Oxygen & Carbon Dioxide Analyser

Model 1637-Mk II

Operators Manual

May 2018

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1. OVERVIEW & SPECIFICATIONS

The Novatech model 1637-Mk II analyser is an instrument used for measuring oxygen and carbon dioxide concentration in a sample of gas. It is designed for use in the food packaging industry where products are packaged in a modified atmosphere of nitrogen and/or carbon dioxide.

The two modes of operation for the 1637 MK II device are 'Sample & Hold' and 'Continuous Sampling'.

In Sample & Hold Mode, gas is extracted from the packaging via a sample line fitted with a hypodermic needle. The needle penetrates the food packaging and the internal pump draws a sample of the headspace gas into the analyser for measurement. At the completion of each sample the oxygen and carbon dioxide levels are shown on the display as well as an indication of whether these values are within the pre-determined range.

In Continuous Mode, gas is either drawn into the analyser using the internal pump or pushed through the analyser by process pressure. The oxygen and carbon dioxide content is continuously sampled and displayed on the device LCD. For remote monitoring, two isolated and fully programmable 4-20mA outputs and 4 programmable relays can be configured to give indication of whether the gas levels are within range, and that the device is functioning correctly.

The 1637-Mk II has several key features that offer the user flexibility and ease of operation.

- Sample & Hold or Continuous live monitoring of both Oxygen and Carbon Dioxide
- Oxygen sensitivity down to 0.1ppm
- Carbon Dioxide display resolution of 0.1%
- Automatic calibration of oxygen & carbon dioxide in Sample & Hold Mode
- 2x fully programmable isolated 4-20mA outputs for remote monitoring in Continuous Mode
- Internal sample log which can be reviewed or downloaded to a PC
- Large LCD display with local indication of Oxygen & Carbon Dioxide during use

1.1 Hardware Specifications

Oxygen Range   1 part per million (ppm) to 100% oxygen.

Oxygen Response Time   <4 seconds with gas flow of 100cc per minute

Oxygen Accuracy   ±1% of actual measured value with repeatability ±0.5% of measured value

Oxygen Display Resolution
30.0 to 100%	±0.1%
1.00 to 29.99%	±0.01%
100 to 10,000ppm	±1ppm
0.1 to 99.9ppm	±0.1ppm

CO_2 Accuracy
0 to 40%	±2%
40 to 80%	±3%
80 to 100%	±5%

CO_2 Range   0 to 100%

CO_2 Response Time   <8 seconds with gas flow of 100cc per minute

Gas Connection   1/8" Swagelok®

Communications   Bluetooth® Wireless

Analog Outputs   2 isolated 0-20mA or 4-20mA field selectable
active outputs (DO NOT loop-power)

Analog Output Load   1000 ohm maximum

Alarm Relays   4 isolated programmable, failsafe (active open)
2A/240VAC, 2A/30VDC

Mains Voltage Supply   85 to 265VAC 50/60Hz

Mains Power   115W continuous, 500W maximum instantaneous

Warm-Up Time   5 minutes

Environmental Rating
Operating Temperature   0 to 50°C (32 to 120°F) or 0 to 45°C (32 to 110°F) with CO_2 option.
Relative Humidity   5% to 95% (non-condensing)

Weight   6Kg

Dimensions   265mm (W) x 150mm (H) x 350mm (D)   (10.5" x 6" x 13.75")

Range of Analog Outputs   in continuous mode, field selectable from the following:
Oxygen	0 - 0.1% oxygen to 0 - 100% oxygen
Carbon Dioxide	0 - 1% to 0 - 100% carbon dioxide
Oxygen EMF	0 - 100mV to 0 - 1500mV

1.2 Product & Logging Specifications

Number of Products Stored	200 maximum
Product Name	~22 characters (alpha-numeric and symbols). Exact number of characters is limited by the width of the display and will vary.
Log Memory Capacity	3680 readings Each reading records date, time, product, oxygen, carbon dioxide

1.3 Heater Supply for the Oxygen Sensor

> **CAUTION**
> The Oxygen sensor heater is supplied with mains voltage. This supply has electrical shock danger to maintenance personnel. Always isolate the analyser before working with the oxygen sensor.
> The sensor assembly must always be connected to earth.

The heater is supplied from the mains power directly, and the temperature is controlled to a set-point of 720°C (1320°F) after turn on.

1.4 Oxygen Sensor Impedance

The impedance of the oxygen sensor is an indication of the age and condition of the oxygen sensor. As the oxygen sensor ages its impedance will increase and the speed at which the sensor will respond to changes in oxygen concentration will decrease. When the impedance reaches the alarm threshold the sensor should be replaced. By exceeding this impedance level, the sensor response rate will slow down to the extent the erroneous oxygen readings may be seen.

To monitor the health of the oxygen sensor the analyser automatically checks the impedance at fixed intervals. The process of checking takes less than 20 seconds, during which the display will indicate that an impedance check is in progress.

Each time the device is switched on it will automatically check impedance five minutes after the oxygen sensor reaches operating temperature of 700°C. If the analyser remains switched on it will repeat this check every 24 hours.

The impedance alarm threshold is 8kΩ. If the measured impedance exceeds this level, the impedance alarm will be triggered. Refer to chapter 4.2 Hardware Alarms.

1.3 Case

Mains Power Socket
(side of case)

Sample Gas
Inlet

Display

Needle Holder

Keypad

Display
The 1637-Mk II display is a 192x64 pixel monochrome graphical LCD. In standard operation it shows the
current oxygen and carbon dioxide readings, also previous sample readings, alarm status, product selected,
date & time.

Keypad
User interface for interacting with the analyser

Sample Gas Inlet
Sample line is attached to this 1/8" Swagelok® coupling

Needle Holder
Safe storage for the hypodermic needle when it's not in use

Mains Power Socket
External mains power input; uses a standard IEC type connector.

