OX-AN® Dual Oxygen and Moisture Monitoring System Operation Manual

Issue 3.2

Contents

OX-AN Oxygen and Moisture Glove Box Monitor

1.0 General Operation

The OX-AN Oxygen and Moisture Glove Box Monitoring System continuously monitors and displays the level of Oxygen (O_2) and moisture (displayed as H_20) from two individual locations within a glove box. The system is pre-configured with detection levels for O_2 and moisture which provide audible, visual and control outputs.

A key switch located on the front panel enables a selection of user accessible features. The key switch is set to the OFF position (vertical) when the system is operational.

During normal operation the LCD displays the O_2 sensor range, the percentage O_2 and the moisture level in parts per million (ppm). A typical LCD output is shown as Figure 1.

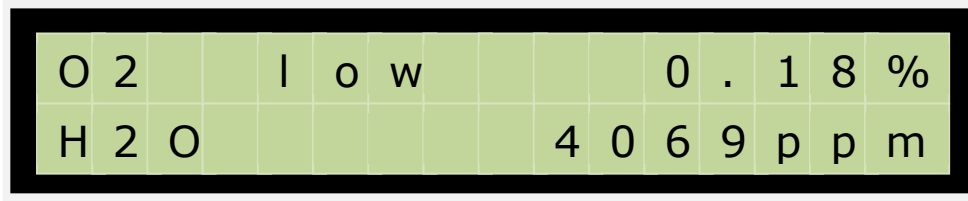| O 2 | | l o w | | 0 . 1 8 % |
| H 2 O | | | | 4 0 6 9 p p m |

Figure 1 LCD Output - Normal Operation

Automatic Operation

If the value of O_2 or moisture exceeds the corresponding threshold level, the system automatically sets the relevant outputs. When the value of O_2 or moisture returns to a value below the threshold the system automatically resets the outputs.

No user action is required for normal operation.

2.0 Oxygen Monitor Features

The system incorporates a dual range O_2 sensor which combines accurate measurements in the range 0 – 1% with the ability to measure the relatively high levels of O_2 present in air without degradation of the sensor. This dual range feature means that the monitoring system can be left operational, even in the event of a major air intrusion within the glove box.

The O_2 monitor section has two associated outputs:

- Purge Output
- Alarm Output

The activation levels for these outputs are pre-configured as:

Oxygen Level	Action
0.19%	De-activate Purge output (if active)
0.30%	Set Purge output
0.29%	De-activate Alarm output (if active)
0.40%	Set Alarm output

2.1 Oxygen Sensor Ranges

For the OX-AN Oxygen and Moisture Glove Box Monitoring System, the O_2 sensor ranges are set to:

Low Range 0 – 1% O_2
High Range 1 – 25% O_2

The automatic range change thresholds are:

O_2 Level	Action
0.99% or below	Set O_2 sensor to Low Range if currently in High Range
1.0% or above (note: high range displays one decimal place)	Set O_2 sensor to High Range

Note that the system automatically changes between low and high range. On power up the system initialises to low range.

The O_2 sensor range is displayed on the LCD, see Figure 4 and Figure 5.

```
O2     low        0.18%
H2O            4069ppm
```
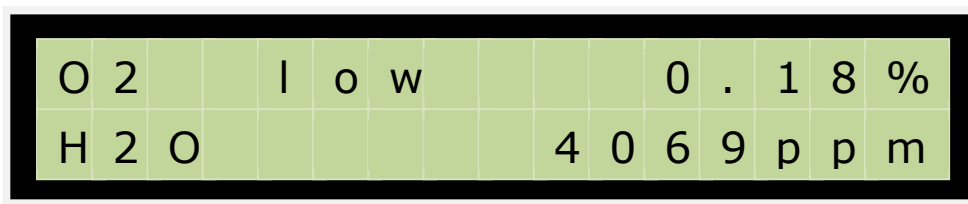
Figure 4. LCD Output for O_2 Sensor Low Range

```
O2     high       18.8%
H2O            4069ppm
```
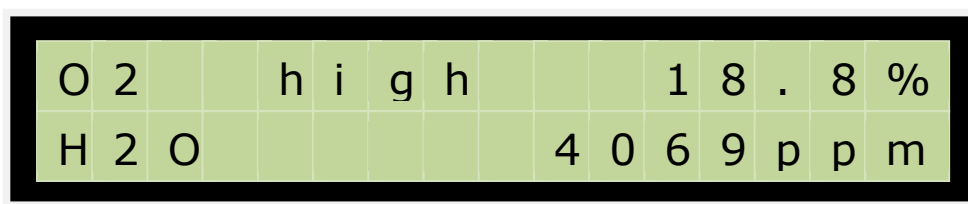
Figure 5. LCD Output for O_2 Sensor High Range

