



Rapidox 1100ZR Oxygen Analyser

Instruction Manual

Revision 3.7

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Declaration of Conformity

Manufacturer: Cambridge Sensotec Ltd.
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Product Names: Rapidox portable oxygen gas analyser

Model Numbers: RX1100ZR

Conform to the following specifications:

EMC: EN 61326:1998 Electrical equipment for measurement,
control and laboratory use

Declaration: I declare that the above products conform to the applicable requirements of the LVD Directive 73/23/EEC and the EMC Directive 89/336/EEC and is CE marked accordingly.

Signature: 

Name: Dr. Mark Swetnam

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Company: Cambridge Sensotec Limited

Date: 4th May 2009

WEEE Regulations 2006



Cambridge Sensotec takes its responsibilities under the WEEE Regulations extremely seriously and has taken steps to be compliant in line with our corporate and social responsibilities. In the UK, Cambridge Sensotec has joined a registered compliance scheme "WeeeCare" (WeeeCare registration number WEE/MP3538PZ/SCH).

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1. Introduction

The Rapidox 1100ZR oxygen analyser allows fast and accurate oxygen analysis over the oxygen range 1ppm to 100% O₂. The analyser provides continuous on-line oxygen analysis, with a typical response time of less than 4 seconds for a 90% response to a step change in gas compositions.

The Rapidox 1100ZR is a fully integral unit complete with a powerful diaphragm pump to provide variable gas sampling up to approximately 1.2 litres per minute.

The sensor head is located inside the analyser and comprises a zirconia ceramic tube that needs to be heated to 650°C before it will conduct oxygen ions. The analyser supplies heat to the sensor, which is controlled very accurately by a regulated power supply incorporated in the instrument. An internally mounted pressure sensor compensates for any fluctuations in pressure or vacuum caused by differing flow conditions.

The analyser is packed with features including programmable alarm circuits, programmable analogue outputs, easy calibration (user selectable gases), RS232 communications and complete communications / data-logging software.

2. Features

- ✓ Very fast measurement response (typically 4 seconds for a 90% response).
- ✓ Wide measurement range available (1ppm to 100% O₂).
- ✓ Accuracy $\pm 1\%$ of the actual measured oxygen with a precision of $\pm 0.5\%$.
- ✓ Easy calibration procedure requiring any two or three gas mixtures (ordinary room air is usually one).
- ✓ Low maintenance, sensor life expectancy typically 17,500 hours
- ✓ Powerful variable speed diaphragm pump fitted for sampling the gas
- ✓ Large back-lit LCD display (16 x 2 characters).
- ✓ RS232, 0-10V and 4-20mA current loop outputs (both fully programmable).
- ✓ Fully programmable alarm circuits.
- ✓ Full data-logging software accessed via RS232 connection to a PC (RS485 available on request).
- ✓ PIN code protection available
- ✓ Optional printer attachment

3. Specification

3.1 *Dimensions & Power Requirements*

Case dimensions: W=250mm; D=263mm; H=150mm. Weight=3.5kg. Metal carrying handle supplied as an option. Runs on ANY Worldwide voltage 90-260VAC 50/60Hz.

3.2 *Accuracy and Precision*

Sensor response time is typically 4 seconds for a 90% response involving a step change in composition. High accuracy is maintained between calibration points. Accuracy is $\pm 1\%$ of the actual measured oxygen content with a precision $\pm 0.5\%$. Outside the calibration range accuracy is typically $\pm 2.5\%$.

3.3 *Display*

The analyser has a 2-line 16x2, 9mm character, back-lit liquid crystal display (LCD), whose data update rate is user-programmable. The LCD displays four significant figures of oxygen (O₂). The display notation (percent, ppm, exponential or 'automatic') is user selectable.

3.4 *Calibration*

The simple and fully flexible calibration procedure requires two or three calibration gases (ambient air 20.95% is normally used as calibration gas "HIGH"). The calibration gas compositions are user-selectable and programmed into the Rapidox via the keypad menu or the RS232 link and configuration software. Factory pre-sets can be reloaded to allow the unit to be 'rescued' from a failed calibration. The Rapidox is calibrated using the keypad on the front panel or directly with the software provided. The LCD changes to calibrate mode to inform the user of progress.

3.5 *Operating Temperature*

Gas inlet temperature must not exceed 60°C. The Rapidox unit's normal operating temperature is 5-35°C.

3.6 *Outputs*

The RS232 serial port (RS485 is available on request) outputs on demand values for oxygen (ppm), the internal pressure sensor data (pressure in bar), time (hh:mm:ss) and date (dd/mm/yy). This data can be downloaded and logged using the software provided.

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Standard 0-10V and 4-20mA analogue outputs are available on the rear panel for both O₂ and pressure, as are 10V (logic level) normally-open or normally closed reed relay alarm signals (assignable to any gas). These outputs are fully user-programmable via the front keypad or RS232 link and the supplied configuration software using the RS232 link.

4. Technical Specification

Property	Specification
Supply Voltage	90-260VAC, 50/60Hz
Power consumption	100W (max)
Analyser dimensions	250mm X 263mm X 150mm
Weight	3.5 kg
Display	16 × 2 character (9mm) back lit LCD
Warm up time	3-4 minutes at 20°C
Normal operating temperature	5-35°C
Sensor Range	1ppm to 100% O ₂
Sensor Accuracy	±1% of the actual measured oxygen content with a precision ±0.5%
Outputs: O ₂ & pressure	0-10V (user-programmable) into minimum 5kΩ
O ₂ & pressure	4-20mA current loop (user-programmable) into maximum 500Ω
O ₂ high and low alarms	Relay circuits – fully user-programmable
All data and parameters	RS232 or RS485 - data streamed on demand
Sample Pump	Mains type diaphragm vacuum pump (variable flow) with power switch on rear panel.
Flow Rate	0-1.2 L.min ⁻¹
Max. gas temperature on input	60°C
Calibration	Requires 2 or 3 user-selectable gas compositions (air is default plus another two)

5. Precautions

Make sure you read and understand these instructions and keep them safe for later use. The unit should not be exposed to extreme temperatures < -5°C or > 60°C. Normal operating temperature is 5-35°C. Avoid direct sunlight. Do not use liquid cleaners, aerosols or solvents to clean the case. Use a damp cloth for cleaning. Do not use this equipment near water. Avoid touching the LCD display as this may cause permanent damage. Make sure the rear ventilation slots and the fan on the rear panel are free of obstruction.

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There are no user serviceable parts in this unit. Do not attempt to repair yourself. Refer all servicing to qualified Cambridge Sensotec personnel.

6. Warning

This unit is NOT designed for use in life support situations. No responsibility can be held for injury or loss of life caused by inappropriate use of this equipment.

7. Rapidox Operating Instructions



Figure 1: Rapidox 1100ZR front panel. Numbers are referred to in the text.

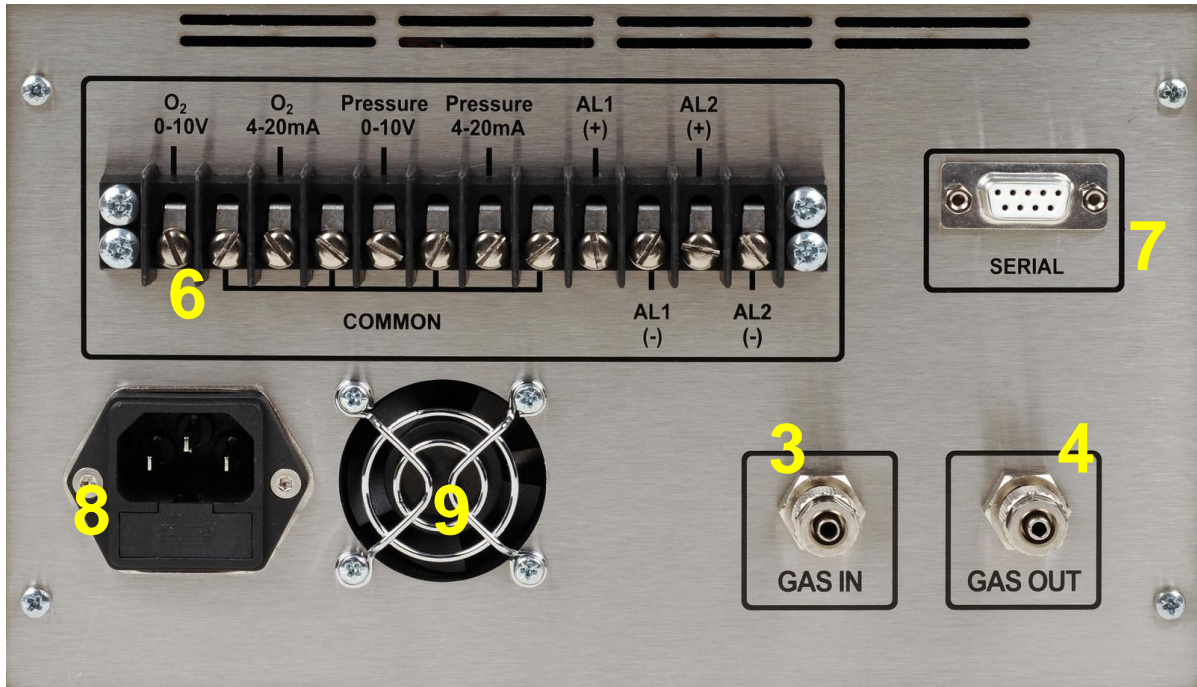


Figure 2: Rapidox 1100ZR rear panel. Numbers are referred to in the text.

7.1 The Rapidox Analyser - Menu System

All of the user-programmable functions are accessed via a menu system which is controlled using the front panel Keypad (2). To access the menu press the ENT button and to escape and return to the operating screen press ESC at any time. The menu system flow chart is shown below:

7.2 Getting Started

Ensure that the Rapidox analyser is located away from extreme heat and dirt environments. Plug the unit in to a suitable supply (noting the information on the serial sticker and using the power cable supplied) using the rear power socket (8). Make sure that the cooling fan (9) is not obstructed during operation.

Push the gas sample tube (6mm OD/4mm ID) to the GAS IN (3) connector and fit the retaining collar hand tight. Repeat for the GAS OUT (4) connector should an outlet tube be required. The pump will draw gas at a flow rate depending on the value set either in the software or from the menu. The default setting is one hundred percent.

Turn the unit on using the red power switch on the front (5). The LCD (1) will display the firmware version followed by the message "HEATING SENSOR". The sensor will take approximately four minutes to come up to temperature, after which the Rapidox will begin to take measurements. The progress of the sensor heater is shown in the form of a bar graph on the LCD (1). Once at temperature the LCD display will show the oxygen reading and the pressure. The symbol AL1 or AL2 may appear to the bottom right of the LCD if the alarm system is enabled

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and an alarm condition applies.

Allow thirty minutes for the box to stabilise fully. This allows the components of the analyser to reach a stable working temperature. During this warm-up period it is common for the baseline oxygen to drift by a small amount, which may be corrected by re-calibrating (see section 7.5).

7.3 Pump Control

The flow rate of gas drawn into the analyser can be controlled using the menu option 9: "Set Pump Flow". The unit is supplied with the flow rate set to 100% which equates to approximately 1.2 Litres per minute. If you wish to change the flow rate press ENT and select menu option 10. Use the UP & DOWN arrows to change the value from OFF – 100% in steps of 10% increments. Alternatively the pump can be switched on or off using the switch (10) on the rear panel. Please make sure that this is switched on and the pump is running. When using the unit with a pressurised (flowing) gas source the pump can be left switched off.

7.4 Menu Access / Passwords

The analyser has an option to set a password that will restrict access to the menus. The password menu is disabled by default in the factory. If you wish to password protect the analyser press ENT and scroll down to the PASSWORD option (Menu option 11). Pressing ENT again will ask you for the default password which is "0000". Enter this using the UP and DOWN arrows. Once the password has been entered successfully you can choose between ENABLE and DISABLE in the menu using the UP and DOWN keys.

The other option is to RESET the password to a new value. The password must be 4 digits long and can be any combination of numbers from 0-9. Make sure that the new password is noted down!

If the password function has been enabled then in the future each time the menu system is accessed then the password prompt will display. After the correct password is entered then the full menu will be accessible. You can make as many changes as you want to the options and only press ESC once you have finished. Pressing ESC takes you out of the password protected area and you will have to re-enter the password to go back in again.

