ V
Temperature Compensation:	+/- 2% of signal variation from 0-40°C
Relative Humidity Range:	0 - 99%, non-condensing
Operating Temperature Range:	-20°C to +50°C
Resolution:	0.01% Oxygen
Expected Operating Life:	1 - 2 years in ambient Oxygen*
Hydrophobic Filter Operating Life:	No data available on the life of the filter but would expect it to last at least 6 months.

The Hydrophobic Filter should be changed each time the incubator is cleaned as it may have picked up some contamination or be affected by the cleaning fluids used. There is no visual indicator to show that it is time to replace the filter (unless it is visibly dirty).

Incubator Control

Programming:- 0.1 to 19.0% in 0.1% steps.

Control Accuracy:- +/- 0.1% (typical).

Programmed Level:	Measurement Accuracy:
0.1 – 1.0%	+/- 0.1% (typical)
1.0 – 10.0%	+/- 0.25% (typical)
10.0 – 19.0%	+/- 0.5% (typical)

Incubator Recovery Rates (after 30 second Door Opening):-

Oxygen Recovery to 1.0% 25 – 30 Minutes

Nitrogen Input Rate 25 litres / Minute

Nitrogen Consumption to 1.0% Oxygen 625 – 750 litres

Oxygen Recovery to 0.1% Oxygen 35 – 40 Minutes

Nitrogen Consumption to 0.1% Oxygen 875 – 1125 litres

NB – All measurements made with the following assumptions:-

Nitrogen cylinder capacity (BOC Size 'W') 9380 litres

Cylinder pressure 230 Bar

Nitrogen input pressure 1 BAR (15 lbf / in²)

Nitrogen input rate 25 litres / Minute at 1 BAR (lbf / in²)

Consumption at 0.1% (Door closed) 500 litres / 24hrs

Typical Oxygen Reduction Rates

To 16% - 3 minutes 11% - 4 minutes 6% - 8 minute

It is recommended that an automatic changeover unit is used to eliminate the risk of Nitrogen supply failure.

CO₂ Recovery (0.1 – 0.9% programmed Oxygen Level)

CO₂ is switched on once the Oxygen level is within 0.1% of Set Point. Recovery to 5.0% takes about 7 – 10 minutes.

CO₂ alarms are armed automatically once CO₂ Set Point has been reached.

Nitrogen Control System (0.1 – 0.9% programmed Oxygen level)

To minimize Nitrogen consumption after the glass door has been opened, the Control System operates as follows:-

The Control System switches the Nitrogen valve on continuously until the O₂ is within 0.1% of set point.