2.2 Oxygen Thresholds

The system uses a number of pre-configured thresholds to control the process and alarms. For the OX-AN Oxygen and Moisture Glove Box Monitoring System, the O_2 sensor thresholds are configured as:

O_2 Level	Control Output	Visual Indication	Audible Indication
0.19%	Remove Purge output if active	Amber OFF	Sounder OFF
0.30%	Set Purge output	Amber ON	Sounder ON
0.29%	Remove Alarm output if active	Red OFF	No Change
0.40%	Set Alarm output	Red ON	No Change
0.99%	Set Input to Low Range if in High Range	No Change	No Change
1.0%	Set Input to High Range	No Change	No Change

3.0 Moisture Monitor Overview

The system incorporates a single range moisture sensor with a range of 0 – 20000ppm.

The Moisture monitor provides two outputs:
- 4-20mA repeat of sensor value
- Alarm Output

3.1 Moisture Thresholds

For the OX-AN Oxygen and Moisture Glove Box Monitoring System, the moisture sensor thresholds are configured as:

Moisture Level	Control Output	Visual Indication	Audible Indication
5000ppm	Remove Moisture Alarm output if active	Red OFF	Sounder OFF
10000ppm	Set Moisture Alarm output if active	Red ON	Sounder ON

4.0 Fault States

4.1 Shorted and Missing Sensors

The system generates fault outputs in response to shorted or missing sensors. A missing sensor is defined as a loop value of <3mA. A shorted sensor is defined as a value >21mA.

Sensor Input State	LCD Display	Visual Indication	Audible Indication
O_2 Sensor Shorted	O2 Shorted	Red ON	Sounder ON
O_2 Sensor Missing	O2 Missing	No Change	No Change
Moisture Sensor Shorted	H20 Shorted	Red ON	Sounder ON
Moisture Sensor Missing	H20 Missing	No Change	No Change

The system should not be operated continuously if a fault is displayed. Operation in this mode can potentially damage the monitor.

4.2 Memory Checksum Error

The system continuously monitors the internal memory to check for corruption. If the memory is found to be corrupt, the system will display a checksum error message and illuminate the Amber LED block.

Please contact OX-AN Gas Detection Ltd if the system displays a checksum error message.

4.3 Single Sensor Operation

In the event of a fault occurring with either the O_2 or Moisture sensor, the system can be configured to operate with only the remaining sensor active.

To configure the system for single sensor operation, make the appropriate channel "inactive" from within the Engineers Menu.

Channel one – Moisture
Channel two – O_2

See section 8 for more details of the Active Channel option.

5.0 System Controls

The OX-AN Oxygen and Moisture Glove Box Monitoring System is housed in a 19" rack mounted enclosure. The system i/o comprise a 2×16 character backlit LCD, three multi-LED blocks, seven pushbuttons and a key switch.

The key switch is used as an enable for the buttons located below the LCD. This allows the user to make changes to the LCD display format and to access the Engineers Menu.