If the password has been forgotten please contact Cambridge Sensotec who will advise you on how to recover it.

7.5 Rapidox Calibration

Once the unit is at temperature it may be necessary to calibrate the sensor. Full calibration is a simple procedure requiring only two or three gases (one of which is normally air – 20.95%). The two gas values are user-selectable and can be

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changed by using the front keypad (2) or the communications software described in section 8, and the calibration values can be stored on file for later use.

Care must be taken to calibrate the analyser so that, whenever possible, the range of measurement lies between the two calibration point extremes. For example, if you are working at 10ppm but have calibrated the analyser between 21% and 100% then the analyser will be inaccurate. You would need to calibrate at, say, 1ppm and 21% to be sure of good accuracy. The procedure is as follows:

- 1) Bearing in mind the points made above, decide which two (or three) gases you are going to use for calibration. If you are constantly working at a particular range of compositions then it would be wise to obtain small cylinders of calibration gas with analysis certificates. Cambridge Sensotec can supply these. Press the ENT button on the front panel keypad (2) to access the menu system. The calibration function is option 1 on the menu list, which can be scrolled using the UP and DOWN arrows. Press ENT again to enter the calibration menu. Use the UP and DOWN arrows to select O₂ HIGH, O₂ MIDDLE or O₂ LOW and press ENT to proceed. The top line of the display shows the current calibration gas stored and the bottom line of the display shows the prompts. If the gas value is not what you require you can edit the value (in ppm scientific notation) using the up and down and right arrows on the keypad. The cursor flashes underneath the digit to edit. For example air (20.95%) should be entered as 2.095E+05ppm (209,500ppm). Note that you can not go backwards to edit a digit to the left of the cursor. Instead keep pressing the RIGHT button and the cursor will wrap around back to the beginning. Alternatively press ESC to start again. Press ENT when you are ready to proceed.
- 2) The sensor needs to be exposed to the first calibration gas from a cylinder (or exposed to ambient air, 20.95% if this is the calibration gas of choice). Allow several minutes to pass to flush the sensor properly. Wait for the top line of the display (1) to become stable. To complete the calibration press and hold the ENT button for two seconds. During this time you will see a bar graph progress across the lower display. The analyser will then recalibrate and display "O₂ recalibrated" and then return to normal run mode. The display will now correctly read the value of the first calibration gas. Note that if the ENT button is released before two seconds have elapsed, the recalibration will be aborted and when the analyser eventually returns to run mode it will use the existing calibration.
- 3) Note that the analyser should ideally be calibrated at normal ambient pressure. If the pressure correction mode is set to AUTO then it is still possible to perform an accurate calibration at pressures other than ambient. However above 25mbar (gauge) or below -25mbar (gauge) the display will flash and "P?" will display to warn you that the pressure is either above or below the range recommended for accurate calibration.
- 4) The analyser predicts the correct signal from the sensor during calibration and if this is outside the range of expected values then the display will flash

and display “G?” to warn you that either the cal gas flowing over the sensor is different to the value you have programmed OR the sensor may be old and approaching the end of its life. Check before proceeding!

- 5) To calibrate against the second or third calibration gas, repeat the procedure from 2 but this time press ENT followed by the UP or DOWN button to scroll through to the “O₂ Middle” or “O₂ Low” screen. Flush the sensor chamber with the second calibration gas allowing several minutes for the new gas to flush through. Wait for the display to become stable before pressing the ENT button for two seconds. The analyser will then recalibrate and display “O₂ recalibrated” and then return to normal run mode. The display will now correctly read the value of the calibration gas.
- 6) The analyser is now correctly calibrated and will read accurately between these two calibration points. Note that this procedure can be performed remotely using the software described in section 8. You can now repeat this process for the third calibration gas if required.
- 7) If at any time, you encounter difficulties and wish to restore the machine to its factory set calibration, use the configuration software provided and load the default settings (described in section 7.16 below). Each machine is provided with a unique file that contains the factory settings. This is located on the CD-ROM provided and is copied onto your PC during the installation process.
- 8) Note that the three calibration points are independent of each other so you can calibrate the analyser in any order you desire. However please note that O₂ HIGH must always be greater than O₂ MIDDLE which must always be greater than O₂ LOW. Typically the factory settings are: O₂ HIGH=20.95%, O₂ MIDDLE=0.1% (1000ppm) and O₂ LOW=0.001% (10ppm).

NB You must always perform a FULL calibration to achieve good accuracy.

7.6 *Cleaning the Sensor*

You can clean the sensor at any time by pressing ENT on the keypad (2) and scrolling down to option 2 “Clean Sensor” or using the software described in section 8.6. Press the ENT button to proceed. The screen displays “Clean Sensor?”. Press ENT again and the cleaning will take place. The procedure takes approximately five seconds and the LCD display shows the progress of the operation. Once finished the analyser will take a moment to re-stabilise. The sensor is cleaned each time the unit is switched on prior to operation. If you are operating in gases with large amounts of soot, there is a risk that the sensor surfaces will become contaminated with particulates, which will impair performance if allowed to build up. The cleaning operation pumps oxygen through the zirconia tube, which burns the particulates away from the sensor surface.

7.7 Alarms

The Rapidox is fitted with two independent and fully programmable alarm relay outputs, which can be programmed to be either normally open (N/O) (closes on alarm) or normally closed (N/C) (opens on alarm). You have the option of assigning each alarm to the oxygen, pressure (internal) or temperature sensors, as well as enabling the alarm relay circuits, enabling an audible buzzer and enabling a visual warning on the screen.

The alarms can be programmed by the user via the keypad (2) on the front panel or using the software provided (section 8.5.3). To change the alarm settings scroll down the menu to no. 3 “Set Alarms” and press ENT. Now use the UP & DOWN arrows to select “Alarm 1” or “Alarm 2” and press ENT. The next screen shows the message “Assign To:”. Use the UP and DOWN arrows to select O₂, or Pressure depending on which measurement you want the alarm to work with, and press ENT to proceed. The default is O₂.

The next settings configure the behaviour of the alarm. Use the UP & DOWN arrows to select ON or OFF for the following parameters:

1. **OUTPUTS:** This enables the rear panel relay outputs when ON is selected
2. **AUDIBLE:** This enables or disables the audible buzzer inside the unit which will sound in an alarm condition
3. **VISIBLE:** This enables or disables warning messages on the LCD screen on the front of the Rapidox. During an alarm condition either “AL1” or “AL2” (or a combination of both) will flash at the bottom right hand corner of the display.
4. **POLARITY:** This determines whether you are setting a rising or falling alarm. Use the arrows to change the direction of the alarm to up or down. A rising alarm means that the alarm will be silent at values below the set-point but as soon as the value rises above the set-point the alarm will be triggered
5. **SETPOINT:** The current alarm set-point is displayed in scientific notation with a flashing cursor under the first digit. Use the UP & DOWN arrows to change the digit and the RIGHT arrow to progress until the correct value is displayed. When done, press ENT to proceed to the next setting.
6. **CONTACTS:** The relay outputs can be set to either normally open (N/O) or normally closed (N/C). The factory default is N/O, meaning the contacts will close when an alarm condition occurs. Press ENT to save all the above settings for the selected alarm.

Alarm 2 can be set in exactly the same way as described above and both alarm

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circuits are completely independent of each other. Note that you must programme all the parameters for each alarm for the settings to be saved. The bottom line of the LCD will display “Alarm x set” (where ‘x’ is the selected alarm channel) to confirm that the settings have been saved.

The alarm circuit relays are accessed via the terminal block on the rear panel and are clearly labelled. Alarm 1 is assigned to the terminals labelled “Alarm High” and Alarm 2 is assigned to the terminals labelled “Alarm Low”. The relay circuit is rated at 24V 0.5amps maximum.

The alarm limits for oxygen are set to a minimum of 10^{-20} ppm and a maximum of 1000%. At any time, should a sensor become disconnected so there is a fault condition then the Rapidox will set the alarm channel to OFF to prevent false alarms, and the relay contacts for the affected channel will go to the programmed N/O or N/C setting.

7.8 *Analogue Outputs*

The Rapidox analyser provides various analogue outputs. The standard industrial analogue outputs (0-10V and 4-20mA) for both oxygen, and temperature (or internal pressure) are accessible via the terminal block (6) on the rear panel. These outputs have a 12 bit resolution (approximately 1 in 4000) and the lower and upper values are fully user-programmable using the keypad (2) or the software provided (section 8). In the case of oxygen, three output mode options are provided for setting the outputs, in order to give the user maximum flexibility:

1. **LIN (ppm):** The linear oxygen output mode setting produces an output that is scaled linearly between 0 and 10V (or 4 and 20mA). So, for example, if the scale is set 0V = 0% O₂ and 10V = 100% O₂ then 5V would indicate an oxygen reading of 50% O₂. The scaling of this example is shown in the following plot, from which other intermediate values can also be read. This setting is more suitable for medium to high ranges of oxygen, or where the user wishes to monitor oxygen over a narrow range.

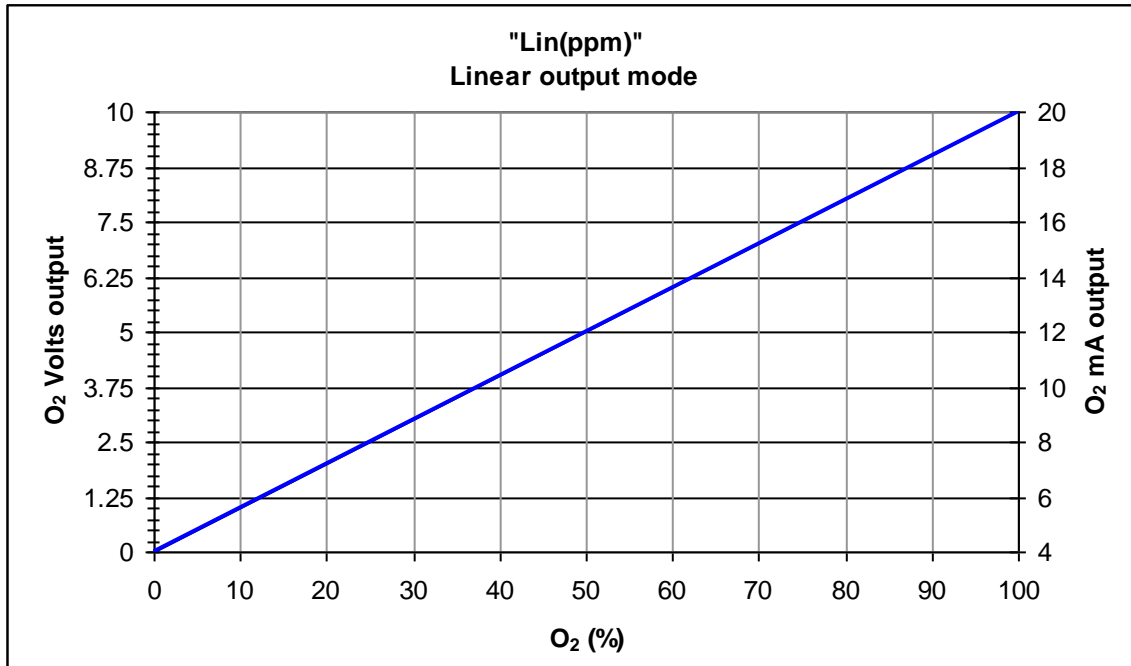


Figure 3: Graph showing the linear output mode option for oxygen

The following general formulae can be used to calculate the oxygen from the voltage or current outputs when set to the linear output mode:

Output type	Formula for calculating oxygen from analogue output signal
0-10V	$O_2 = V_{out} / 10 * (O_{2H} - O_{2L}) + O_{2L}$
4-20mA	$O_2 = (mA_{out} - 4) / 16 * (O_{2H} - O_{2L}) + O_{2L}$

Where: O_{2L} = user setting of oxygen for 0V or 4mA output ¹
 O_{2H} = user setting of oxygen for 10V or 20mA output ¹
 V_{out} = the measured voltage output in volts
 mA_{out} = the measured current output in mA

¹ O_2 , O_{2L} and O_{2H} must all be in the same units.