1.4 LCD Display
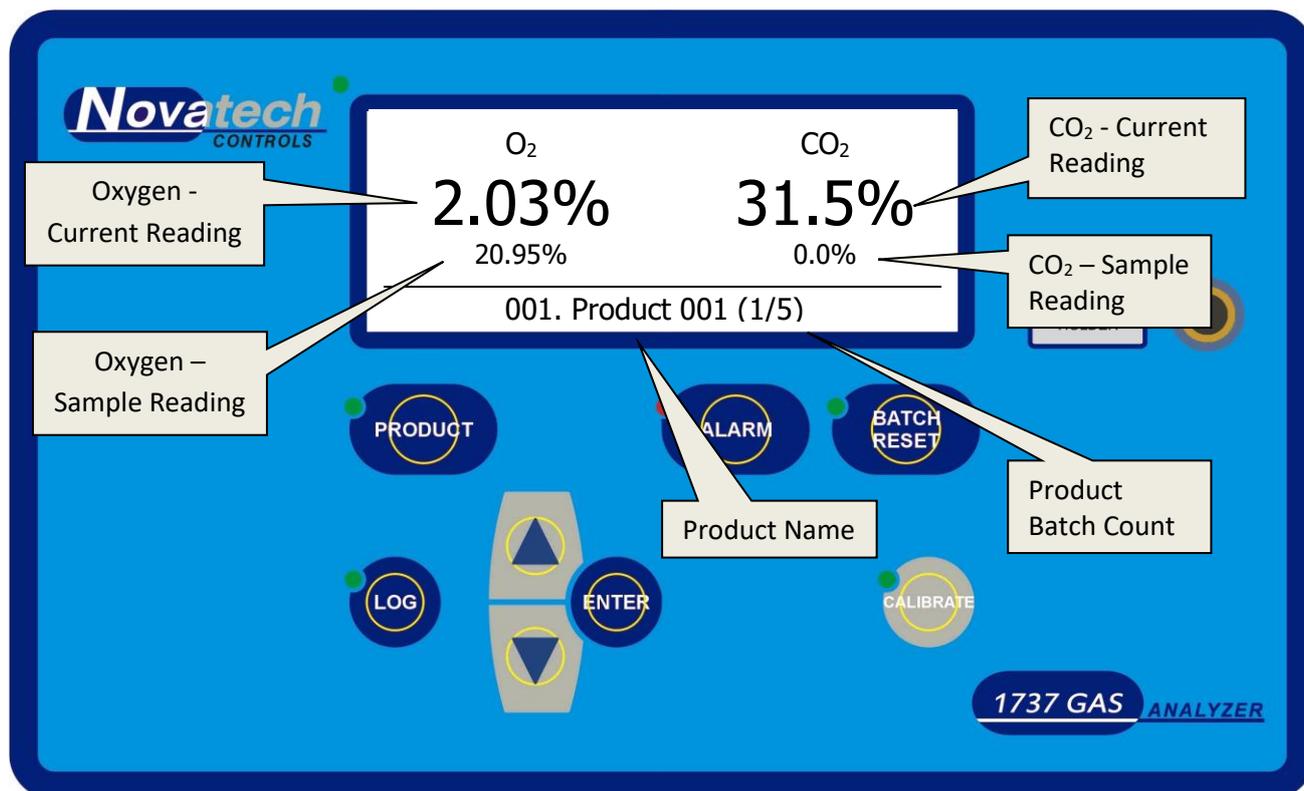
Oxygen – Current Reading
The large number on the left hand side of the display shows the current oxygen reading.

Oxygen – Sample Reading
The small number on the left hand side of the display will show the last oxygen sample taken.

When a new sample is being taken the previous sample will be removed and the oxygen sample remains hidden until the sample is complete.

Carbon Dioxide – Current Reading
The large number on the right hand side of the display shows the current carbon dioxide reading.

Carbon Dioxide – Sample Reading
The small number on the right hand side of the display will show the last carbon dioxide sample taken. Refer to oxygen sample reading above for further information during sampling.

Product Number
This is the index number of the currently selected product

Product Name
A brief description of the product that is currently selected

Product Batch Count
This is a counter that can be used when testing in multiple sample batches. The first number is the current sample; the second is the total number of samples to be testing in the batch.

1.5 Keypad
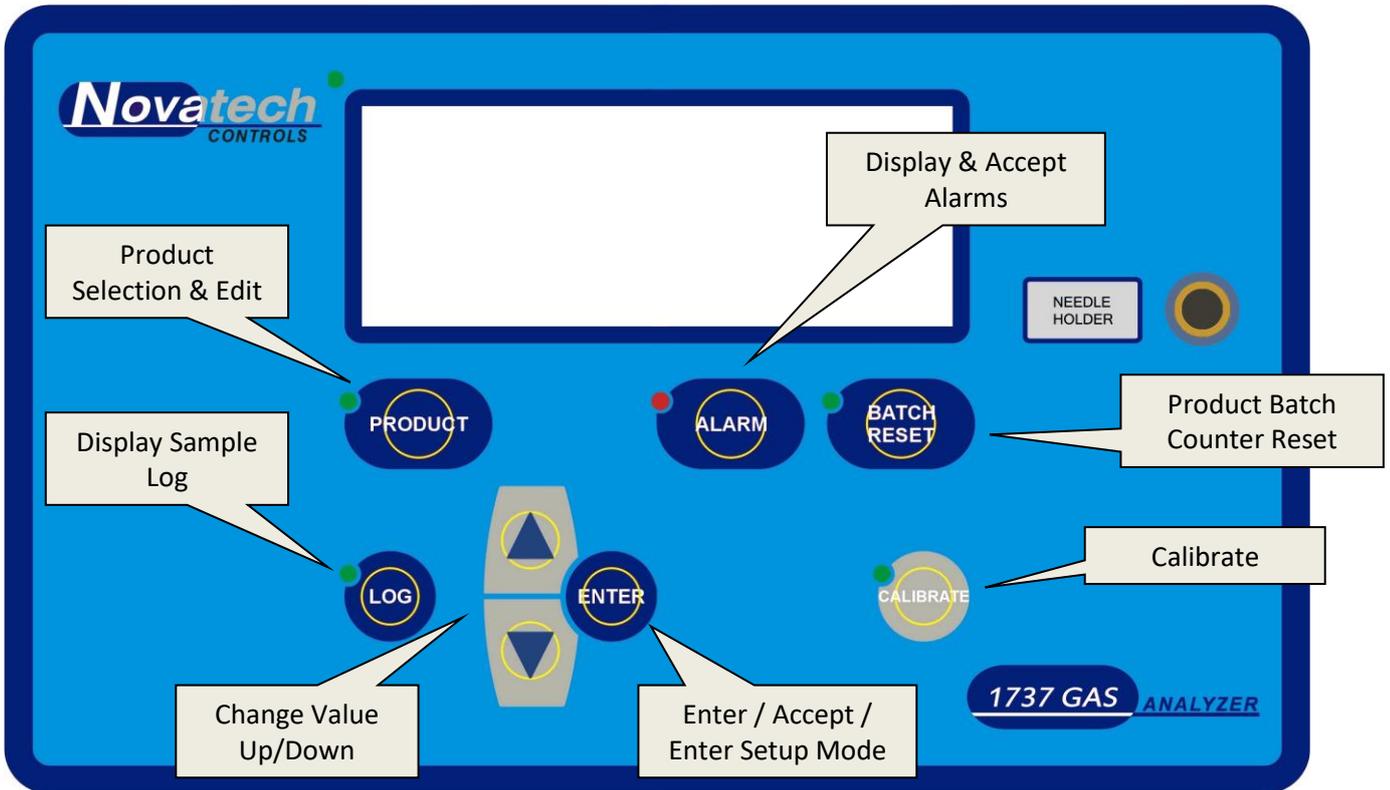
Product Selection & Edit
A short press of the key will bring up the product list to allow the operator to select a product for testing. Press and hold for ~2 seconds to bring up a product edit menu. A short press while in either product list or product edit will take the analyser back to the main screen

Display Sample Log
A short press on the key will show the 'data log summary' of all the samples that have been taken. While in setup mode this key functions as a 'back' key to navigate out of the menu system.