The layout of the user interface is shown as Figure 4.
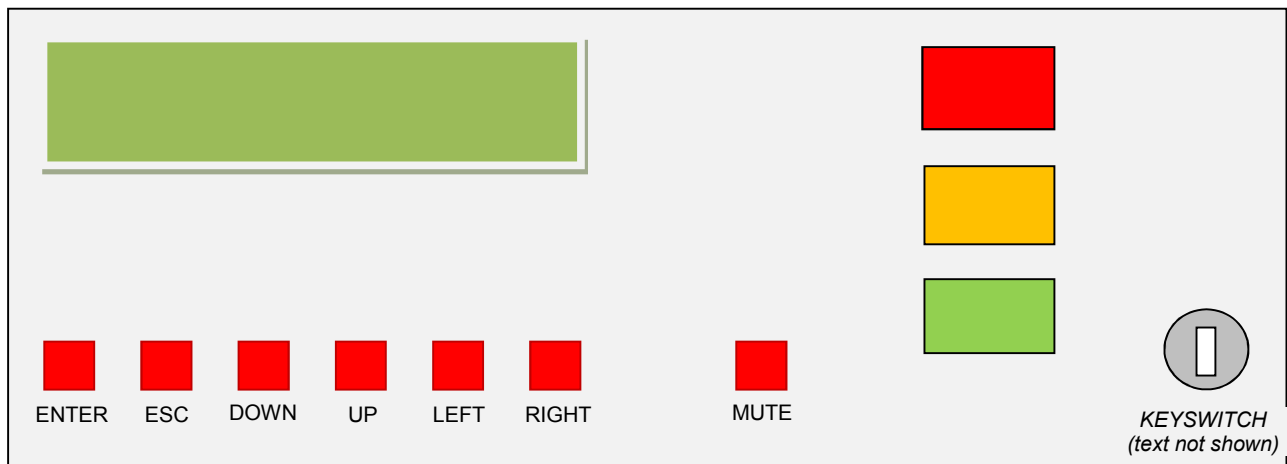
Figure 4 System Controls

5.1 Visual Indicators

Green LED Block	System operational with no outputs activated
Amber LED Block	O_2 Purge active
Red LED Block	O_2 or Moisture Alarm activated

6.0 System Operation Modes

The system has four modes:

1. Operational with Key Switch OFF
2. Operational with Key Switch ON
3. Engineers Menu
4. Calibration Mode

The system is only operational in modes 1 and 2 above. In Engineers Menu and Calibration Mode, the system does not operate as a gas detection system.

6.1 Operational - Key Switch OFF

In this mode the system is fully automatic and requires no user intervention.

Key Switch	OFF (Vertical)
Button	**Action**
ENTER	None
ESC	Hold down and switch key switch to ON to enter Engineers Menu
UP	None
DOWN	None
LEFT	None
RIGHT	None
MUTE	Mutes active sounder

6.2 Operational - Key Switch ON

This mode allows the user to make some modifications to the format of the LCD display.

Key Switch	ON (Horizontal)
Button	**Action**
ENTER	Toggles LCD display of alarm levels
ESC	None
UP	Toggles LCD display of time
DOWN	None
LEFT	None
RIGHT	None
MUTE	Mutes active sounder

Extended Options

Key Switch	ON (Horizontal)
Button	Action
*ESC + DOWN	Change to High O_2 Range
*ESC + UP	Change to Low O_2 Range

For testing only – range transfer is automatic. System must be reset (powered down and back up) after using this option.

6.3 Engineers Menu

In this mode the system does not operate as a monitor. The Engineers menu is used to modify the user configurable settings.

*Engineers Menu	
Key Switch	ON or OFF
Button	Action
ENTER	Select menu option / save changes to menu option value
ESC	Leave menu option without saving changes
UP	Move up through menu options
DOWN	Move down through menu options
LEFT	Move cursor left in selected menu option
RIGHT	Move cursor right in selected menu option
MUTE	Cycles between channels in selected menu option

*To enter the Engineers Menu:
Hold down the ESC button whilst switching key switch from OFF to ON position.

6.4 Calibration Mode

This is a special mode of operation which provides functionality for resetting the default values and recalibrating the 4-20mA sensor inputs. For existing systems, this mode is only used during significant upgrades or during a re-commission of the system.