- LOG (ppm):** This setting produces an output that is scaled logarithmically between 0V and 10V (or 4 and 20mA). So, for example, if the scale is set to 0V = 0.0001% (1 ppm) and 10V = 100% (1000000 ppm) then 5V would indicate an oxygen reading of 0.1% (1000 ppm). This scale is more suitable for large ranges of oxygen down to very low ppm levels. Note that because the scaling is logarithmic 0V cannot be set to 0% oxygen since $\log(0)$ is $-\infty$! The lowest permitted setting is 0V = 10^{-20} ppm (or 10^{-24} %) O_2 . The scaling of this example is shown in the blue line in following plot, from which other intermediate values can also be read. For comparison, the red line shows the limitations of using the linear oxygen output mode over the same range.

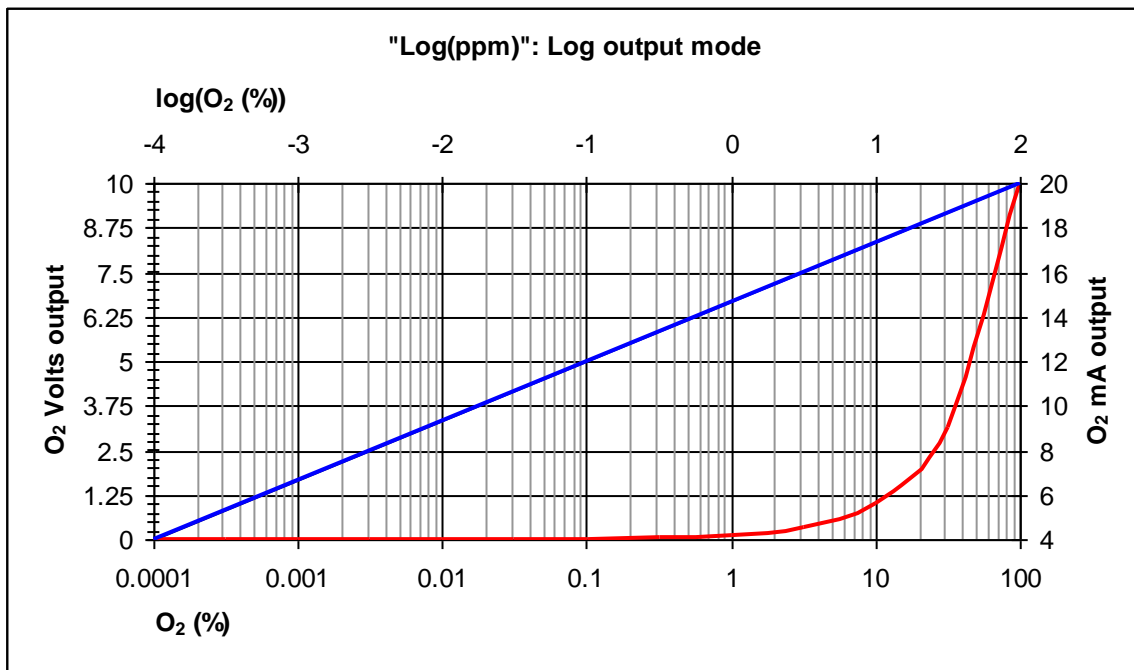


Figure 4: Graph showing the logarithmic output mode option for oxygen (blue) compared with linear mode (red).

The following general formulae can be used to calculate the oxygen from the voltage or current outputs when set to the log output mode:

Output type	Formula for calculating $\log_{10}(O_2)$ from analogue output signal
0-10V	$\log_{10}(O_2) = V_{out} / 10 * \log_{10}(O_{2H} / O_{2L}) + \log_{10}(O_{2L})$
4-20mA	$\log_{10}(O_2) = (mA_{out} - 4) / 16 * \log_{10}(O_{2H} / O_{2L}) + \log_{10}(O_{2L})$

Where: O_{2L} = user setting of oxygen for 0V or 4mA output ²
 O_{2H} = user setting of oxygen for 10V or 20mA output ²
 V_{out} = the measured voltage output in volts
 mA_{out} = the measured current output in mA

² O_2 , O_{2L} and O_{2H} must all be in the same units.

Note: $O_2 = 10^{\log(O_2)}$

- 3. RAW (mV):** This setting is for certain customers who like to monitor the raw sensor EMF signal. The signal from a sensor goes from approximately -50mV at 100% O₂ through zero at approx 5% O₂ and to +1000mV at extremely low O₂ levels. So, for example, if the scale is set to 0V (output) = -50mV (sensor voltage at approximately 100% O₂) and 10V (output) = 250mV (sensor voltage at approximately 1ppm O₂) then 5V would indicate a sensor voltage of 100mV. The scaling of this example is shown in the following plot, from which other intermediate values can also be read.

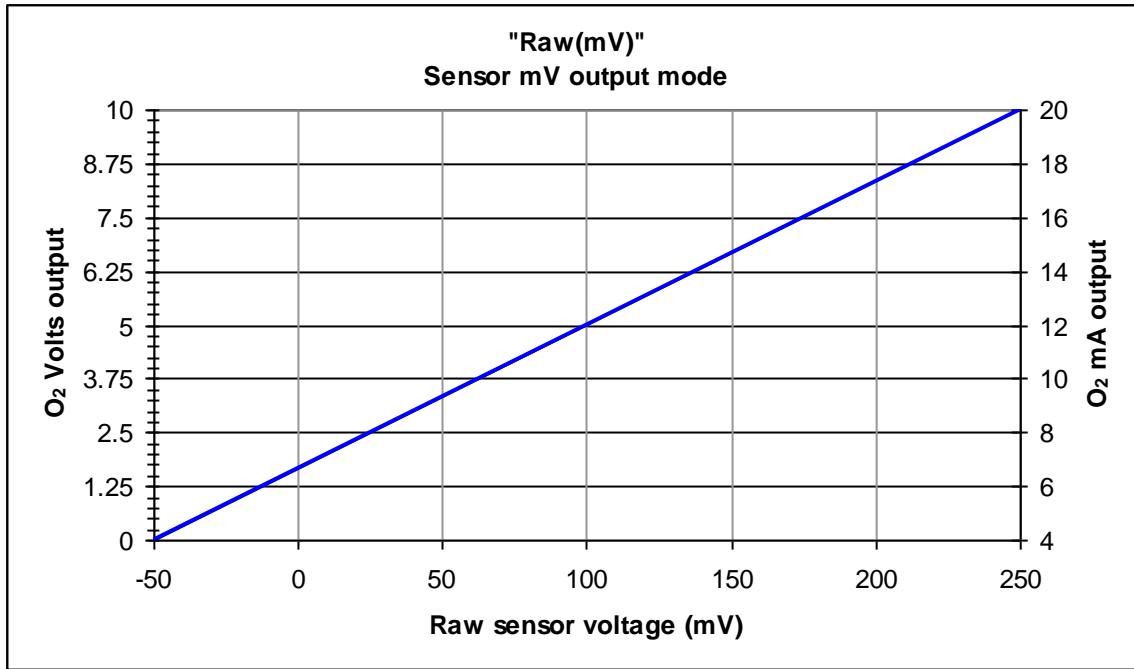


Figure 5: Graph showing the raw sensor mV output mode option for oxygen

The following general formulae can be used to calculate the oxygen sensor raw voltage (O_{2mV}) from the voltage or current outputs when set to the raw sensor voltage output mode:

Output type	Formula for calculating sensor mV from analogue output signal
0-10V	$O_{2mV} = V_{out} / 10 * (O_{2mVH} - O_{2mVL}) + O_{2mVL}$
4-20mA	$O_{2mV} = (mA_{out} - 4) / 16 * (O_{2mVH} - O_{2mVL}) + O_{2mVL}$

Where:
 O_{2mVL} = user setting of oxygen mV for 0V or 4mA output
 O_{2mVH} = user setting of oxygen mV for 10V or 20mA output
 V_{out} = the measured voltage output in volts
 mA_{out} = the measured current output in mA

The auxiliary outputs can be set to Temperature or Pressure. The first option will output the value read from the thermocouple when attached. The second option will output the value read from the internal pressure sensor.

To modify the oxygen analogue output range scroll down the menu to option 5 “Set Outputs” and press ENT. Use the UP & DOWN arrows to select the output type either “lin(ppm)”, “log(ppm)” or “raw(mV)” and press ENT. You can now edit the lower and upper values using the UP & DOWN and RIGHT arrows. Once programmed the new values remain in the memory until they are edited again in the future.

To select and modify the auxiliary outputs scroll down to menu option 5 “Set Outputs” and pres ENT four times. Use the up and down arrow buttons to choose between “Temperature” or “Pressure” and press ENT. If “Temperature” is selected then you can change the low and high range using the same procedure described

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above. The range is set between 0°C and 1250°C. If “Pressure” is selected then the permissible range is -1000mbar to +2000mbar.

Note that if the auxiliary output is assigned to temperature and the temperature units are set to “None” then the outputs will be set to 0V and 0mA.

Note that the voltage (0 to 10V) and current (4 to 20mA) outputs are locked together, so that these outputs cannot be set independently of each other. In normal operation therefore, 0V output always corresponds to 4mA and 10V always corresponds to 20mA output.

During initial warm up of the Rapidox when the display reads “Sensor Heating” the output sent to the rear terminal for oxygen will stay at 2mA (0.628V) which is the standby signal. The output for the temperature or pressure sensor will begin to work after the initial boot up screen.

If at any stage a sensor becomes disconnected (externally or internally) or the signal exceeds the measurable range for that sensor, then the display will indicate there is a fault and the outputs will change to 1mA (0.313V) which is the sensor fault signal. This will recover as soon as the sensor is reconnected and the fault cleared.

7.9 *Setting the Display Units*

The notation used by the display is fully programmable to suit your needs using the keypad (2) or the software provided (section 0). The following options are available to you:

- 1. Oxygen:** The oxygen reading can be displayed in percent (e.g. 20.95%), ppm (e.g. 0.01ppm) or scientific (e.g. 2.095E+05ppm). If percent is selected the Rapidox will display oxygen as a percentage down to 0.1% and ppm below this value. There are also options to display the oxygen reading in terms of a pressure (units will be the same as the units selected for pressure) or a nitrogen balance (%N₂) reading. In this case the reading displayed is 100-O₂% =N₂ so for example in air 21% the nitrogen balance reading will display 79% N₂. Note that this is NOT an actual nitrogen reading.
- 2. Pressure:** The reading can be displayed in mbar, bar, psi, torr or kPa.

To program these options scroll down to menu no. 5 “Set Units” and press ENT. Use the ENT key to progress through the list and the UP & DOWN keys to select the required units. Once selected press ENT to store and return to run mode.

7.10 *Setting the Display Options*

The user can select the LCD refresh rate and the format of the line 2 display using the keypad or the software provided. Scroll down the menu to option no. 6 “Set

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up Display” and press ENT. Use the UP & DOWN arrows to select either the LCD refresh rate or Line 2 Options:

- 1. LCD Refresh Interval:** The frequency of the display update can be selected from 0.1 to 1.5 seconds. The current setting can be edited using the same method as described previously. Once edited press ENT to store and return to the main menu. The default setting is 0.3 seconds.
- 2. Line 2 Options:** The information displayed on line 2 of the LCD can be chosen by the user. The options are None or Pressure (displayed in mbar, bar, psi, torr or KPa. Use the UP & DOWN arrows to select the required option and press ENT to store and return to the main menu.

7.11 Internal Pressure Sensor

The Rapidox 1100ZR is fitted with an internal pressure sensor which monitors small changes in pressure inside the sensor head. The pressure will normally be zero mbar under normal operation but if the unit is being fed by a gas cylinder or connected to an apparatus under partial vacuum then the pressure will change and this will have a direct effect on the oxygen partial pressure and the sensor reading. You have the option of displaying the pressure reading on the LCD display (1) as described above in 7.10. The display will now show the pressure reading from the internal sensor. If you want to view different units select no. 5 “Set Units” from the menu and press ENT three times to reach the pressure screen. Use the UP & DOWN arrows to select mbar, bar, psi, torr or kPa and press ENT. The display will now show the pressure in the selected units.