Change Value Up/Down
These two keys are used to change a selection or value.

Enter, Accept, Enter Setup Mode
The enter key is used to confirm a selection. A short press of this key from the analyser main screen will enter the Setup Menu. For more details see Chapter 3.

Display & Accept Alarms
In the event of an alarm being triggered, the alarm LED will flash and the analyser will beep to alert the operator. Press this key to acknowledge the alarm. If the alarm LED is on (not flashing), pressing the alarm key will show the list of currently active alarms.

Product Batch Counter Reset
Press and hold for ~2 seconds to reset the product batch counter.

Calibrate
From *Extended Display Mode*, press and hold this key for ~2 seconds to bring up the calibration selection menu. Use the up/down keys to select which calibration to perform, press enter to perform calibration, or calibrate again to exit without making any changes.

2.1 Turning on the 1637-Mk II

1. Plug the power lead into the analyser and the mains socket.
2. Turn on the power, noting there is a separate power switch on the side of the analyser where the power lead socket is located.

The display will light up and show the Novatech company logo along with software version, serial number, and last calibration date.

3. Screw the sample line onto the 1/8" Swagelok® tube connector above the mains socket on the right hand side of the analyser.

The oxygen & carbon dioxide sensors inside the analyser take approximately 5 minutes to stabilise ready for sampling. During this time there will be no readings displayed on the device.

4. When the analyser is ready to sample it will alert the operator with a single loud beep, the display should look like the below picture (if there is no Carbon Dioxide sensor it will only have oxygen in the centre of the display)

```
    O₂            CO₂
  20.95%        0.0%
    -             -
    001. Product 001 (1/5)
```
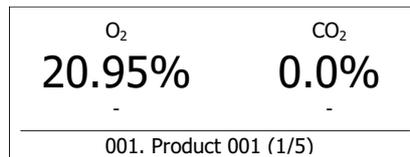
2.2 Taking a Reading

5. Insert the hypodermic through a piece of septum into a food pack to commence a gas reading. The numbers on the display should start changing immediately. Leave the needle in the pack for 5 to 10 seconds, or until the head space is nearly all evacuated.

Take care not to suck any food product or liquid into the sample line. Doing so may damage the analyser and any damage caused by contamination will not be covered by warranty.

6. The display will show the oxygen and carbon dioxide readings in the large characters, the display will say 'Sampling' to indicate that a sample is being taken.

```
    O₂            CO₂
  2.13%         22.4%
 .. Sampling ..  .. Sampling ..
    001. Product 001 (1/5)
```
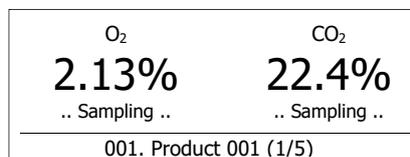
7. On completion of the sample the analyser will notify the operator with one of two noises; two clicks if the reading is within the alarm thresholds, or one loud beep if not. The sample just taken will be shown in small characters below the current reading in larger characters.

```
    O₂            CO₂
  20.95%        0.0%
   2.13%         22.6%
    001. Product 001 (2/5)
```
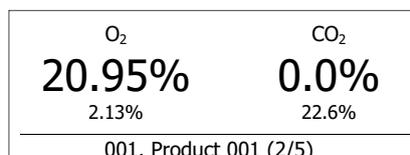
For more detailed information regarding the operation of this analyser, refer to the table of contents and read the specific chapters.

3.1 Operation of the Menu System

The analyser is configured via a menu system that is accessible whenever the analyser is idle. The device has two separate menus; the *'Setup Menu'* and the *'Configuration Menu'*.

Each menu is numbered on the top-left corner and has a brief description of what functionalities it controls. The menu itself will have up to four individual items shown in a list, and on the left-hand-side is a cursor symbol **'>'**, which indicates which item is currently selected.

The keypad uses four keys to navigate through and modify items; *up/down*, *enter* and *log*. As a guide, the *up/down* keys move the cursor up and down and change the value, *enter* is used to select items pointed to for editing, and for saving changes, *log* is used to step backwards, un-select the currently selected item, exit without saving changes, and leave the menu system.

To change an item in the setup menu, navigate first to the menu using the *up/down* keys, and select the menu by pressing the *enter* key. Next navigate to the sub-menu item using the *up/down* keys and select the item by pressing the *enter* key a second time. The item is now selected for modification and will be highlighted. Use the *up/down* key to change the value, and once finished press the *enter* key a third time to save changes. If you wish to un-select the current item, or exit without changing the value press the *log* key.

Once finished, exit the Setup menu by pressing the log key.

Below is a list of options accessible from the Setup and Configuration Menus. The options for each item are listed beneath each heading. The factory default setting is indicated in bold type.

3.2 Extended Display Mode

The analyser has two display modes; the first being the 'Standard Display Mode', the second 'Extended Display Mode'. When the analyser is first powered on it starts up in *Standard Display Mode*. In this mode the oxygen is displayed in large writing on the left hand side of the display, and likewise Carbon Dioxide is displayed on the right-hand-side. The *Standard Display Mode* is ideal for normal use, while for troubleshooting or extracting more detailed operational information, *Extended Display Mode* may be preferred.

To toggle between the two display modes, while idle from the main screen press and hold the Change Value Up key for approximately 5 seconds. If done correctly the analyser will beep and the display mode will be changed.

In *Extended Display Mode*, additional information regarding the Oxygen & Carbon Dioxide sensors is shown, such as Oxygen sensor EMF & Impedance, and Carbon Dioxide cell temperature.

3.3 Setup Menu

To access the Setup Menu, while the analyser is idle, press **enter** from the main screen.

01. Analyser Options
Analyser Mode

Options: **Sample & Hold** / Continuous

The two options here are 'Sample & Hold' and 'Continuous' mode. In Sample & Hold mode the device automatically detects when the hypodermic needle has been inserted into a package. It draws the sample gas out of the package and continuously samples until the readings have stabilised or started returning to ambient. On completion it locks in the sample reading on the display, logs to memory and checks sample gas alarms if they are enabled.

In Continuous Mode the device reads oxygen & carbon dioxide continuously. It checks the sampled gas against the alarm thresholds continuously and triggers alarms if they go outside of the set levels. In Continuous Mode the 4-20mA analog outputs and alarm relays are used to transmit alarm states and gas levels.

Pump Power Off

Options: Always On / 15 secs / 30 secs / 60 secs / **2 mins** / 5 mins / 15 mins / 30 mins

The analyser can turn the sample pump off in Sample & Hold mode if there has been no sample activity or keys pressed for a specified period of time. Enabling this option will prolong the life of the sample pump. When the analyser is in Continuous Mode the pump will never power off due to inactivity.