Commissioning Menu	
Key Switch	ON or OFF
Button	Action
ENTER	Save current option changes
ESC	Leave current option without saving changes
UP	None
DOWN	None
LEFT	None
RIGHT	None
MUTE	None

7.0 Normal Operation - LCD Options

If the key switch is the ON (horizontal) position, the LCD output can be modified using the ENTER and UP buttons:

Button	Action
ENTER	Toggles LCD display of threshold levels
UP	Toggles LCD display of time

7.1 Displaying Thresholds
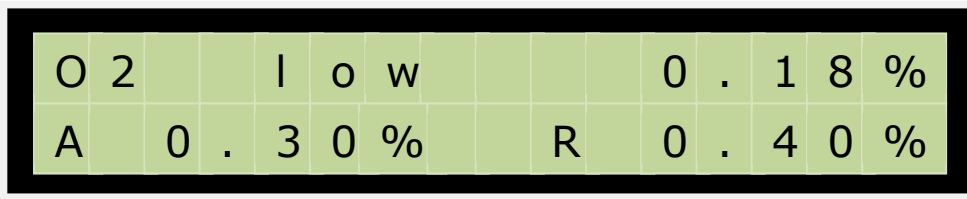
In normal operation the LCD display output can be configured to display the threshold values by turning the key switch to the ON (horizontal) position and then pressing the ENTER button.

This will toggle the display of the threshold levels. When the threshold levels are being displayed the LCD will cycle between:

Screen 1 - O_2 level on the top line and the O_2 thresholds on the lower line
Screen 2 - Moisture level on the top line and the moisture threshold on the lower line

Example LCD outputs are shown as Figure 5 and Figure 6.

Figure 5. LCD Output for O_2 with Threshold Levels

Figure 6. LCD Output for Moisture with Threshold Levels

7.2 Displaying Time

In normal operation the LCD display output can be configured to display the time and date by turning the key switch to the ON (horizontal) position and then pressing the DOWN button.

This will toggle the display of the time and date. When the time is being displayed the LCD will cycle between:

Screen 1 - O_2 level on the top line and time and date on the lower line
Screen 2 - Moisture level on the top line and time and date on the lower line

Example LCD outputs are shown as Figure 7 and Figure 8.

Figure 7. LCD Output for O_2 with Time and Date

Figure 8. LCD Output for Moisture with Time and Date

8.0 Engineers Menu

The Engineers Menu is used to edit the configurable system values. The OX-AN Oxygen and Moisture Glove Box Monitoring System includes the following configurable values:

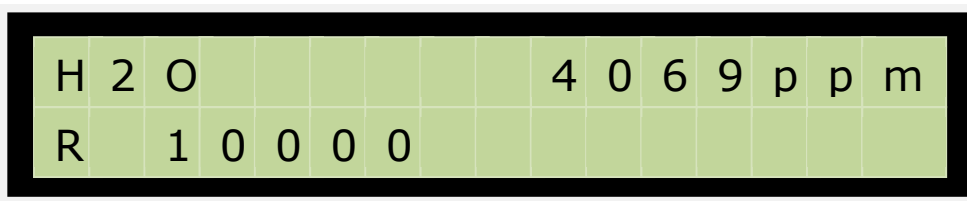| Value	Format	Description
Time	Hour: Min: Sec	Time for system – used for display only
Date	Day/Month/Year	Date for system – used for display only
Hold Off	Seconds	Delay between reaching upper threshold value and triggering associated output
Mute Time	Minutes	The time for which the sounder is muted after pressing the MUTE button
Active Channels	Set Y/N for channel one and two	Inactive channels are not scanned, displayed or acted upon.

To enter the Engineers Menu hold down the ESC Button whilst switching key switch from OFF to ON position.

Note: The system is not operational whilst in Engineers Menu.

The Engineers Menu opening screen is shown as Figure 9.

```
Eng  Menu  v3.0
16ch  2  Gas  RB
```
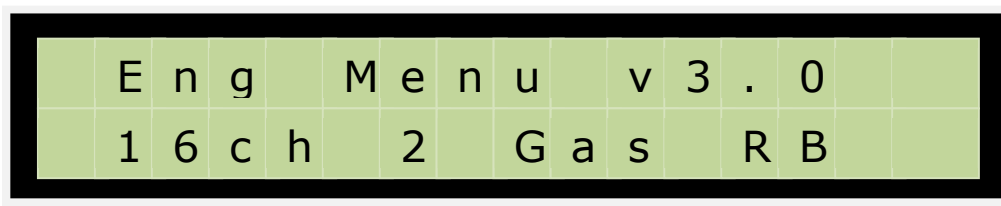
Figure 9. Engineers Menu Opening Screen