7.12 Pressure Mode

The user has the option of using the reading from the internal pressure sensor to automatically correct for changes in gas pressure and hence oxygen pressure. A manual pressure correction value for ambient pressure conditions can also be entered to improve accuracy of the correction (factory setting is 1013 mbar). To access this function scroll down to menu option 7 “Pressure Mode” and press ENT. The desired mode can then be selected using the UP & DOWN arrows and pressing ENT to store and proceed. The two modes available are:

- 1. None:** If this mode is selected then there is no pressure correction performed on the oxygen reading. The pressure and oxygen sensor act independently. If the sensor is working in air (20.95%) and the pressure is doubled to 1000 mbar then the reading will also double to 41.9%. This is the correct oxygen partial pressure in air at 2 bar since there is a simple linear relationship between pressure and concentration.
- 2. Auto:** This is the factory default setting. If the Auto mode is selected then the Rapidox 1100 uses the reading from the internal pressure sensor to correct the oxygen partial pressure and maintain a concentration reading. If the sensor is working in air (20.95%) and the pressure suddenly jumped to,

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for example, 500 mbar above atmospheric, the oxygen reading would remain at 20.95% because the sensor has been corrected for the pressure change. This allows users who are working with fluctuating input pressures to maintain a 'meaningful' reading of oxygen concentration that will only be affected by changes in gas composition and not gas pressure.

Note that when this mode is activated the user will be asked to enter a value for the current ambient pressure to improve the accuracy of the correction. The factory default is 1013mbar which is the average ambient pressure for the UK. The ambient pressure at your location will depend on altitude and prevailing weather conditions.

7.13 Setting the Baud Rate

If you are using the software for data logging you can chose the communications speed (Baud Rate) by scrolling down the menu to no. 8 "Baud Rate" and using the UP & DOWN arrows to select either 9600 or 57,600. Press ENT button again to store and return to normal operation. The default factory setting is 57,600. However if you are using an older PC you can decrease this to 9600 to improve the reliability of the software and data communications.

7.14 RS232 / RS485 Port

It is possible to factory set the data communications port to either RS232 or RS485. Once configured at the factory it is not possible to change unless the unit is returned to Cambridge Sensotec Ltd.

Data from the Rapidox is sent on demand to the 9-way 'D' type socket (8) on the rear panel and can be read using a simple terminal programme such as 'HyperTerminal' in Windows, or with the user's own custom software. Alternatively a simple and convenient data logger programme is included with the supplied software and is described in section 9 below.

7.14.1 RS232 Protocol

Oxygen data can be read from the RS232 port at the back of the Rapidox. The default RS232 configuration is 57600-8-N-1, as shown in this example for COM1:

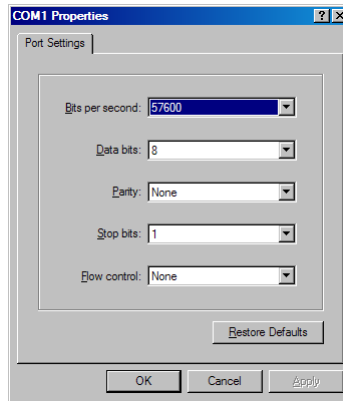


Figure 6: Rapidox default COM properties box

Alternatively, the baud rate can be reduced to 9600 via the “Set Baud Rate” menu item, using the front panel keypad on the Rapidox. This setting is stored in EEPROM.

Connection: Connect to RS232 socket at the back of the Rapidox using a 9 way D-type plug. Signals are as follows:

Rapidox D-type Socket:	PC/PLC:
Pin# 2 = Data Out	→ Data In (RX)
Pin# 3 = Data In	← Data Out (TX)
Pin# 5 = Common/Gnd	-- Common/Gnd

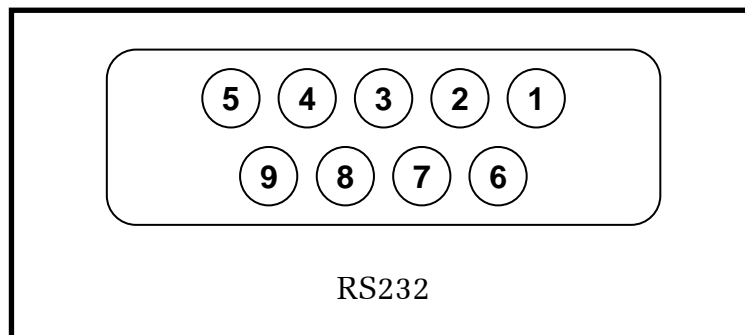


Figure 7: Rapidox RS232 pin configuration

All other pins (1,4,6,7,8,9) = Don't care

Reading Data: Data is read using command “D”. Send the single character “D” to the Rapidox. The Rapidox replies with one of the following responses. All valid responses end with [CR] & [LF] (where [CR] = ASCII 13 and [LF] = ASCII 10).

Response: !Initialising[CR][LF]
 Meaning: Rapidox is still initialising

Response: !Sensor heating[CR][LF]
 Meaning: Rapidox is still heating sensor to operating temperature

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Response: !Sensor cooling[CR][LF]

Meaning: Rapidox is still cooling sensor to operating temperature. This can happen when switching from Normal to Helium operating mode.

Response: !Cleaning sensor[CR][LF]

Meaning: Rapidox has finished heating sensor and is cleaning the sensor for 5 seconds

Response: !User setup active

Meaning: The configuration menu has been activated via the front panel keypad. The menu will automatically time out 60 seconds after the last key was pressed, or press the keypad's ESC key to return immediately to normal run mode.

Response: !Possible sensor fault

Meaning: The sensor has failed to reach operating temperature within 10 minutes from power up. This may be due to the age of the sensor, or because a high thermal conductivity gas is being used.

Response: !No sensor or sensor fault[CR][LF]

Meaning: Sensor is not connected, or there is a fault in the sensor

Response: d2.959E+05,-1.426E+01,2.000E+00, ,23:19:40,14/01/00,
M,,AL1&2[CR][LF]

Meaning: "d" means data is being sent
"2.959E+05" is Oxygen reading in ppm
", " = data separator
"-1.426E+01" is Oxygen sensor reading in mV
", " = data separator
"2.000E+00" is the internal pressure sensor reading in bar (gauge)
", " = data separator
"23:19:40" is Rapidox time – ignore this
", " = data separator
"14/01/00" is Rapidox date in DD/MM/YY format – ignore this
", " = data separator
"M" is the current oxygen "range" setting
", " = data separator
", " = data separator
"AL1&2" means both alarm conditions 1 and 2 exist **
[CR] = ASCII 13 (Carriage Return character)
[LF] = ASCII 10 (Line Feed character)

** If no alarm conditions exist, this data is empty, so the response would look like:

d2.959E+05,-1.426E+01,2.000E+00, 3.619E+01,23:19:40,14/01/00,M,,[CR][LF]

Response: ?

Meaning: "D" command was not recognised. Try to send it again.

7.14.2 RS485 protocol

Please contact Cambridge Sensotec for further information on this feature.

7.15 *Printing*

If you have purchased the printer option then you have the option to print out various data from the analyser straight on to thermal paper. Simply connect the printer to the unit using the serial socket on the rear of the machine and make sure the printer is switched on (battery and mains versions are available). To print the live values on the LCD at any time simply press the RIGHT arrow button on the front panel. Each push of the button will print out the serial number followed by the data in a tabbed format followed by a blank line. If the button is held down, the printer will keep printing data (but not the serial number).

When the printer is first connected or turned on, a “start-up” message like the one displayed on the LCD when the Rapidox is switched on will be printed, and will look like this:

```
Cambridge  
Sensotec Ltd  
Rapidox 1100ZR  
Oxygen Analyser  
S/N: 2100942  
FW v 01.03.03.01
```

7.16 *Load Defaults*

If you make a mistake programming the Rapidox it is possible to restore the machine back to its factory settings by loading the unique default configuration that is supplied on your software CD-ROM. The default set-up can only be accessed using the software provided. Please see section 9.22 for further details.

Alternatively, you can reset to ‘generic’ factory defaults directly from the front panel keypad. Press ENT to enter the user setup menu and select menu option 10 “Load Defaults” and press ENT to proceed. The next screen will say “Load Defaults ?” with the prompt to press and hold ENT for 2 seconds to confirm. To complete this press the ENT button until the bar graph has completed and the screen says “Defaults Loaded” This will give you all the basic settings that are factory set. You will now need to re-calibrate the sensor and check all the settings are suitable.

8. Rapidox Software Instructions

8.1 *Software Installation*

It is possible to programme a range of variables to the Rapidox using an RS232 (or RS485 if configured) link with a PC running MS-Windows (all versions) and the supplied Rapidox software. The software is installed automatically by inserting the Rapidox CD into the CD-ROM drive. If auto-installation does not start then you can click the Windows START button and select RUN. Type X:\setup.exe where X is the drive letter of your CD. Alternatively access the CD from Windows Explorer or the 'My Computer' icon on your desktop, and double-click on the 'Setup.exe' programme. Follow the on-screen instructions to install the programme onto the hard drive. Once installed, you can access the programme by clicking START - PROGRAMS – Rapidox Software.

The software has been tested successfully on most language machines including Chinese, Korean & Japanese and all current versions of Windows operating system. We do not recommend the use of Vista as connecting devices to this operating system can be problematical at best.

Note that software is 'regionally aware' and will therefore accept and display data using the decimal separator that is set in the PC's Regional Settings in the Control Panel. For example, in the UK or US, you might enter the value 2.5 - in continental Europe this would normally be entered as 2,5 assuming the PC's Regional Settings have been set up to use ',' as the decimal separator.

8.2 *Getting Started*

Make sure that the Rapidox is connected to a free serial port on the rear of your computer. These will nearly always be COM1 or COM2 but the software will scan through the ports until it finds the Rapidox. The analyser must be switched on for this to succeed and while you are communicating with it. On start up the software will locate the Rapidox and display the following page:

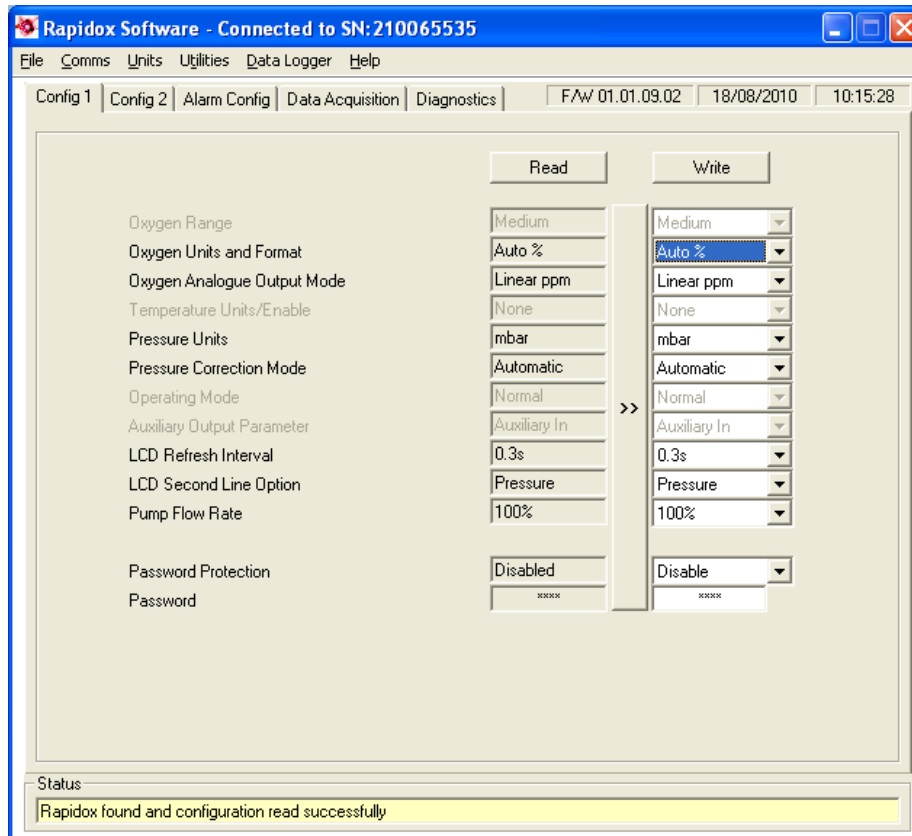


Figure 8: Rapidox configuration page. Note the actual values used may differ from those shown above.

The yellow status box at the bottom will display confirmation that the Rapidox was found and the result of the last action, or any error messages if there is a problem with communication. If you experience problems check that your serial cable (supplied) is correctly fitted to a valid serial port. Also check the status of your COM port settings in Device Manager accessed by clicking START – Settings - Control Panel.

8.3 On-Screen Help

You can access the on-screen help facility at any time by clicking on the help menu on the menu bar and select the 'Help' option or press F1.