Product Selection

Options: Enabled / **Disabled**

The product description and selection system can be used to quickly select alarm thresholds when in Sample & Hold mode. When product selection is enabled the alarm thresholds are set using the product edit function. See chapter 3.5 for further details on using Product Selection.

Temperature Units

Options: **Celsius** / Fahrenheit

This option sets the units of display for temperature. Note: Temperature for the oxygen & carbon dioxide cells are not displayed as standard. The display of temperature can be useful in some troubleshooting scenarios. Refer to the troubleshooting chapter of this manual for more details.

02. Internal Clock Date & Time
Date / Time

Use the keypad to set the internal clock on the analyser. This information is used as a timestamp on samples recorded in the product sample log. As an alternative to this method for setting the date & time, the Bluetooth PC Interface can be used to sync the analyser internal clock to the connected PC.

Daylight Savings

Options: **Enabled** / Disabled

This flag can be used to adjust the time for daylight savings without adjusting the internal clock. When enabled the clock is moved forwards one hour.

03. Sample Gas Alarms

Note: Setup Menu 02 is only made available when Product Selection is disabled in Setup Menu 1. For details on how to configure sample gas alarms using Product Selection refer to Chapter 3.5. If Product Selection is disabled, use this menu to set the sample gas alarm thresholds.

Low O_2 Alarm / High O_2 Alarm / Low CO_2 Alarm / High CO_2 Alarm

Options: Oxygen: **Disabled** / 100ppm - 100% in graded increments. Increments of 100ppm from 100ppm to 1%, increments of 0.1% from 1% to 25%, then increments of 1% from 25% to 100%.

Carbon Dioxide: **Disabled** / 0.1 – 100% in 0.1% increments.

Note: Setup Menus 03, 04 & 05 are only made available when the analyser is operating in Continuous Mode.

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04. Transmitter Output 1

Output Var

Options: **Oxygen** / Carbon Dioxide / Oxygen EMF / No Output

Scale 4mA / Scale 20mA

Options: The scaling options of the 4-20mA outputs depend on the output variable selected;

Oxygen: 0% – 100% in graded increments. Increments of 100ppm for 0% to 1%, increments of 0.1% from 1% to 25%, increments of 1% from 25% to 100%.

Carbon Dioxide 0% to 100% in 1% increments

Oxygen EMF: 0mV to 1500mV in 100mV increments

04. Transmitter Output 2

Output Var

Options: Oxygen / **Carbon Dioxide** / Oxygen EMF / No Output

Scale 4mA / Scale 20mA

See Setup Menu 03 for detailed explanation of scaling options

06. Alarm Relays
Relay 1 / Relay 2 / Relay 3 / Relay 4

These four field programmable relays can be triggered on hardware or process alarm conditions. By default, Relays 1 through to 3 are configured to trigger on process related alarms, and Relay 4 is configured by default to trigger on hardware related alarms. If you wish to use Relay 1-3 to trigger specific hardware alarms it must be first disabled from Relay 4, after which the de-selected hardware alarm will become available as an option in Relay 1-3.

Multiple alarm conditions can be configured for any individual Relay, the menu system indicates that an alarm has been associated with a Relay by placing an asterisk on the far right side of the line when scrolling through the alarm conditions. By default, Relay 1-3 are not programmed with any alarm conditions, Relay 4 is programmed to trigger on all hardware alarm conditions.

Options:		Relay 1	Relay 2	Relay 3	Relay 4
Hardware Alarms	Oxygen Heater Fail				*
	Oxygen High Impedance				*
	Oxygen TC Open Circuit				*
	CO_2 Sensor Error				*
	CO_2 Lamp Error				*
	Sample Pump Error				*
	Sample Pump Overload				*
	Internal BBRAM Error				*
	Internal Memory Error				*
	ADC Hardware Check Fail				*
	Output 1 Failure				*
	Output 2 Failure				*
	Oxygen SSR Failure				*
	Bluetooth Error				*
Process Alarms	Oxygen High				
	Oxygen Low				
	Carbon Dioxide High				
	Carbon Dioxide Low				

3.4 Configuration Menu

To Access the Configuration Menu, the analyser must first be set to 'Extended Display Mode'. See Chapter 3.2 above on instructions on how to access this feature.

Once in Extended Display Mode, to access the Configuration Menu, while the analyser is idle press and hold the *enter* key for approximately 3 seconds from the main screen.

01. Input Calibration
Reference 1 / Reference 2 / Reference 3 / Reference 4.

These four options set the analog calibration for the analyser. The analog reference points are located inside the analyser on the main PCB near the centre/top. During calibration these analog reference voltages are read using a digital multimeter, and the respective values are entered into these four menus.

For further information on Analyser calibration refer to Chapter 6.

02. Installation Options
<u>CO₂ Cell</u>
Options: **Enabled** / Disabled

If there is no CO_2 cell installed in the analyser, Carbon Dioxide is automatically disabled, and this menu is of no use. If, however the analyser does have a CO_2 cell installed and you wish to manually disable Carbon Dioxide without physically removing the cell then this menu should be used.

<u>Bluetooth</u>
Options: **Enabled** / Disabled

Bluetooth™ communications is achieved using an optional Bluetooth module. If the Bluetooth module is not installed this menu should be set to disabled to prevent Bluetooth fail alarms.

03. Analog Ch.1 Calibration
04. Analog Ch.2 Calibration
Note: Both Calibration Menu 04 and 05 are only accessible if the analyser is configured in Continuous Sampling Mode. See Chapter 3.3 for further details.

<u>Mode</u>
Options: Auto Calibrated / Manually Calibrated / Calibrate 4mA / Calibrate 20mA

The two 4-20mA analog output channels can be calibrated automatically using on-board circuitry, or manually using a DMM or other external hardware. Menu items 'Auto Calibrated' and 'Manually Calibrated' indicate the analyser is currently transmitting using the selected calibration. If you select either of the next options then the analyser will transmit a fixed manually calibrated 4mA or 20mA level on the selected channel allowing the operator to measure this level and to adjust the calibration accordingly.

<u>4mA Trim</u>
Options: 2.50mA to 6.50mA in 0.01mA increments, default **4.00mA**

<u>20mA Trim</u>
Options   18.00mA to 22.00mA in 0.01mA increments, default **20.00mA**

The menu item '4mA Trim' appears when 'Calibrate 4mA' is selected in Mode above, likewise '20mA Trim' appears when 'Calibrate 20mA' is selected in Mode above. The default value 4.00mA or 20.00mA indicates that no manual calibration has been performed. In order to manually calibrate a particular level, set this value to default then read the output using external hardware. Whatever value is seen on the external hardware, enter this value into the Trim menu and press **enter**. The analog output level should immediately adjust towards the calibrated 4mA or 20mA level.