The available menu options are shown as Figure 10. Use the UP and DOWN buttons to cycle through the available options.

```
┌─────────────────────────┐
│  Eng Menu v3.0          │
│  16ch 2 Gas RB          │
└─────────────────────────┘
           │
┌─────────────────────────┐
│  Set Time               │
│                         │
└─────────────────────────┘
           │
┌─────────────────────────┐
│  Set Date               │
│                         │
└─────────────────────────┘
           │
┌─────────────────────────┐
│  Hold off(sec)          │
│                         │
└─────────────────────────┘
           │
┌─────────────────────────┐
│  Mute Time(min)         │
│                         │
└─────────────────────────┘
           │
┌─────────────────────────┐
│  Active Channels        │
│                         │
└─────────────────────────┘
           │
┌─────────────────────────┐
│  Exit                   │
│                         │
└─────────────────────────┘
```

Figure 10. Engineers Menu Options

8.1 Editing

8.1.1 Editing Numeric Values
To edit numeric values press the ENTER button when the relevant menu option is displayed.

The data is immediately presented for editing. Individual digits are incremented or decremented using the UP and DOWN keys. Use the LEFT and RIGHT buttons to move between digits.

Save the edited data by pressing the ENTER button. Exit without saving by using the ESC button.

8.1.2 Editing Yes/No Inputs
To edit Yes/No values press the ENTER button when the relevant menu option is displayed. The input value is then available for editing.

For Yes/No entry the entered value toggles with either the UP or DOWN button. Save the edited data by pressing the ENTER button or exit without saving using the ESC button.

8.1.3 Changing Channel
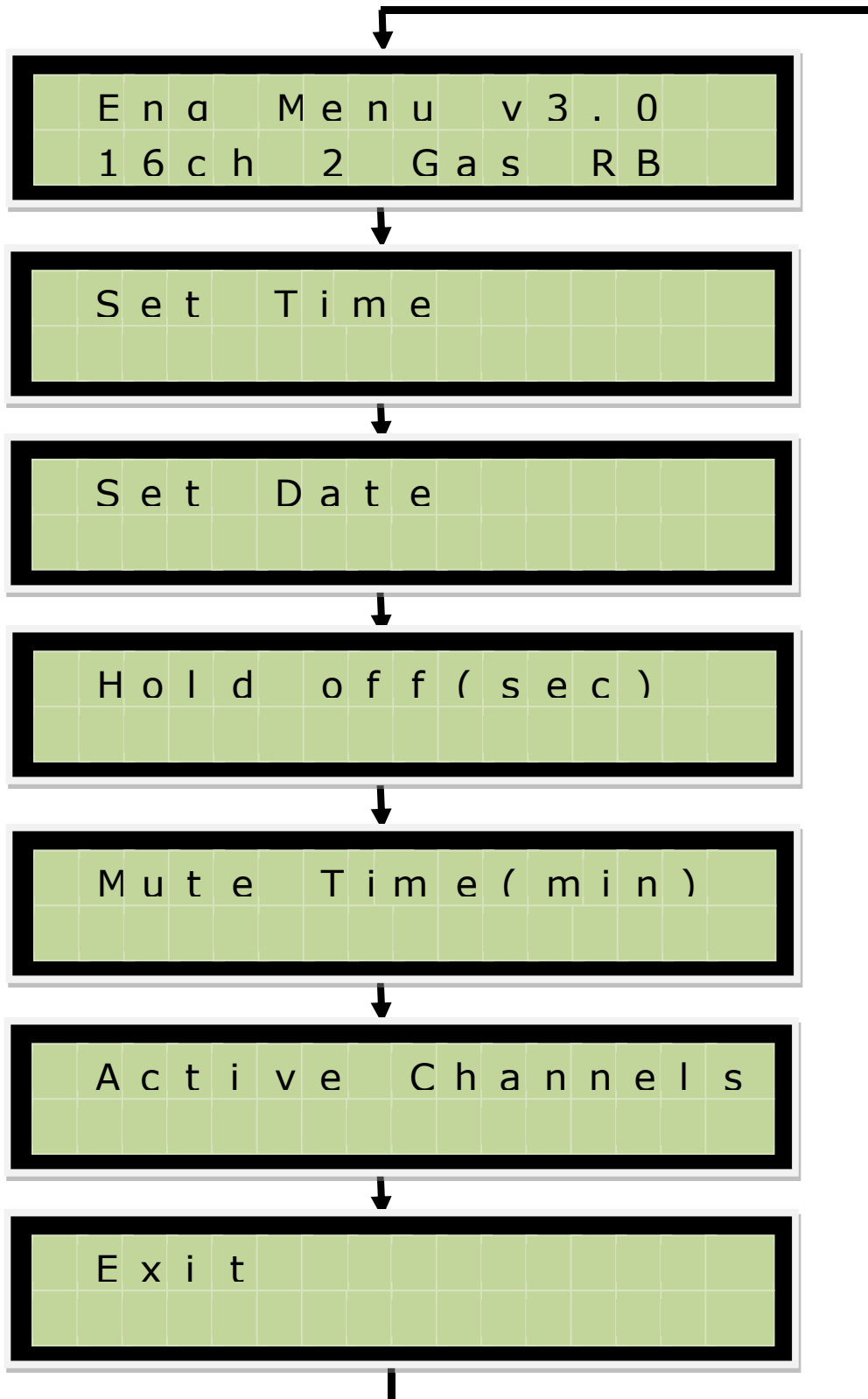For options which are channels specific, the channel can be incremented using the MUTE button after selecting the parameter to edit (from the menu).