8.4 Configuration Page

The configuration page is split into three, and you can switch between them by clicking on the tabs labelled “Config 1”, “Config 2” or “Alarm Config”. Each page allows the user to reprogramme an array of variables used by the Rapidox. Once written to the Rapidox, the new variables remain permanent until overwritten.

To read the current configuration stored in your Rapidox select 'Read Analyser Configuration' from the 'File' menu, or click the 'Read' button on any of the

'Config' pages. Note that the entries in the boxes on the RHS (under the 'Write' button) will turn red if the value is different to that just read and a red asterisk will appear next to the 'Write' button to warn you that a change has been made. The left-hand set of grey text fields ('read fields') will be updated with the current configuration data. To save this information (e.g., if several people share the same instrument) click the long copy ('>>') button (between the 'Read' and 'Write' columns) on any of the 'Config' pages in order to transfer the data into the edit boxes, select 'Save Configuration as' from the 'File' menu and choose a filename. This data set can be subsequently reloaded at any time by selecting 'Load Configuration File' from the 'File' menu and then selecting the folder where the configuration files have been stored.

If at any time you wish to restore the Rapidox to its factory default settings select 'Default Configuration' from the 'File' menu to load these values. The software will search for a unique '.rxc' file which is loaded onto the PC during the software installation. The filename is 'XXXXXXXX.rxc' where 'XXXXXXXX' is the unit's serial number, which can be found on the rear of the machine. The original copy of this file is also on the CD-ROM that came with the analyser. Normally this file is automatically copied to the main Rapidox folder, but if the software cannot locate it then it will ask you for the serial number to help it search. The 'rxc' file will be loaded into the 'Write' columns, and the software will then automatically perform a 'Read' to update the data in the 'Read' columns in order to highlight the differences between the current configuration (in the 'Read' columns) and the settings from the file (in the 'Write' columns). If you wish to proceed with the reconfiguration simply click any of the three 'Write' buttons to reprogramme the Rapidox.

The right-hand set of white editable text fields ('write fields') is used to enter new values to be programmed into the Rapidox. The values in these fields can either be entered manually, or copied across from the 'read fields' by clicking the vertical 'Copy' button, and then edited as required, however greyed boxes under the 'Write' buttons are not editable as they contain calibration data; they can only be changed by copying data across from the 'Read' fields. Note that when you click on the copy button all three 'Config' pages are updated at the same time and there is no need to repeat the action when you toggle to the other page. Alternatively, you can load saved configuration data by selecting 'Load Configuration' from the 'File' menu and selecting the required file. In order to programme the analyser select 'Write configuration to the analyser' from the 'File' menu, or click the 'Write' button on any 'Config' page.

8.5 Reconfiguring the Analyser

The on-screen edit boxes contain variables that can be reprogrammed into the Rapidox in exactly the same manner as using the front panel keypad. For a full description please refer to the relevant section in this manual.

The user can choose whether to use ppm or percent notation to edit the text boxes, where appropriate, by selecting the 'UNITS' menu and clicking on 'Percent' or

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'ppm'. To access a field, either click inside it or use the TAB key to scroll through them. The field parameters are as follows:

8.5.1 Config 1 Screen

- 1) **Oxygen Range:** Not available for the Rapidox 1100ZR
- 2) **Oxygen Units & Format:** See Section 7.9 for a full description. Use the drop down box to select PPM EXPONENTIAL, PPM MIXED, AUTO%/PPM or PRESSURE. The default setting is AUTO%/PPM.
- 3) **Temperature Units/Enable:** Not available for the Rapidox 1100ZR
- 4) **Pressure Units:** See sections 7.9 for a full description. Use the drop down menu to select MBAR, TORR or KPa as the unit for pressure measurement. The default setting is MBAR.
- 5) **Pressure Correction Mode:** See section 7.12 for a full description. Use the drop down menu to select NONE, AUTOMATIC or MANUAL. The default setting is NONE.
- 6) **Operating Mode:** Not available for the Rapidox 1100ZR
- 7) **Auxiliary Output Parameter:** Not available for the Rapidox 1100ZR
- 8) **LCD Refresh interval:** Use the drop down menu to select a refresh rate for the LCD (min 0.1, max 1.5 sec). The default is 0.3 seconds.
- 9) **LCD Second Line Option:** See section 7.10 for a full description. Use the drop down menu to select PRESSURE or NONE.
- 10) **Pump Flow Rate:** See section 7.3 for a full description. Use the drop down menu to select a pump flow value from 10-100% or OFF.
- 11) **Password option:** See section 7.4 for a full description. The password is factory disabled and set to 0000. Use the drop down menu to enable or disable the password feature and the password box **** can be used to enter a new password. Note that you will be prompted to enter the original password to make changes to the password or its status.

8.5.2 Config 2 Screen

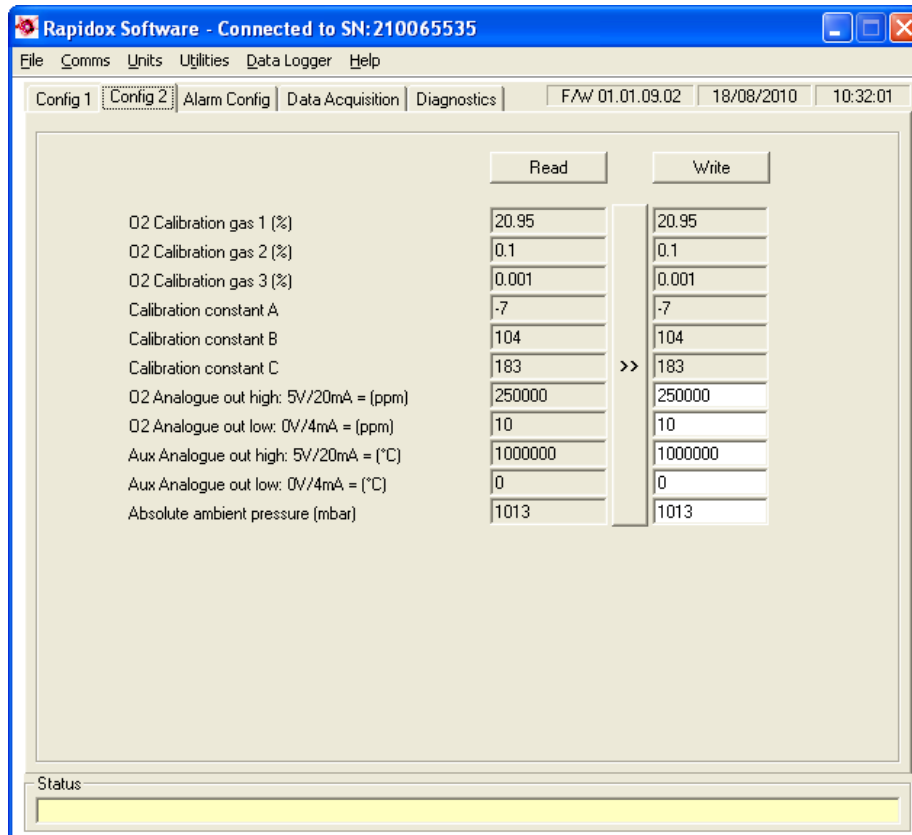


Figure 9: Configuration 2 page. Note the actual values used may differ from those shown above.

- 12) **Calibration Gas 1, 2 & 3:** These boxes are greyed out in this version and the data is for information purposes only. If you want to change the current calibration gas then follow the procedure given in section 8.7.
- 13) **Calibration Constant A B & C:** These boxes contain the calibration constants that the Rapidox calculates automatically when you perform a calibration. You will see that they change each time you perform a new calibration. Generally the air value should be approximately -10mV and a low ppm value (e.g. 10ppm) would be approximately 180mV
- 14) **O₂ Analogue Output (0V/4mA & 10V/20mA):** Use these two boxes to set the High and Low oxygen values for the analogue outputs (6) on the rear panel. For example if you want 4mA to represent 1% and 20mA to represent 21% then enter these two values into the appropriate boxes. The value can be entered either in % or ppm depending on the units selected. The default is %. The default values are 25% for the high setting and 0.001% for the low setting.
- 15) **Auxiliary Analogue Output (0V/4mA & 10V/20mA):** Use these two boxes to set the High and Low auxiliary (pressure sensor) values for the analogue

outputs (6) on the rear panel. For example if you want 0V/4mA to represent 0mbar and 10V/20mA to represent 100mbar then enter these two values into the appropriate boxes. The units are automatically determined by the settings made in 4).

- 16) **Absolute Ambient Pressure:** Use this box if you want to enter the current ambient pressure (in mbar). This value is used in the automatic pressure correction function only and provides enhanced accuracy in the correction. The default is 1013mbar which is the average ambient pressure in the UK.

8.5.3 Alarm Config Screen

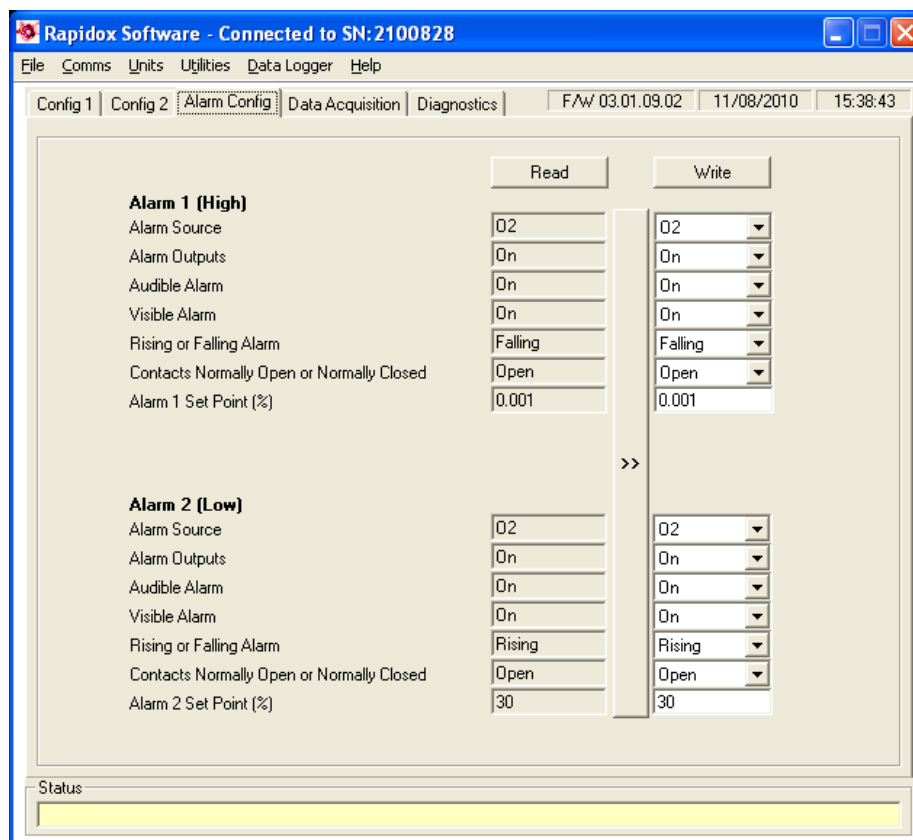


Figure 10: Alarm configuration screen. Note the actual values used may differ from those shown above.

- 17) **Alarm Source:** Use the drop down box to assign a detector to the alarm. If you want the alarm to be based on oxygen readings select oxygen from the drop down list. The choices are: oxygen, pressure or temperature.
- 18) **Alarm Outputs:** This option enables or disables the alarms on the rear panel (labelled Alarm High +/- and Alarm Low +/-). Make sure these are enabled if you wish to use the signals from the alarm circuit.
- 19) **Audible Alarm:** This option enables or disables the audible buzzer fitted to the Rapidox internally. When an alarm condition occurs the buzzer will emit a continuous noise to alert the operator.

- 20) **Visible Alarm:** This option enables or disables the visual warning on the front LCD. When enabled and an alarm condition occurs the message “AL1” or “AL2” will flash in the lower right hand corner.
- 21) **Rising or falling Alarm:** This option allows the alarm to be set as a rising or falling type. If the alarm is rising then the reading must rise above the set-point for the alarm to be activated. If the alarm is falling then the reading must fall below the set-point for the alarm to activate.
- 22) **Contacts N/O or N/C:** This option allows the user to programme how the relay contacts are set on the rear panel. Normally Open means that the contacts are open circuit when an alarm is not activated and Normally Closed means that the contacts are closed when the alarm is not activated.
- 23) **Alarm Setpoints:** Use this box to programme the set-point value at which you want the alarm to activate. The units are in %, ppm or mbar depending on which sensor you have assigned to the alarm.