If the uncalibrated 4mA or 20mA levels are significantly out it may require some fine tuning once the Trim value has been entered.

When fine tuning the analog output, if you wish to increase the analog output by a small step decrease the trim value by one increment and press **enter**. Likewise, if you wish to decease the analog output by a small step increase the trim value by one increment and press **enter**.

Make sure that you press **enter** after each incremental change to the Trim value as the analog output will not be updated to reflect changes until you have done this step.

05. Sample Pump

Sample Pump
Options: **Internal** / External

The sample pump used to draw the sample into the analyser is in most cases located inside the analyser, however in some special cases it may be required that the pump be located externally. By setting this option to External the internal pump drive circuitry and associated hardware alarms are disabled.

Pump Voltage
Options: 2.50V to **5.00V** in 0.25V increments

 This option is only available if the sample pump is set to internal in the previous menu item. The voltage to the pump is directly proportional to the pump speed and volumetric sample rate.

06. Oxygen Calibration

Offset
Options: ±6.00mV or **Automatic**

The zirconia based Oxygen sensor used by the analyser will have some fixed offset associated to it. This value corresponds to the probe EMF reading when sampling ambient air. If the device is configured as 'Sample & Hold' then the offset can automatically be adjusted by the analyser when it detects that it's sampling ambient air. If the device is being commissioned in Continuous Mode, it is important to manually set this value. When entered manually, the offset value is the Oxygen probe EMF reading in ambient air, in the same polarity as shown on the display in Extended Display Mode.

Low O2 Calibration
Options: 80.0% to 120.0% in 0.1% increments. Default value is **100.0%**.

The low oxygen calibration factor can be used to fine tune the oxygen calculation at low oxygen readings. It will not affect the measurement at ambient. It is advised that you do not alter this value.

Damping
Options: No Damping through to 10x Sampling. Default is **2x Sampling**

While in Continuous Mode, oxygen measurement can be damped by averaging successive readings from the sensor. This will smooth out any fluctuations in the sample gas level, but will also slow down the reaction time of the analyser. The larger the number selected here, the more successive readings that are averaged.

Oxygen damping is not applied while in Sample + Hold mode.

07. CO_2 Signal Tuning

> **NOTE: All values in this menu are set using the automatic Carbon Dioxide calibration process described in Chapter 6. Altering these values directly is not advised, and doing so will alter the device calibration.**

CO_2 Gain / CO_2 Offset
The Carbon Dioxide analog circuitry needs to be correctly configured to maximise input range and accuracy. The Gain & Offset alter this signal accordingly.

Lamp Duty Cycle
The CO_2 signal lamp is switched with a fixed duty cycle that can be altered using this menu. It is not advised that you alter this value manually.

Lamp Cycle Time
The cycle time of the CO_2 signal can be adjusted to increase or decrease sample time. It is not advised that you alter this value manually.

08. CO_2 Calibration

> **NOTE: All values in this menu are set using the automatic Carbon Dioxide calibration process described in Chapter 6. Altering these values directly is not advised, and doing so will alter the device calibration.**

Zero Counts /Span Counts
The Zero Counts value correlates to the number of counts sampled via the internal ADC when the CO_2 cell is reading 0% Carbon Dioxide (ambient air). The Span Counts correlates to the number of counts samples when the CO_2 cell is reading 100% Carbon Dioxide. These values are both set automatically during the automatic calibration process and should not be altered.

Cal Temperature
The temperature at which the CO_2 cell is calibrated is used to fine tune the Carbon Dioxide readings. This value is set automatically during the automatic calibration process and should not be altered.

09. CO_2 Mid Gas Calibration

Mid Cal Gas
Options: 20.0% to 60.0% in 0.1% increments. Default **30.0%**.

To fine tune the calibration of the Carbon Dioxide, a 'Mid Gas Calibration' is recommended using a certified gas bottle with CO_2 concentration close to that being measured. The concentration of the CO_2 gas to be used for this Mid Gas Calibration should be manually entered into this menu.

Mid Cal Adjust
Options: ±7.0% in 0.1% increments. Default is **0.0%**

This number shows the fine tune trim factor applied to the CO_2 calculations at the Mid Cal Gas concentration entered in the menu above. This value is set during the automatic CO_2 calibration process described in Chapter 6.

10. Products & Log
NOTE: Clearing internal log or resetting Products is not reversible.

Reset Internal Log
The analyser has an internal log that automatically records information on all samples taken using the device. This log can be reviewed or downloaded via Bluetooth™ for review and archiving. To clear the internal log, select this item and press **enter**.

Reset Products
The analyser has a Product Selection system for configuring process gas thresholds and alarms. The products as shipped from the factory are designed to be altered to the end users specification. To reset the Product descriptions and sample gas alarm thresholds to factory defaults select this menu and press **enter**.

11. Mains Detection

> **NOTE: It is not advisable to alter any values in this menu without being explicitly instructed to by the manufacturer or supplier.**

Mains Voltage
Options: **Automatic** / 100-127V / 220-240V

Mains Frequency
Options: **Automatic** / 50Hz / 60Hz

The oxygen sensor inside the analyser uses mains power to run the heater.   The default setting for the analyser is to automatically detect mains voltage and frequency. If the mains detection system fails for any reason then mains voltage and frequency can be manually set using this menu.

SSR Fail Protection
Options: **Enabled** / Disabled

In the event of the solid state relay (SSR) that controls the oxygen heater failing and short circuiting on then the device can automatically detect this and protect the oxygen sensor from being damaged. If the SSR fail system is causing errors then it can be manually disabled. This is not advisable.

12. Transmit Options

This menu is only visible if the analyser is set to 'Continuous Mode'. See Chapter 3.3 for details.

Output Range
Options: **4-20mA** / 0-20mA / 4-20mA Restricted / 0-20mA Restricted

The two analog outputs can be scaled 4-20mA or 0-20mA. The outputs are active powered and capable of driving 20mA @ 1000 ohms, or 24mA @ 850 ohms. If enabled, the analog outputs will transmit the selected process variable as scaled. If the process variable is over or under scale, then the output will continue to transmit scaled analog signal outside of range unless this option is set to 'Restricted'. If set to 'Restricted', this prevents the analog outputs from transmitting outside of the selected output range, even if the selected process variable goes out of range.

Variable Invalid
Options: **Hold 0mA** / Hold 4mA / Hold 20mA

While the analyser is in operation the analog outputs are always transmitting and are never be switched open circuit. For instances where the process variable selected to transmit is invalid, the output needs to have a 'hold' level that will indicate that there is no valid value.

3.5 Product Selection

Overview
The 1637-Mk II analyser is designed to be easily customised to the requirements of the end user. The analyser is designed with the primary use of sampling modified atmospheres in enclosed spaces, but can also be used for continuous monitoring.