Note that the channel must be selected prior to editing the data. If the channel is incremented without explicitly saving an edited value, any changes will be lost.

The editing sequence is:

1. Select menu option
2. Select channel
3. Edit data
4. Save data

This sequence must be repeated for each channel.

The channel number is shown in the lower left of the screen – see Figure 11.

Channel ⟶

```
  A c t i v e     C h a n n e l s
[  0  ]                 Y
```

Figure 11. Engineers Menu Options

8.2 Menu Options

The following sections provide details of the individual menu options.

8.2.1 Set Time
This option allows the real time clock to be set. The input format is 24 hour.

```
S e t     T i m e
              0 0 : 0 0 : 0 0
```

Figure 12. Engineers Menu Set Time

Notes:
Initial value is always set to all zeros
No input data validation is carried out

8.2.2 Set Date
This option allows the real time clock date to be set.

```
S e t     D a t e
              0 0 / 0 0 / 0 0
```

Figure 13. Engineers Menu Set Date

Notes:
Initial value is always set to all zeros
No input data validation is carried out

8.2.3 Hold Off (sec)

This value determines the time, in seconds, for which the level of O_2 or Moisture must be above the threshold before the alarm state is activated. This facility helps to reduce the incidence of alarms caused by fast changing input levels.

```
Hold  off   (sec)
      000
```
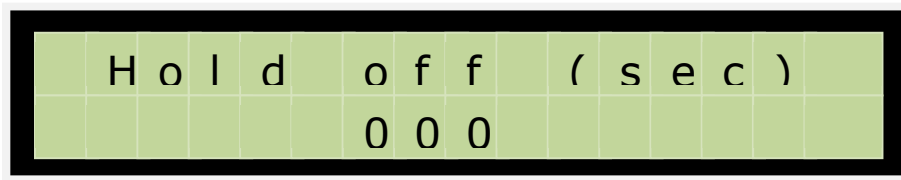
Figure 14. Engineers Menu Hold Off

- Min Value = 0
- Max value = 255

8.2.4 Mute Time (min)

This value determines the time, in minutes, for which the sounder is muted following a MUTE button press. The sounder will be reactivated after the time has elapsed.

```
Mute  Time(min)
      240
```
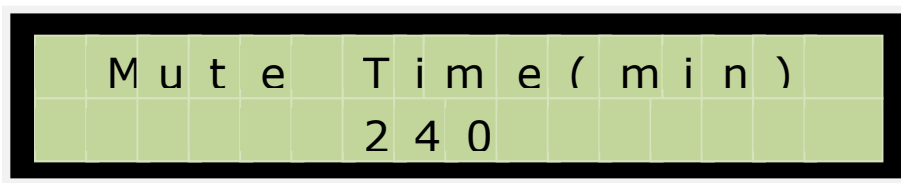
Figure 15. Engineers Menu Mute Time

- Min Value = 0
- Max value = 255

8.2.5 Active Channels

This option provides facilities for determining whether the input from a channel should be allowed to trigger alarms (output).