Once you have finished editing the parameters, select ‘Write Configuration to Analyser’ from the file menu and the new data set will be written to the Rapidox. The Rapidox is reprogrammed using the new configuration. The software then reads the new settings back from the Rapidox and displays them in the boxes on the left-hand side confirming that the configuration was successful. When you have finished programming the analyser for new calibration gases you must recalibrate the instrument to benefit from the changes.

8.6 On-Screen LCD

It is possible to display an LCD emulator on the desktop of your PC. This reproduces exactly the display on the Rapidox unit and is convenient if you are some distance away from the machine. To activate the LCD select the utilities menu and select the LCD on option. This will display a small window showing the LCD that can be positioned independently anywhere on the desktop.

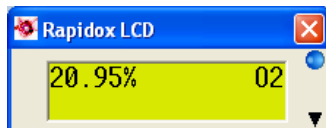


Figure 11: On-screen LCD

The blue LED indicator will flash to show that the display is updating.

8.7 Remote Calibrating and Cleaning

With the on-screen LCD display active it is possible to remotely calibrate the analyser and clean the sensor. Click on the down arrow icon in the bottom right-hand corner of the LCD display to expand the window:

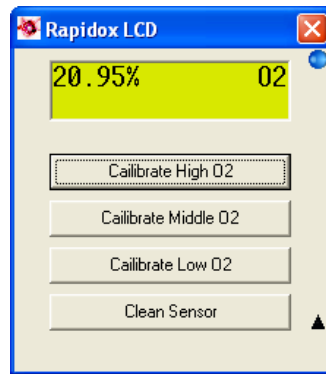


Figure 12: Remote calibration and clean function

Use the four buttons to calibrate or clean the sensor directly from the PC. Before calibrating the analyser with gas, make sure that you know the exact O₂ concentration in your gas bottle AND you have a calibration certificate from the gas supplier confirming the concentration. You can calibrate the analyser in any order but remember that the gas value for O₂ High must be greater than the gas value for O₂ Middle, which must be greater than the gas value for O₂ Low. Allow sufficient time for the calibration gas to pass over the sensor and let the reading on the LCD stabilise. This is extremely important to perform a successful and accurate calibration.

The software uses the three calibration gas values already stored in the Rapidox as a starting point. These are typically High = 20.95%, Middle = 0.1% and Low = 0.001% as set in the factory but may be different if the user has recalibrated with other gas values in the past. Either way you are given an option to change the cal gas value before proceeding to the actual calibration.

Assuming you are using fresh air (20.95%) to calibrate O₂ High then simply click on the button labelled "Calibrate High O₂" to see the following:

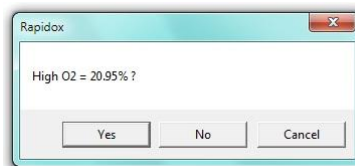


Figure 13: Calibration Gas Confirmation Screen.

If the current stored value is correct and matches your cal gas value then simply click "Yes" to proceed. If you are using a different value to the one you see on the screen then click "No" to change it as shown below:

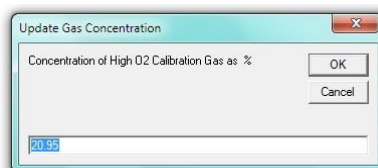


Figure 14: Calibration Gas Update Screen.

Enter your new value in the units as instructed and click “OK” to proceed. This value will then be stored until you want to change it again. You will now see the following screen:



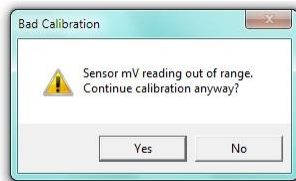
Figure 15: Calibration Confirmation Screen.

This is your final chance to change your mind before committing to a calibration. Check carefully that the gas value on the screen actually matches the value of your calibration gas before clicking on “Yes” to complete the calibration. At this point you should observe that the LCD display will reset itself to the correct calibration. You can now proceed with the rest of the calibration process by selecting the Middle and Low gases in the same manner.

8.8 Calibration Error Messages

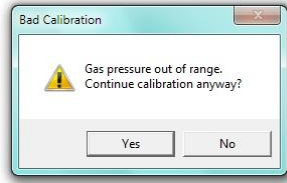
During the calibration process described in 8.7 above it is possible to receive screen error messages as described here.

- 1) **Bad Sensor Reading:** The Rapidox software makes a prediction of the expected sensor mV for each calibration gas value entered. If the mV signal coming from the sensor is out of the expected range the following message is displayed:



This normally indicates one of two things: that you are using the wrong cal gas value compared with the actual gas flowing over the sensor OR the sensor is getting old and can no longer output the expected signal required for a healthy calibration.

- 2) **Bad Pressure Reading:** The Rapidox software checks to see what the gas pressure is before allowing the calibration to continue. If the pressure is outside the range -25mbar to +25mbar (gauge) then the following message is displayed:



This normally indicates that you are allowing gas from a cylinder set at too high pressure to enter the analyser. Try displaying the pressure reading on the second line of the LCD and adjusting the gas regulator to trim it close to 0 mbar. If you are using a standard gas regulator then try switching off the sample pump on the rear of the analyser OR better still use a demand flow regulator and allow the gas to enter the analyser from the draw of the pump.

Note that the above are only advisories and you can proceed with the calibration if you believe everything is checked and correct.

8.9 Software Utilities

The utilities menu is located on the main file menu as shown below:

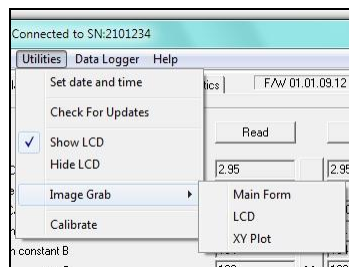


Figure 16: Software Utilities Menu

8.9.1 Setting Analyser Date and Time

The current date and time of your PC are displayed on the configuration screen and can be loaded into the Rapidox by selecting the Utilities menu and clicking the 'Set date and time' option. This information is used in the RS232 data string for data logging purposes. Make sure that your PC clock is set correctly before using this function, as you cannot edit the date and time shown by the Rapidox software. The date and time formats displayed are those set in the PC's Regional Settings.

8.9.2 Check for Updates

This function will check online and advise you if any software updates are available for your machine. This function is not automatic. To update the software you need to visit www.cambridge-sensotec.co.uk and select the support page where a list of downloads are provided.

8.9.3 Image Grabber

This is a simple function to allow the user to copy the software screens into the Windows clipboard. This is useful for diagnosing problems; allowing a quick and simple way of sending the Sensotec technicians actual screen shots of the software. To recover the images simply press CTL+V to paste.

9. Rapidox Data-Logging Software

9.1 Introduction

The Rapidox software includes a full data logging facility. Data can be saved to a file automatically at regular intervals and the format is compatible with modern spreadsheet programmes such as MS-Excel. A live-time graphing facility is also included which has many powerful features. Note that the data logging facility will only function if the analyser is in NORMAL run mode.

9.2 Setting up the Data Logger

Click on the tab labelled 'Data Acquisition' to display the following page:

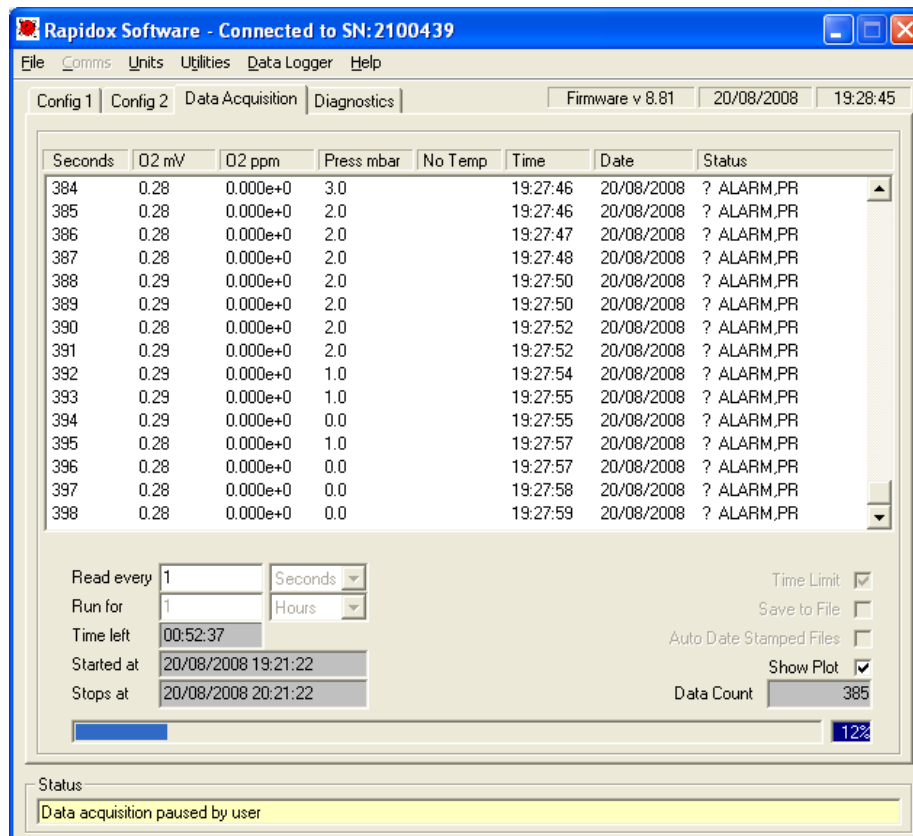


Figure 17: Data Logging page

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During logging, data from the analyser is shown in the central area of this page. The data is displayed in the following columns: time (in seconds), the raw signal from the sensor (in mV), the oxygen value (in ppm scientific notation), pressure in mbar, the time (in regional format), the date (in regional format), and status (displays the range setting or the word ALARM if the alarm is activated).

To start data logging select the frequency of measurement by entering a time and selecting a unit from the drop down list. For example if you wish to log data once every minute type 1 in the box and select 'Mins' from the drop down menu.

You can open the NOTES window at any time by selecting NOTES from the 'Data Logger' drop down menu. A small text box appears in which you can type a text message. This note is then saved as a header in the data file set and can be viewed along with the data.

You can either choose to have data logged continuously until 'Stop' is selected from the Data Logger menu, or you can choose to set a time limit for data logging by checking the box labelled 'Time Limit', setting the duration in the 'Run For' box and selecting units with the drop down list. For example if you wish to log data for thirty minutes type '30' in the box and select 'Mins' from the drop down list.

9.3 Running the Data Logger

If you wish to save the data into a file for later use, check the 'Save to File' box before selecting 'Run' from the Data Logger menu. You will be prompted for a file name and location before data logging commences. The file and path information will appear in the box at the top of the page labelled 'Data File Name'. If you forget to select file saving before starting a run, you will nevertheless be prompted at the end as to whether you wish to save the run data.

The blue progress bar displays the state of completion of the run, and the blue box to the right of it the same information as a percentage. You can stop the run at any time by selecting 'Stop' from the Data Logger menu. The yellow Status bar at the bottom of the page gives information about the data logging operation.

Once data logging is complete you may open the text format data file using any compatible spreadsheet programme such as MS Excel, and use the data to generate plots and reports.

You can pause the data logger at any time by selecting 'data logger' and 'pause'. Repeat to continue logging from where you left off, noting that the clock keeps ticking during the pause period.

9.4 Auto Date Stamped Files

If you are planning to run the data logger for extended periods of time then you should consider checking the 'Auto date stamped file' option. This feature will

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save the data at midnight for the previous twenty four hours and so on until the data-logging is complete OR the user interrupts. The data file is stored with a date suffix in brackets in yy-mm-dd format.

This feature ensures that data is saved periodically in sensible sized files. This will prevent the computer from crashing and will also ensure that the data is small enough to fit into an Excel spreadsheet

As an example, the user wishes to run the data-logger for seven days recording every minute starting at lunchtime on 12th November 2005. He starts the data logger with the auto-date stamp function enabled. When prompted he gives the filename as test1. In this situation the data logger will run from lunchtime to midnight and then save the first file as test1 (2005-11-12). The data logger then clears and continues for another twenty four hours until midnight the following day. The data is then stored as test1 (2005-11-13). This will continue for seven days when the data-logger will finish.