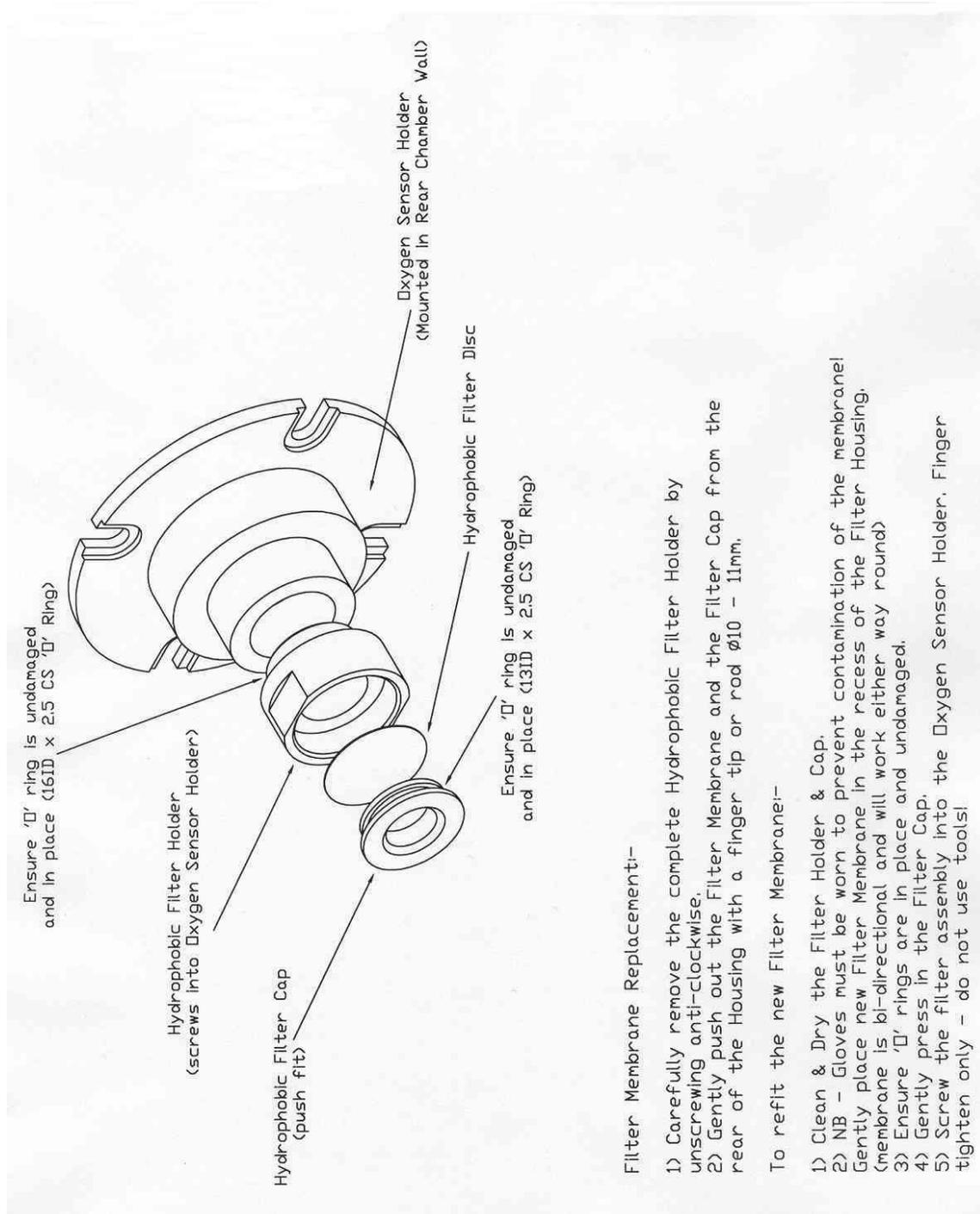
The CO₂ valve is then switched on to allow the CO₂ level to reach Set Point. If the Oxygen level is above Set Point 15 minutes after the Nitrogen valve has switched off, it is switched on for 40 seconds and the CO₂ valve is switched on for 20 seconds. The CO₂ valve will then pulse until set point is reached.

The process described above will repeat itself until the O₂ Set Point is reached and is also repeated when the O₂ level rises above the set point.

If for any reason the O₂ level rises towards setpoint +0.2%, the N₂ valve will open continuously until the O₂ level reaches setpoint.

The CO₂ Auto Zero which normally takes place after a CO₂ alarm is cancelled because it would introduce additional Oxygen into the chamber. It may also be advisable to cancel the programmed CO₂ Auto Zero for the same reason.

Assembly Diagram of Hydrophobic Filter & Holder



Filter Membrane Replacement:-

- 1) Carefully remove the complete Hydrophobic Filter Holder by unscrewing anti-clockwise.
- 2) Gently push out the Filter Membrane and the Filter Cap from the rear of the Housing with a finger tip or rod $\phi 10 - 11\text{mm}$.

To refit the new Filter Membrane:-

- 1) Clean & Dry the Filter Holder & Cap.
- 2) NB - Gloves must be worn to prevent contamination of the membrane! Gently place new Filter Membrane in the recess of the Filter Housing. (membrane is bi-directional and will work either way round)
- 3) Ensure 'O' rings are in place and undamaged.
- 4) Gently press in the Filter Cap.
- 5) Screw the filter assembly into the Oxygen Sensor Holder. Finger tighten only - do not use tools!