Figure 16. Engineers Menu Active Channels

- Value Y or N
- Channel specific

8.2.6 Exit

Pressing the ENTER button when this option is displayed exits the Engineer mode and returns the system to operational mode.

Figure 17. Engineers Menu Exit

9.0 4-20mA Input Calibration

The unit is calibrated for loop current measurements of up to 20mA by applying a load of 3mA as the lower reference and a load of 23mA as the full-scale level. These calibration values are stored within the EEPROM (IC9).

Calibration is carried on loop (channel) one.
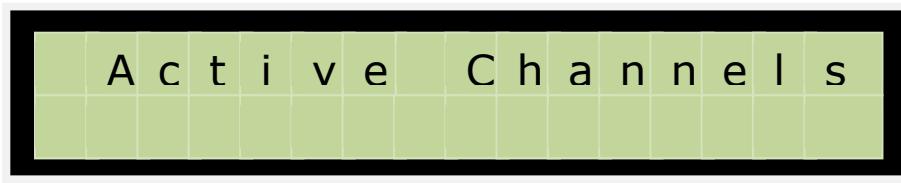
Calibration involves drawing a known steady current from the loop circuitry using a suitable calibration unit. The system parameters are then set based on the current measured by a calibrated meter.

Note that the calibration menu is displayed when the CAL terminals adjacent to the processor are shorted. These terminals must remain shorted throughout the full calibration procedure.

9.1 Calibration Equipment

Calibration of the 4-20mA input requires equipment which will provide a mA sink ranging from 3mA to 23mA. The drawn current is measured with a meter connected within the mA return signal wire. For OX-AN 3 terminal loop connectors, the mA return is the centre terminal.

Contact OX-AN Ltd if you require further information regarding suitable calibration equipment.

9.2 Calibration Procedure

The calibration procedure involves optionally writing the default values to the on-board EEPROM and then setting the offset and gain for the system analogue to digital converter. The procedure varies depending upon whether the EEPROM is blank or pre-programmed. All on-site systems will have a pre-programmed EEPROM.

Note: If the EEPROM is blank, the system will not operate when powered up.

9.2.1 Writing Default Values to a Blank EEPROM

If the EEPROM is blank, the board should be powered up with the CAL jumper in place.

The display is shown as Figure 18.

```
W  r  i  t  e     D  e  f  a  u  l  t  s  ?
```
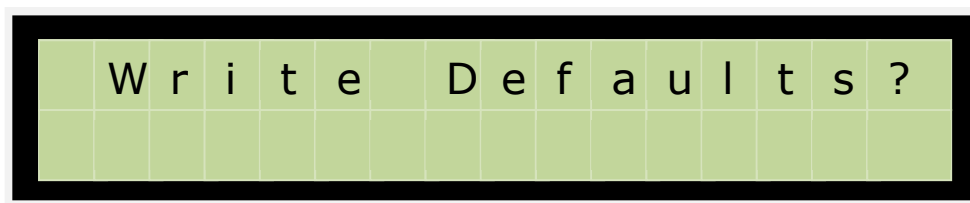
Figure 18. Commissioning Menu – Write Defaults

Press the ENTER button to write default values to the serial memory.

Remove Cal jumper and reset board. Follow instructions for calibration using pre-programmed EEPROM.