After this the user will have a sequence of files:

```
test1 (2005-11-12).txt  
test1 (2005-11-13).txt  
test1 (2005-11-14).txt
```

And so on. Combined together they represent all the data over the last seven days. Note that the Rapidox uses the computer clock and date to perform this action, so make sure that they are correct before starting a run.

To view the data in its entirety the user would need to load each file in turn back into Excel to combine.

9.5 Live Time Graphing Screen

The Rapidox data-logging package includes a live-time graphing facility that allows you to monitor the progress of your data in a graphical format (see Figure 18). To access the graph check the box labelled 'Show Graph'. The graph will appear in a new window, and can be accessed at any time without disturbing a run that is already in progress. You can select 'Run' and 'Stop' from the Data Logger menu to begin and end data logging, and the window can be minimised to (and restored from) the task bar while logging data.

To close the window and return to the main data-logging page select 'Close Plot' from the File menu or click on the close window button.

The features of the graph window are described below:

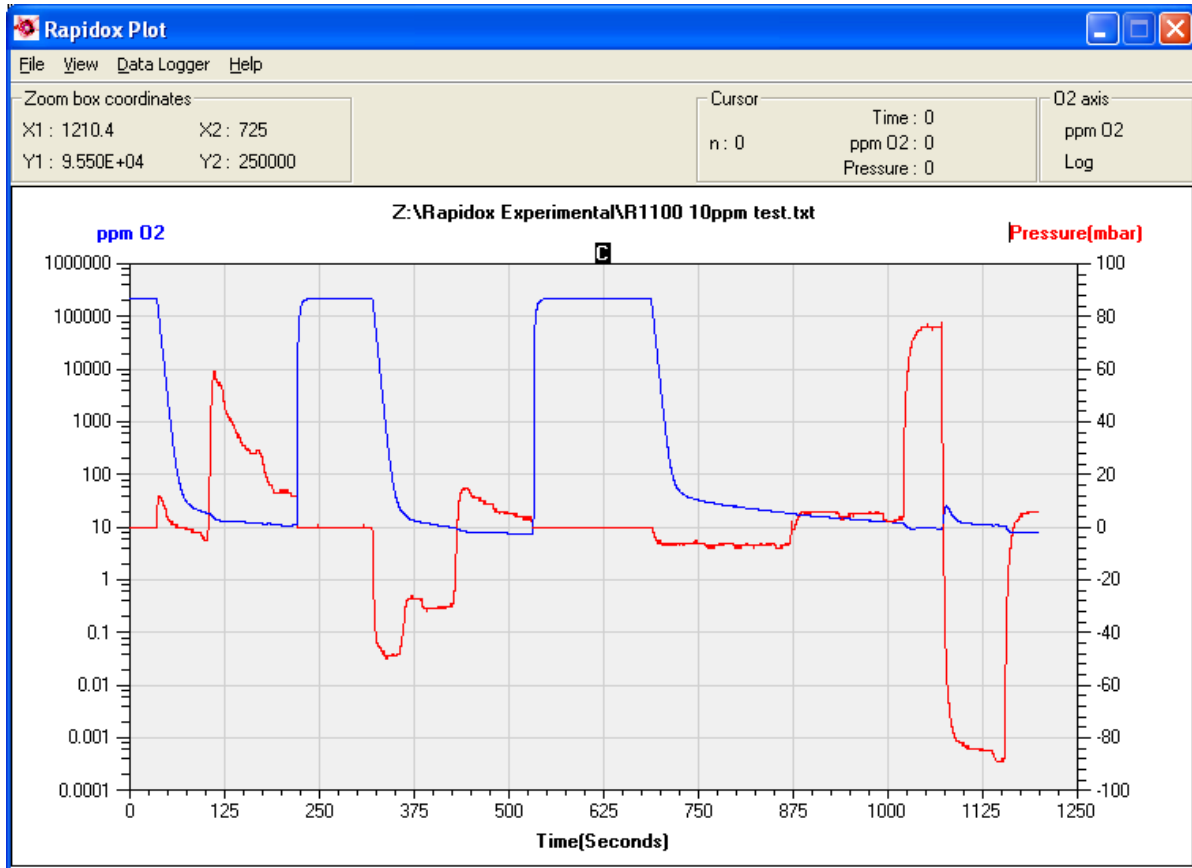


Figure 18: Live-time graphing screen

9.6 Main Graph Window

The graph is an XY plot, with time plotted on the X-axis, oxygen plotted on the primary Y-axis (Y1) and pressure plotted on the secondary Y-axis (Y2). The X-axis and the two Y-axes auto-scale during data logging so that all data points are shown on the graph.

9.7 Plot Colours

The default colours used on the graph are set to blue for oxygen and red for pressure. To change the colours double-click on the coloured axis label at the top of each axis. A colour palette window will appear (see Figure 19) and a new colour can either be chosen from a colour box, or for more variety, by clicking the 'Define Custom Colors >>' button. Click on 'OK' to select the new colour or 'Cancel' to return to the graph without change.



Figure 19: Plot colour palette menu accessed by double-clicking on the axes titles.

9.8 Graph Titles and Labels

If you want to change the text of the graph axis labels, place the mouse pointer over the text and do a single left click to enter edit mode. The text can then be modified. Similarly, to change the title of the graph, place the mouse pointer over the title and click once to edit. If you choose not to enter a title the graph will display the path and filename of the run as the new title once the run has finished. Note that these changes are only temporary and will be overwritten by the defaults if a new run is started or the graph window is closed and reopened. They are provided so that the plot may be printed with alternative labels.

9.9 Plot Co-ordinates

The box labelled 'Plot co-ordinates' to the upper left of the graph window displays the actual plot co-ordinate value at the mouse pointer. This can be used to get a quick oxygen value from the graph. Simply place the mouse pointer at a place of interest and read the corresponding X1 and Y1 values in the box.

9.10 Last data point

During data acquisition, the box labelled 'Last data point' will appear at the upper middle of the graph window. It displays the last data values read from the analyser.

9.11 Using the Cursor

Clicking and holding the left mouse button with the pointer over the 'C' at the top of the plot area activates the cursor, which appears as a vertical dashed line on the plot. While keeping the mouse button pressed, you can now move the pointer anywhere in the plot area or on the 'C' in order to move the cursor. The box labelled 'Cursor' to the upper right of the graph window will display actual values

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for oxygen, temperature, time and the data point number (n) at or immediately to the left of the cursor position. The cursor can be used to investigate actual data values at specific points of interest on the graph.

9.12 Zooming

You can zoom in to any part of the oxygen plot by simply placing the mouse pointer on the new graph start position and then clicking and dragging a new box to re-size the graph. The label on the box to the upper left of the graph window will change to 'Zoom box co-ordinates', and an extra set of co-ordinates, labelled X2 and Y2, will appear, showing the co-ordinates in X and Y units of the second corner of the zoom rectangle as you drag the mouse pointer. The plot will zoom and auto-scale when you release the mouse button. This can be repeated if you wish to zoom in even further. To zoom back to the original size select 'Zoom Full' from the View menu.

Note that although you can use the zoom facility during a live run, the graph will auto-scale to full size with each new data point.

9.13 Y-Axis Graph Units

You can toggle the Y1 oxygen units at any time from percent to ppm and vice versa. Select 'O₂ Units' from the View menu and chose either percent or ppm. The current selection is then displayed in the top right box labelled 'O₂ Axis'.

9.14 Oxygen Scale

You can display the Y1 oxygen axis in linear or logarithmic format at any time by selecting 'O₂ Scale' from the view menu. The current selection is then displayed in the top right box labelled 'O₂ Axis'. Note that the zoom function is disabled when you are viewing on a log scale.

9.15 Second Y Axis

The secondary Y axis located on the right hand side of the graph can be used to display the pressure taken from the internal pressure sensor. The axis is linear and auto-scaling. To select the mode of the secondary axis select 'view' and then 'second axis display'. Choose from 'none' or 'pressure'.

9.16 Loading an Old Run

A previously logged data file can be loaded and viewed by selecting 'Open Data File' from the File menu and selecting the appropriate TXT or CSV file. A progress bar is displayed while the data is being imported. Note that very large data files may take several seconds to load. The data is re-graphed and you can

zoom, label axes, change colours etc., before printing the graph.

9.17 Printing Graphs

You can print the graph at any time by selecting 'Print Plot' from the File menu. This will bring up the printer dialogue box for your specific printer where you can choose various printing options. Make sure that the printer page is set to landscape to obtain a full size print out.

9.18 Data Logging in the Background

It is possible to begin data logging and then minimise the windows to continue working with another application. To minimise the graph simply click on the minimise button on the blue title bar at the top of the window. You can then use the ALT + TAB keys to take you to other programmes already running. To return to the graph simply maximise from the start menu bar or press ALT + TAB again. If the graph does not redraw immediately select 'Zoom Full' from the View menu to redraw.

9.19 Pausing the Data Logging

You can pause the data-logging at any time during the run by selecting the 'data logger' menu and selecting 'pause'. Repeat the action to continue, noting that the live graph will draw a straight line between the paused points to keep continuity of the axes. The clock keeps ticking during the pause period.

If you decide to access the menu of the Rapidox using the front keypad during data logging, then the software will pause automatically. A message appears on the screen informing the user that the unit is being accessed from the keypad. Once the menu has been exited, the software will continue data logging from where it left off.

9.20 Changing the Data Logging Parameters Mid-run

Once the data logging has begun you may change the sample interval time by pausing the data logger and then entering a new value for the time interval. The data logger can then be resumed with the new values in place. Note that you can not change units (e.g. seconds to hours) once logging has started. If you originally selected seconds then you may change the current value to a new value between 1 and 3600 seconds, if you originally selected minutes then you may change between 0.02 and 360 and if you selected hours you may change between 0.01 and 6 hours. Note it is not possible to modify the original total length of time that the data logging will run for once a run has commenced.

9.21 Working with Spreadsheets

The data-logger saves data files in a standard comma separated ASCII text format which can be readily imported into spreadsheet programmes such as MS Excel, in order to produce plots and reports as desired. For specific information on how to import text files into your spreadsheet programme please refer to the help guide supplied with the programme.

Data is saved in comma separated value format, with a '.txt' file extension as the initial programme default. However, when entering the file name, you can instead select a '.csv' extension: the programme will register the last used file extension as the new default. The '.csv' extension is recognised by MS Excel, so that opening the file will automatically run MS Excel, and this may be of benefit if your regional decimal separator is period '.' rather than comma ','. However, if your decimal separator is comma, you should continue to use the '.txt' extension and open the file explicitly from within your spreadsheet programme, defining the field delimiter as 'comma' where appropriate.

9.22 Disaster Recovery

To prevent catastrophic loss of important data during a computer crash or power failure, the data is automatically saved point by point in a temporary file called 'Rapidox temporary data file.txt'. This file is located in the same directory as the main Rapidox programme itself and can be renamed or copied to recover data that would otherwise be lost. Note that this file is overwritten each time 'Run' is selected from the Data Logger menu so make sure all data is recovered successfully before starting another run.

Note that during a run using the 'auto date stamped' feature the temporary data file is wiped clean as soon as the previous data set has been saved successfully. In the case of a crash the temporary data file should be used to recover the last day's worth of data that was not saved to the hard disc.

9.23 Diagnostics

The Rapidox software includes a diagnostics page that is accessed from the tab labelled 'Diagnostics'. This screen will display various values and settings that are operating inside your machine. There is no editing possible on this page – it is purely for information and to enable technical support help you should you experience difficulties with your machine. You may be asked to record values from this page if trouble shooting is required.