To improve the use as a sample and hold device a Product Selection system was created in which a number of Products can be predefined. These products can be as simple as a meaningful description for what is being sampled, or can be more detailed to include alarm thresholds for both oxygen and carbon dioxide, and batch sample counting to allow for grouping of samples in the internal log.

Once configured, the Product Selection system can be used to quickly switch between items being tested, and remove human error from the process of correctly setting up alarm thresholds. Samples taken are also logged with product information attached so that review of samples taken is more informative.

To enable this feature, 'Product Selection' must be enabled in Setup Menu 1.

Selecting a Product
Once enabled, the operator can press the ***product*** key on the keypad to bring up a list of available products. To select a product from the list use the ***up/down*** keys to highlight the desired Product, and press ***enter*** to select the highlighted product and return to the main screen.

To return to the main screen without making any changes, press the ***log*** key.

Creating and Editing Products
By default five basic products are made available with Product Selection is enabled, however to make proper use of the Product Selection functionality the products should be altered to be more meaningful.

To access the Product Edit menu, press and hold the ***product*** key for 2 seconds until the analyser makes a second beep and the words 'Editing Products' appears on the display.

The Product Edit Menu operates similarly to the Product Selection Menu using the ***up/down*** keys to move through the list and ***enter*** to select the highlighted product. On selection of a product a new editing screen is shown where the ***up/down***, ***log*** and ***enter*** keys are used the same as in the Setup Menu system.

Editing of the product description requires the use of the ***alarm*** and ***batch reset*** keys to move the cursor backwards and forwards respectively. The ***up/down*** keys change the underlined character and the number of characters available in the description is bound by a maximum of 22 characters, or the edge of the display.

To return to the list of edit products, and to return to the main screen once product editing is complete, press the ***log*** key.

The 1637-Mk II has an alarm system designed to alert the operator of any hardware or process gas related alarm states.   The analyser uses flashing LED indicators, internal beeper and the LCD display to alert the operator of any new alarms. Additionally, the LED indicator will also remain lit to advise the operator of any alarm conditions that are acknowledged, but still present.

When an alarm is triggered the alarm LED on the front of the case will flash, a single beep will be emitted, and a short description of the alarm will appear on the display.

If the cause of the alarm is a sample gas reading outside of the defined alarm thresholds, the operator acknowledges the alarm by pressing the alarm key to clear the alarm and ready the analyser for the next sample.

Sample gas alarm checks occur at the completion of a gas sample.

Hardware related alarms will trigger any time the analyser detects a problem. With hardware alarms, once the alarm is acknowledged by the operator, the alarm LED stops flashing, but remains lit until the alarm condition is physically cleared. By pressing the alarm key again a list of active hardware alarms is displayed.

4.1 Sample Gas Related Alarms

The alarm parameters for the sample gas alarms are either set in the setup menu when product selection is disabled, or via the product editing features described in Chapter 3.5. When a sample is completed and the oxygen & CO_2 readings have been recorded the new sample readings are checked against the alarm parameters.

High Oxygen / Low Oxygen
The oxygen measurement in the last sample is above or below the high oxygen alarm threshold.

High CO_2 / Low CO_2
The CO_2 measurement in the last sample is above or below the high CO_2 alarm threshold.

4.2 Hardware Alarms

The analyser constantly monitors many aspects of its operation and will quickly detect any faults. These alarms are related to the operation of the hardware and will vary from being easily fixed by the operator through to a serious hardware failure requiring technical assistance or repair.

Oxygen Heater Fail
The oxygen sensor has not been able to reach operational temperature after 20 minutes. This indicates problems with the oxygen heater and may require replacement.

Oxygen High Impedance
The oxygen sensor measures high impedance in normal operation once it has reached the end of its operational life. The operational life of an oxygen sensor is expected to be several years and will require replacement of the oxygen sensor.

Oxygen TC Open Circuit
The oxygen sensor thermocouple is registering as being open-circuit. This may be caused by a break in the wire inside the sensor, or if the sensor wires have come loose in the plug.

CO$_2$ Sensor Error

This error occurs when the CO$_2$ cell is unable to detect a signal within range. It will occur either when the CO$_2$ sensor physically fails, or if the calibration of the CO$_2$ cell has been affected and is reading saturated readings. If re-calibrating the CO$_2$ cell does not fix the problem, the CO$_2$ sensor will need replacement.

CO$_2$ Lamp Error

The CO$_2$ lamp has failed. The CO$_2$ cell will require replacement.

Sample Pump Error

Very low or no current is being drawn by the sample pump. This alarm most likely means the physical connection to the sample pump has been broken or the sample pump itself has ceased working. The pump may require replacement to resume operation.

Sample Pump Overload

Excessive current is being drawn by the sample pump and it has been disabled to prevent damage to the analyser hardware. Replacement of the sample pump will be necessary to resume operation.

Internal BBRAM Error

The real time clock on the main PCB is backed up by a lithium battery to keep time while the system is powered down. This alarm indicates that the battery backed RTC module has failed.

Internal Memory Error

The internal flash memory for storing the sample log and device configuration has failed. This will instantly render the device un-calibrated and it should be returned for service and re-calibration. The data logging functionality will not be working.

ADC Hardware Check Fail

The analogue to digital signal converter has failed to calibrate correctly. In the event of this alarm the analyser will be rendered un-useable and will require service and re-calibration.

Output 1 Failure / Output 2 Failure

Both analog outputs have internal calibration and diagnostic abilities. The two respective alarms will be triggered if the ADC cannot check calibration is within normal specifications, or cannot detect any output signal.

Oxygen SSR Failure

The hardware used to control the heater for the oxygen sensor has failed. The oxygen sensor will not be available until it is fixed.

Bluetooth Error

The Bluetooth module on the main PCB has failed to be detected or initialise in a reasonable time. Wireless communications will be unavailable.

The 1637-Mk II analyser has an optional Bluetooth™ communications module allowing it to wirelessly link with Bluetooth enabled devices. Using Bluetooth, the analyser is able to perform tasks such as configuration of Products & Alarm thresholds as well as exporting the contents of its internal sample log for easy viewing and manipulation.

The PC Interface software supplied by Novatech is compatible with Microsoft® Windows™ and can be freely downloaded from the Novatech Controls website: http://www.novatech.com.au/

Operating System Requirements:
- Microsoft Windows XP or newer
- Bluetooth enabled PC

At this stage there is no intention on the behalf of the manufacturer to produce software for any other operating systems or devices. If you wish to produce your own software for use on other platforms details of the communications stack and protocols will be made available on request.

5.1 Pairing Bluetooth Devices

Before starting the program and communicating with your analyser for the first time you must first pair the analyser and the computer. The procedure for this varies slightly for different operating systems. Some steps below may require Administrator privileges to perform.