9.2.2 Calibration Using Pre-Programmed EEPROM

Power-up the board with CAL jumper removed.
Allow the system to begin operation (i.e. reading values from sensors)
Fit CAL jumper.
The display is shown as Figure 19.

```
W  r  i  t  e     D  e  f  a  u  l  t  s  ?
```
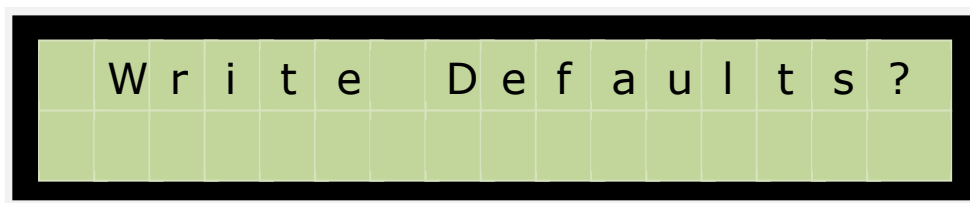
Figure 19. Commissioning Menu – Write Defaults

If required, press ENTER to write default values to the serial memory. Press the EXIT button to leave the existing data within the serial memory.

Warning all edited Engineer data will be lost if you write default settings to the serial memory

The display will now show:

```
┌─────────────────────────────────────┐
│  C a l    S e t     3 m A           │
│  0 0 0 0    m A = 3 . 0             │
└─────────────────────────────────────┘
```
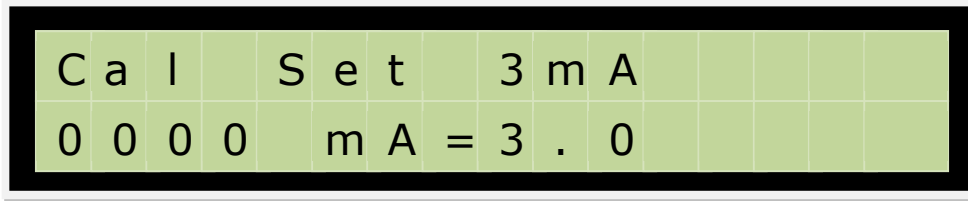
Figure 20. Commissioning Menu – mA Lower Value

Note: the lower line is used for verifying calibration and should be ignored on un-calibrated boards.

1. Connect appropriate calibration equipment (variable current sink and meter) to channel one
2. Set the current being drawn by the calibration equipment to 3mA (read from the meter NOT the LCD display).
3. Press the ENTER button to calibration the mA lower level or press the ESC button to leave without calibrating.

The display will now show:

```
┌─────────────────────────────────────┐
│  C a l    S e t     2 3 m A         │
│  0 0 0 0    m A = 2 3 . 0           │
└─────────────────────────────────────┘
```
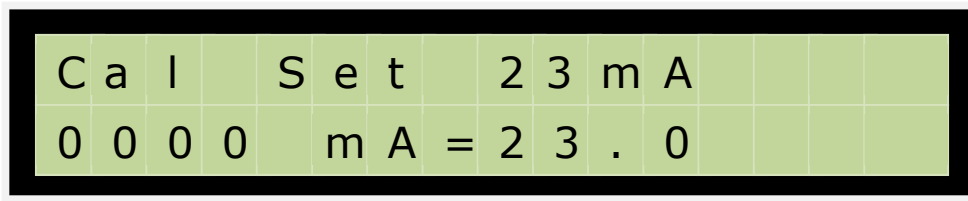
Figure 21. Commissioning Menu – mA Upper Value

Note: the lower line is used for verifying calibration and should be ignored on un-calibrated boards.

4. Set the current being drawn by the calibration equipment to 23mA (read from the meter NOT the LCD display).
5. Press the ENTER button to calibration the full scale level or press the ESC button to leave without setting the upper limit.
6. Remove power from the board.
7. Remove the CAL jumper
8. Remove the calibration equipment.

The board is now calibrated for loop current measurements.

9.3 Verifying Calibration

To verify that a board is calibrated enter the calibration menu by attaching a jumper to the CAL pins. A calibrated board will show the correct mA reading for current which is drawn from the loop (measured with a meter in mA return). Use the ESC button to exit both calibration steps without saving.

10.0 Sensor Calibration

Before calibrating individual sensors, ensure that the OX-AN Oxygen and Moisture Glove Box Monitoring System has been calibrated for 4-20mA input.

Individual 4-20mA sensors should be calibrated using appropriate calibrated gases. Pease consult the sensor manufacturer's documentation for calibration procedures.

Calibration records

Date	New Sensors Type	Serial No.	Gas Level	Engineer

Notes