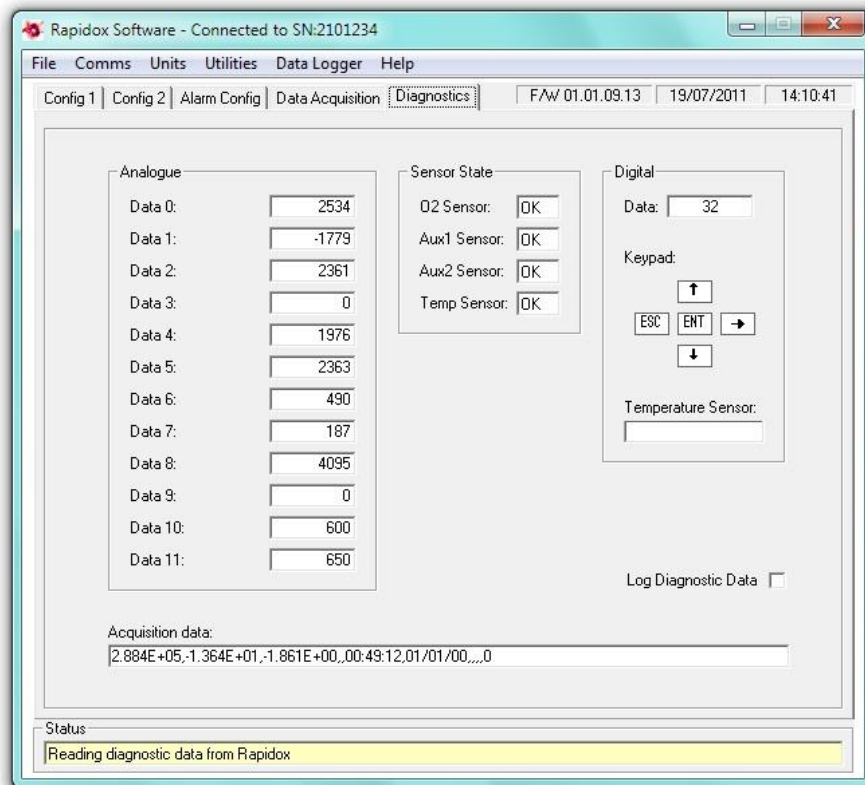


Figure 20: Rapidox Diagnostics Page

1. **Analogue:** The live analogue values displayed in this pane are voltage measurements coming directly from the computer chip inside the analyser. They are for information purposes only but are a useful diagnostics tool for Sensotec staff, as unusual values can indicate a particular fault. To help Sensotec diagnose a fault please capture this window as shown above using the screen capture function described in section 8.9 above and e-mail it to support@cambridge-sensotec.co.uk
2. **Sensor State:** These boxes should all indicate “OK” on a healthy analyser. Note that the Rapidox 1100ZR does not have a temperature sensor fitted so all references to temperature on this screen are not relevant. The possible messages are “OK” “High” “Low” or “Fault”. The High and Low messages indicate that the sensor is out of normal range. The fault message will only display if the sensor is disconnected or has failed in some way.
3. **Digital:** The digital signals coming directly from the computer chip inside the analyser can be monitored here. To test the keypad is working correctly try pushing the buttons and watching the panel. A correctly functioning key will turn the box red on the screen and the digital value for that particular key will show in the data box. If the analyser has an external thermocouple correctly fitted (2100 and 3100 series only) then this will display a signal in the “Temperature Sensor” box.
4. **Log Diagnostic Data:** Checking this box will allow the software to log the

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diagnostic data which can then be e-mailed to Sensotec for analysis. Do not switch to a different tab while logging diagnostic data – the data is only logged while the “Diagnostics” tab is still selected. The software will log diagnostic to a file named “Rapidox diagnostics file 210xxxx.txt” (where “xxxx” is the serial number of the analyser) in the folder shown in the yellow “Status” box at the bottom of the screen. Data is logged every 6 seconds, so the software should be left to run for at least 1 minute to gather a few data points. In order to stop logging, simply uncheck the “Log Diagnostic Data” tick box. Note that diagnostic data is always saved to the same file, and will automatically overwrite any existing file without prompting the user, so if you want to save existing data you must either rename it or copy (or move) it to a different folder, before checking the “Log Diagnostic Data” tick box again. If you are logging diagnostic data during the analyser’s warm up period, the “Acquisition data:” box will display the current sensor heating message, and will only display acquisition data once the oxygen sensor has reached its operating temperature.

Once completed please e-mail this file to support@cambridge-sensotec.co.uk for analysis.

10. Troubleshooting

Q: The Rapidox says 'sensor heating' but won't begin measuring.

A: What kind of gas are you running over the sensor? Does it contain hydrogen or helium? If so then the heater may be struggling to heat the sensor with such cooling gas present. Does the problem go away if room air is allowed into the analyser? Contact Cambridge Sensotec for advice. If the message continues for around eight minutes then the analyser will give up and indicate that the internal heater has failed and the sensor needs replacing.

Q: The Rapidox won't power up at all.

A: There are fuses located on the power socket on both live and neutral lines. These are standard 20mm (1A for 240V versions, 2A for 110V) fuses available from a supplier such as RS Components.

Q: The Rapidox gives strange readings that are way off the expected values.

A: Check to make sure which calibration gases are selected. Are they the same as the actual gases you used to perform the calibration? If not you must recalibrate the analyser or re-load the factory defaults to get you going again.

Q: The sensor does not read 20.9 - 21.0% in air (actual value is 20.95%).

A: If the room air is very humid, it will slightly affect the observed measurement or the sensor may have drifted slightly because of natural ageing. If you are using air as a calibration point then simply do a quick re-calibration in the air to compensate for this.

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- Q: I messed up the calibration procedure and the analyser is not working properly.
- A: Return the box to the factory defaults using the keypad or communications software, by selecting 'Default Configuration' followed by 'Write Configuration to Analyser' from the File menu. Now try re-calibrating the Rapidox.
- Q: The software will not talk to the Rapidox.
- A: Make sure that you are using the correct cable, as supplied (pin 2 to pin 2 etc). A crossed RS232 cable (pin 2 to pin 3 etc.,) will not work. Make sure that your COM ports are recognised by your computer. Check in your Windows device manager to see if there are any conflicts. If you have an internal modem fixed to your PC you may experience difficulties using this software. Contact Cambridge Sensotec for further advice.
- Q: I selected 'Write to the Analyser' and now the Rapidox is way off calibration.
- A: Only select 'Write to the Analyser' once all the values are correctly entered in the boxes on the right. The best procedure is to 'Read Analyser Configuration' and then press 'Copy' so the values in the boxes are the same as those stored in the Rapidox memory. You can then edit these values and then select 'Write to the Analyser' when finished.
- Q: How do I get back to the factory calibration for my instrument.
- A: Select 'Load Configuration File' from the File menu and look for the rxc file on your CD. Select this file and then select 'Write to the Analyser'. This will load the factory calibration back into the Rapidox. Alternatively you can load a standard default configuration any time using the 'Load Default' option on the File menu. This configuration will not be perfect for your analyser but will be good enough to get you started again.

10.1 Warranty

The Rapidox analyser has been carefully tested and inspected before shipment and is guaranteed to be free from defective materials and workmanship for a period of twelve months from date of purchase. The sensor head is replaceable and has a life expectancy in excess of 17,500 hours. However, if the analysis gas contains corrosive gases or large quantities of particulates, sensor life may be shortened. In the case of the latter, it is normally possible to insert a filter prior to the sensor head to remove the particulate material.

10.2 Conditions of Warranty:

1) This warranty is in addition to and does not affect any statutory rights of consumer purchasers. This warranty is valid worldwide on a "back to base basis".

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2) This warranty covers breakdowns due to design or manufacturing faults; it does not apply to damage, however caused, wear and tear, neglect, unauthorised adjustment or repair, or any items of limited natural life.

3) In the event of failure, please take the following action:

a) Refer to the “Troubleshooting” section of your instruction manual to identify and possibly correct the problem.

b) If the fault cannot be resolved, please contact the Cambridge Sensotec service and repair centre at the address given on the cover of the manual.

4) The warranty period applicable shall be 12 months from the date of delivery provided that:

a) Notice in writing of the defects complained of shall be given to Cambridge Sensotec (The Seller) upon their appearance, and

b) such defects shall be found to have arisen from the Seller's faulty design, workmanship or materials, and

c) The defective goods shall be returned to the Seller's premises at the Purchaser's expense if so requested by the Seller.

d) Any repaired or replaced goods shall be redelivered by the Seller free of charge to the original point of delivery but otherwise in accordance with and subject to these Conditions of Sale.

e) Alternatively the Seller shall be entitled at its absolute discretion to refund the price of the defective goods in the event that such price shall already have been paid by the Purchaser to the Seller, or, if such price has not been so paid, to relieve the Purchaser of all obligation to pay the same by the issue of a credit note in favour of the Purchaser in the amount of such price.

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Rapidox CERTIFICATE of CALIBRATION

Date:

Rapidox Serial number:

Calibration Constant A

Calibration Constant B

Calibration Constant C

Calibration Gas 1

Calibration Gas 2

Calibration Gas 3

Configuration Filename

Calibrated by:

Signed:

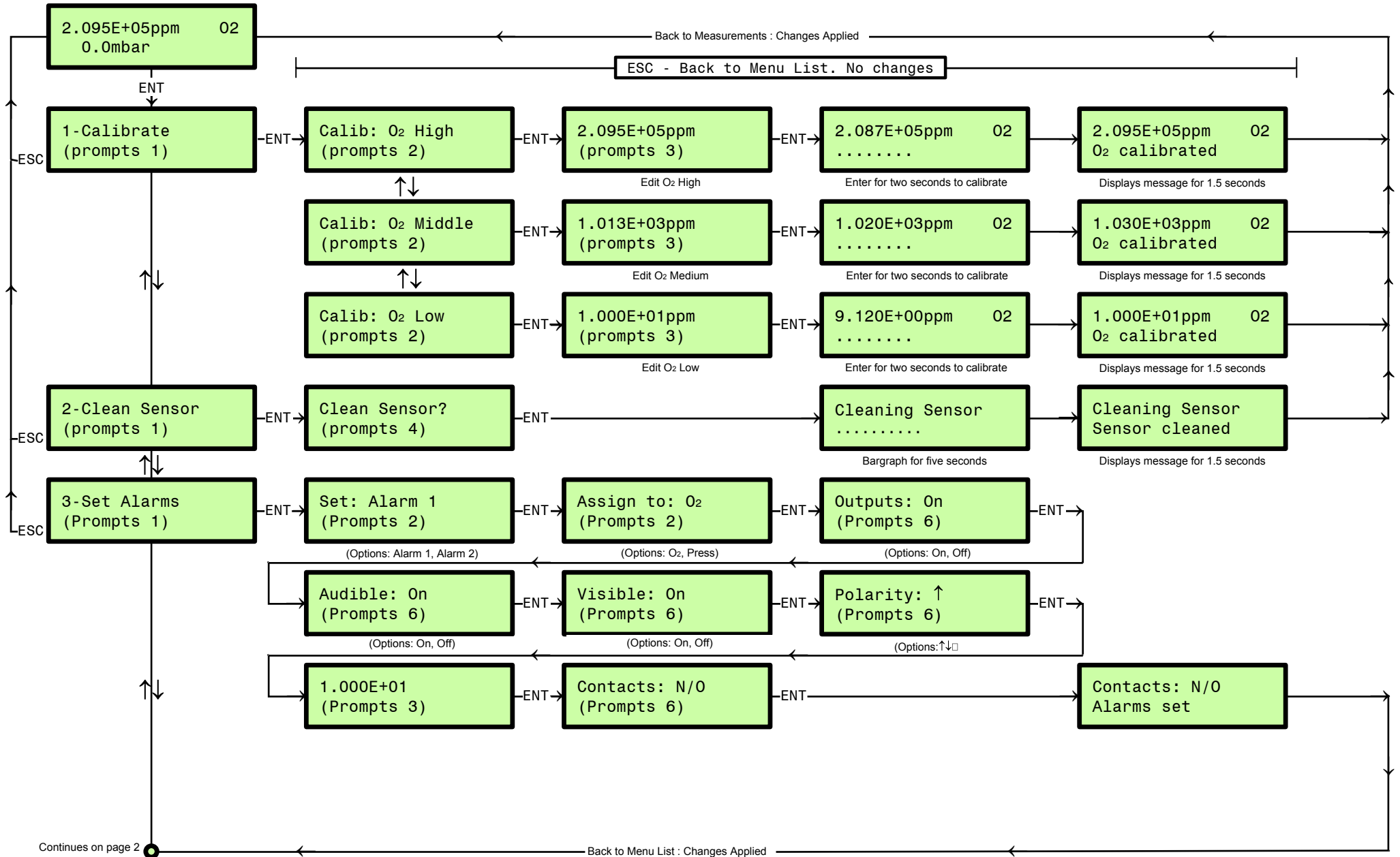
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APPENDIX 1: MENU FLOWCHART FOR RAPIDOX 1100Z



Continues on page 2

ESC - Back to Menu List. No changes