- Turn on the Bluetooth enabled analyser you wish to pair
- From Windows, open the Control Panels, locate and open Bluetooth Devices
- Click the Add button to add a new Bluetooth device. Check the box on the next windows stating 'My device is set up and ready to be found'. Click next.
- After a brief delay a box will appear showing all nearby Bluetooth devices. If the analyser does not appear in the box check that Bluetooth is enabled and click search again to repeat the process. The Novatech Controls 1637-Mk II analysers should be recognisable as blue icons with the name *NTC1637_SN#xxxxx* where x is replaced with the device serial number
- Select the analyser and click next
- In the next window asking for a passkey, select the second radio button from the top 'Use the passkey found in the documentation'
  The passkey for analysers is **novatech** (all lower case). Click next
- If successful Windows will now complete the process of pairing your Bluetooth devices and setting up appropriate connections to allow the software to communicate with the analyser
- Click finish to close the wizard and close the Bluetooth Devices Control Panel.
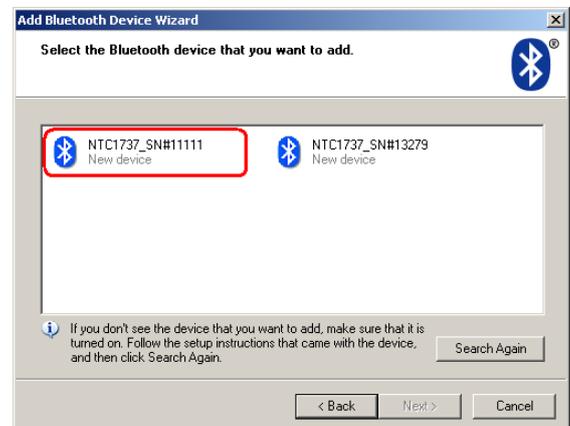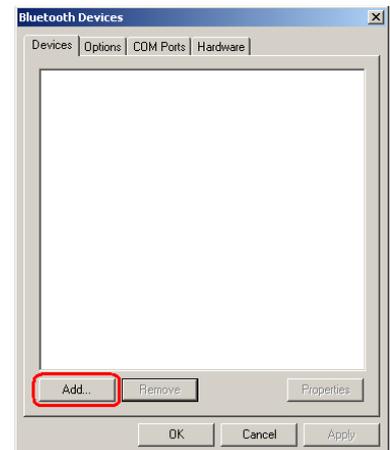
5.2 PC Interface Software

The program is designed to provide a simple interface for editing of products used in the Product Selection system, and for transferring the contents of the internal sample log. There is one main screen consisting of three boxes, some basic device information and a single row of buttons along the right-hand side.

The top box lists all available paired devices, the middle box the products that are defined, the bottom box lists sample log items.
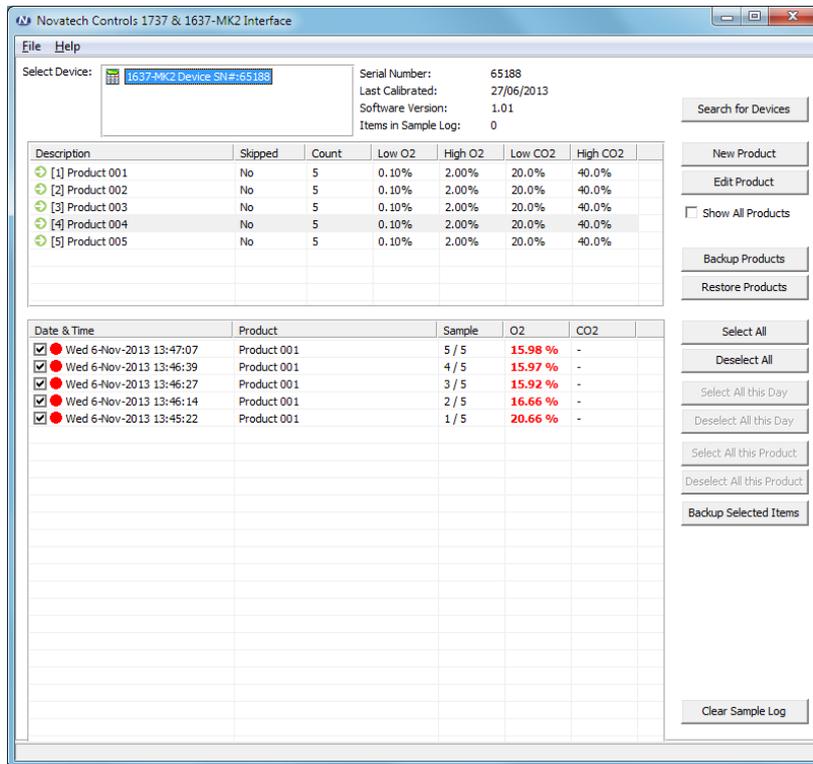
On start-up the program automatically begins searching for 1637-Mk II analyser devices and lists the devices in the top box. The first analyser discovered is automatically selected and the next two boxes showing Products and Sample log are automatically filled. When you select an analyser from the top box the information in the middle and bottom boxes should also automatically update. At any time you can manually refresh Products or the Sample Log by right-clicking the box and using the popup-menu.

The buttons down the right-hand side are used to perform their indicated tasks. Products can be created and edited, or backed up/restored between different devices.

To edit products either double-click the product to be edited or highlight the item in the list and click the *Edit Product* button. A dialog box will be displayed to edit the product details and alarm thresholds. Click OK or Cancel to return to the main screen.

The process of creating a new product is almost the same as editing an existing product. You can have up to 200 individual products defined on the 1637-Mk II analyser.

The sample log consists of a serial of date-stamped Oxygen and CO_2 samples listed chronologically from newest to oldest. The check-boxes next to each item allows for individual selection and de-selection of sample log items.

To assist in selecting specific samples based on either date or product criterion there are buttons Select/Deselect All this day and Select/Deselect All this product. When you click one of these buttons, the program looks at the item currently highlighted item and selects/deselects sample items as

The 1637-Mk II analyser is calibrated before leaving the factory and requires annual re-calibration. The analyser itself is self-calibrating with no adjustments. The analog to digital converter input stages are checked against a precision reference source and calibrated once every minute. If an error occurs due to electronic fault then an ADC Calibration Error alarm will be triggered.

A one-off calibration procedure of the precision references is done during factory calibration and should never need to be repeated for the instrument unless it is repaired.

The two digital to analog output converters are tested for accuracy when the analyser goes through the startup procedure, or when they are enabled. If the output calibration factors are found to be out of range, then a 'Output x Error' alarm is triggered. During this calibration process the output signals will go open circuit for approximately 2 seconds each.

6.1 Oxygen

There is only one calibration adjustment necessary for the oxygen sensor; Sensor Offset. An incorrect value for the Sensor Offset will affect an oxygen reading at 21% by ~1% for every 1mV error, but will have very little effect on oxygen readings below 2%.

When in Sample & Hold mode, the Sensor Offset can be set to Automatic, which allows the analyser to automatically detect when there is no sample gas present. With no sample gas present the zirconia sensor should have no oxygen partial pressure difference across the cell, and the analyser can trim the Sensor Offset accordingly.

When in Continuous mode the analyser is unable to automatically trim the Sensor Offset value. To calibrate the oxygen Sensor Offset manually, first set the analyser to 'Extended Display Mode'. Remove the sample line from any process or sample gas so that the analyser is sampling ambient air. The oxygen sensor EMF should drop down to a steady reading of < ±2mV. This mV value should be entered into the Calibration Menu 05.

6.2 Carbon Dioxide

After power is turned on to the analyser the carbon dioxide sensor will begin functioning in under a minute, although it will not reach full stability and repeatability until the temperature has stabilised, which takes approximately 15 minutes. Before performing a calibration of the CO_2 it is recommended to allow the device to stand in air for 60 minutes to allow the analyser to reach a steady operating temperature.

The CO_2 calibration has two parts that can be selected individually from the calibration menu;
- Zero and Span Calibration
- Mid Gas Calibration

Zero and Span Calibration

The Zero and Span calibration is an automated process requiring a 100% CO_2 test gas. It requires the cell to sample both 0% CO_2 and 100% CO_2 so that it can adjust the gain of its internal sensing circuitry to maximise reading resolution and accuracy. Whilst doing this it also performs a zero and span calibration.

To perform a Zero and Span calibration start by preparing a 100% CO_2 test gas bottle and regulator

- Press and hold the **calibrate** key for 2 seconds to display the calibration menu and select the first option 'Set CO_2 Zero & Span'
- The display will prompt the operator to remove the needle from any CO_2 source, allowing the analyser to sample ambient air. To continue press any key
- When prompted to insert the needle into a 100% CO_2 source. Use the regulator to set the 100% CO_2 gas bottle to approximately 300cc/min and place the sample needle inside the gas tube 2cm so that the sample pump can pull gas rather than having pressurised sample gas forced into the sample line.
- Continue to follow the prompts and remove the needle when requested. You may be asked to insert the needle into the 100% gas source a second time.

Calibration will take a few minutes to complete and following a successful calibration number for CO_2 sensor span and offset are displayed on the LCD and the analyser returns to the main screen.

Mid Gas Calibration

Mid Gas Calibration is performed to increase accuracy of the CO_2 sensor in the specific region of the test gas. It is a single step calibration procedure which requires a certified CO_2 test gas in the range of 20% - 60% CO_2 in nitrogen.

Before starting the calibration process ensure that the Mid Cal CO_2 gas content of the calibration gas has been correctly entered in the Calibration Menu.

- Using a regulator set the mid cal gas source to approximately 300cc/min and place the sample needle inside the gas tube 2cm so that the sample pump is able to pull gas rather than having pressurised sample gas forced into the sample line.
- Wait 30 seconds to ensure the CO_2 sensor has a stable reading.
- Press and hold the **calibrate** key for 2 seconds to display the Calibration Menu and select the second option 'Calibrate CO_2 x.x%' where x.x is the oxygen value of the certified gas.

Once complete the mid gas calibration will immediately become active. It is recommended to test the calibration by immediately taking a fresh sample from the certified gas.

WARNING:
Performing maintenance on the 1637-Mk II analyser will be outside of the scope of most operators. This information is provided as a reference only. The 1637-Mk II is a delicate instrument that incorporates both mains voltage and sensitive electronics and sensors. Damage caused to the analyser during unauthorised repairs or modification will not be covered by warranty.

7.1 Analyser Information Screen

The 1637-Mk II has an information screen that can assist in the preliminary diagnosis of problems, or simply provide additional information regarding the analyser. It is accessible via the keypad and does not affect the operation of the analyser, making it ideal as a first point of reference should you suspect a problem.

To access the information screen; From the main screen press and hold the **up** & **down** keys together for approximately 1 second. Once the information screen appears, release the two keys. Navigate through the information screen using the **up/down** keys and exit back to the main screen by pressing **enter**.

The screen displays the following information;

- Serial number
- Software version & compile date
- Calibration date
- Current ambient & maximum ambient temperature
- Current CO_2 cell temperature & maximum CO_2 cell temperature
- Current date & time
- Next oxygen impedance test time
- ADC calibration details
- DAC calibration details
- Mains Power detection information
- Oxygen heater power output information
- Oxygen stability
- Sample log information
- Bluetooth device address & status
- CO_2 detection information
- Analog output levels

7.2 Frequently Asked Questions

What does it mean when there is a '-' symbol instead of the Oxygen or CO_2 reading?

The Oxygen or CO_2 sensor inside the analyser is not ready for taking readings. It takes up to 5 minutes for the oxygen sensor to reach operational temperature once powered up, less for the CO_2 sensor. Allow the device time warm up before attempting to take readings.

How often should I calibrate the analyser?

The oxygen and CO_2 sensors require re-calibration every 12 months. Between calibrations the device can automatically compensate for changes in environmental conditions. If you believe the analyser is not reading accurately then it will require a known calibration source such as certified content gas bottles to check the calibration.

Why can't I connect to the device via Bluetooth

If you are unable to find the analyser using the 1637-Mk II Bluetooth interface then you should try moving the analyser and Bluetooth radio closer together. If this still does not work then try removing and re-pairing the Bluetooth device with the PC. Refer to Chapter 5 for details.

The oxygen sensor / carbon dioxide sensor is reading high or low

Check that the sample line being used is not blocked or leaking. Ensure the Swagelok fitting is correctly tightened and that the inline filter and hypodermic needle are securely attached. Also check for any cracks in the filter or blockages in the sample line, filter and needle.

It may be useful to replace the entire sample line and see whether this fixes the problem.

Regarding hardware related alarms

If a hardware related alarm triggers it is unlikely the analyser can be repaired on site by the operator. The device contains high temperatures, mains voltage as well as delicate sensors and electronics. For specific information on faults and for repairs please contact the reseller of the analyser, or Novatech Controls directly.

END OF LIFE TREATMENT AND FINAL DISPOSAL

Instructions for Disposal by Users

The Waste from Electrical and Electronic Equipment (WEEE) EU Directive aims to reduce the amount of WEEE going to landfill.

The symbol shown below is on the product or on its packaging, which indicates that this product must not be disposed of with other waste. Instead, it is the user's responsibility to separate their waste electrical and electronic equipment and hand it over to a designated collection point for the disposal of.

To further reduce waste to landfill, the steel and aluminium parts of probes/sensors may be separated and handed to a metals recycler.

The separate collection and recycling of your waste equipment at the time of disposal will help to conserve natural resources and ensure that it is recycled in a manner that protects human health and the environment. For more information about where you can drop off your waste equipment for recycling, please contact your local city office or your general waste disposal service.