G1010 Mark 2
Oxygen Analyser
Instruction Manual
130-0116 Issue 4

This manual contains important

Health & Safety information

G1010 Mark 2 OXYGEN ANALYSER HANDBOOK.

GENERAL DESCRIPTION

The Oxygen Analysers in this range are microprocessor controlled and provide a performance and a range of features without parallel for analysers of this type and cost. Fitted with a display that autoranges over a span of approximately 5 decades, (depending on the model) the alarm and analogue outputs are user programmable.

Four sensor types are available to cover oxygen concentrations from 100% to low parts per million (ppm) in a variety of gas mixtures.

SAFETY and EMC INFORMATION

Please read this section carefully before installing the instrument.

This instrument meets the requirements of the European directives specified below. However it is the responsibility of the installer to ensure the safety and EMC compliance of any particular installation.

The G1010 range of gas analysers

Safety

These instruments comply with the European Low Voltage Directive 73/23/EEC, amended by 93/68/EEC
by the application of the safety standard EN61010(93)

Installation and servicing should only be carried out by suitably qualified personnel.

Electromagnetic Compatibility

This instrument meets the requirements of EN50270:1999 - ‘EMC – Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen.

SPECIFICATION

Display
Multi digit LCD - character height 12.7mm

Display ranges and resolution
E cell model - Display range 0.01% to 100.0%. Resolution: 0.1% from 10% to 100%; 0.01% below 10%. Suitable for samples containing mildly acidic gases. e.g. Carbon dioxide, hydrogen sulphide etc.

N cell model - Display range 1ppm to 50%. Resolution: 0.1% from 10% to 50%; 0.01% from 0.50% to 9.99%; 10ppm from 500ppm to 4999ppm; 1ppm from 0ppm to 499ppm

H cell model - Display range 1ppm to 10%. Resolution: 0.01% from 0.50% to 9.99%; 1ppm from 0ppm to 4999ppm

L cell model - Display range 0.1ppm to 10%. Resolution: 0.01% from 0.50% to 9.99%; 1ppm from 50ppm to 4999ppm; 0.1ppm from 0.0ppm to 49.9ppm

Stability
Better than 2% of reading per month, or 1ppm whichever is greater.

Cell life
E cell - up to 5 years
N, H and L cells - up to 2 years

Sample flow
Between 100 and 300 ml/min for optimum operation. Max. 1 l/min

Sample pressure
The pressure applied to the cell is determined by the vent pressure which should be atmospheric for quoted accuracy. Note: The sensor must not be subjected to rapid pressure changes.

Sample temperature
-5 to +40 °C (non condensing)

Sample connections
Inlet and outlet: captive seal compression fittings suitable for 0.25 inch (or 6mm) o/d tube

Speed of response
T90 is variable depending on sensor and concentration and is approximately 3s at % levels and 20s at ppm levels. The ppm figure assumes that the sensor is purged down.

Analogue output
0 to 5 volts (min. load 10kohms) or
4 to 20mA (max. load 300ohms)

The 20mA point oxygen value is user programmable over the following ranges.

'E' Type cell: 5% to 100%
'N' Type cell: 50ppm to 50%
'L' & 'H' Type cell: 50ppm to 10%

Setting resolution
0.1% from 10.0% to 100%
0.01% from 0.50% to 10.0%
10ppm from 500ppm to 4999ppm
1ppm from 50ppm to 499ppm

Alarm outputs
2 alarms each user programmable for: Mode - HIGH, LOW or OFF; Level - over full display range of instrument and hysteresis - 0% to 10% of set point. Volt free C/O contacts rated at 48v ac or dc, 0.5A, normally energised.

Ambient temperature
0 to 40 °C - continuous
-5 to + 50 °C - intermittent

Supply voltage
110/120 v or 220/240 v 50/60 Hz, 24v DC, ±10% including ripple and noise. Max power consumption 6VA

Mounting
Panel-mounting with two clamps

Enclosure material and protection
Glassfibre-reinforced Noryl to IP40 (IP54 front-panel option)

Dimensions
See Figures 1 and 5

This instrument meets the requirements of EN50270:1999 - 'EMC – Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen

Where relevant, performance figures are quoted under NTP conditions i.e. 20°C (68°F) at 1 atmosphere pressure.

Section 1 INSTALLATION

1.1 Unpacking and visual checking

Take all standard precautions when opening packages. In particular avoid the use of long bladed cutters. Search packing before discarding it and make sure that all of the components are removed. Check that all pipe connections have captive seal nuts.

1.2 Mounting

Chose a site where the ambient temperature is between 0°C and 40° C. and where the analyser will not be subjected to vibration, knocks or jolts. It may be tilted etc. in any attitude.

To install the electronic control/display unit, remove the screw side-clips (if fitted) and slide the unit into the panel cut-out. Re-fit the two clips and tighten them up. Dimensional details are given in Fig. 1

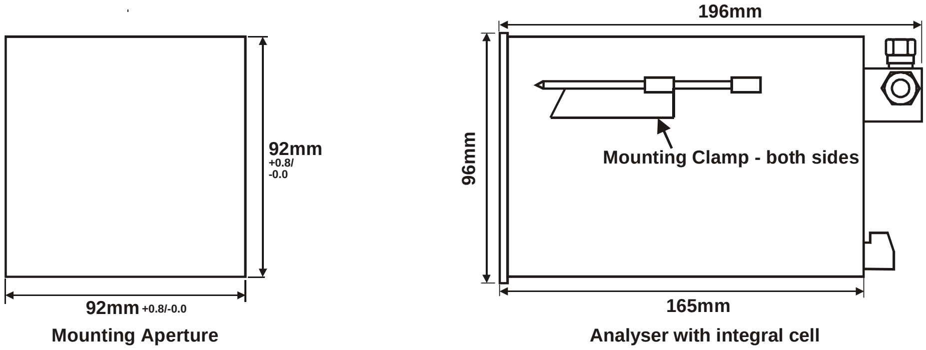


Fig. 1

1.3 Power supply

The standard options are 240V AC, or 110V AC or 24V DC. Refer to the serial number plate located on the side of the instrument for details.

1.4 Connections

All electrical connections via rear panel plug-in terminal block. Terminal identity as shown below

Cell		An. O/P		Alarm 1			Alarm 2			*DANGER* Mains		
+	-	+	-	C	NC	NO	C	NC	NO	L	N	E
1	2	3	4	5	6	7	8	9	10	11	12	13

OR→

DC Power		
+	-	E
11	12	13

See Fig 3 for details of optional remote sensor version.
Note: N/C = Normally closed N/O = Normally open
Normal" refers to the alarm status, not the electrical rest position of the relay.

1.5 Installation Requirements for EMC

To ensure compliance with the European EMC directive certain installation precautions are necessary as follows:

1.6 Routing of wires

To minimise the pick-up of electrical noise all signal wiring should be shielded and routed away from power cables.

1.7 Sample connections

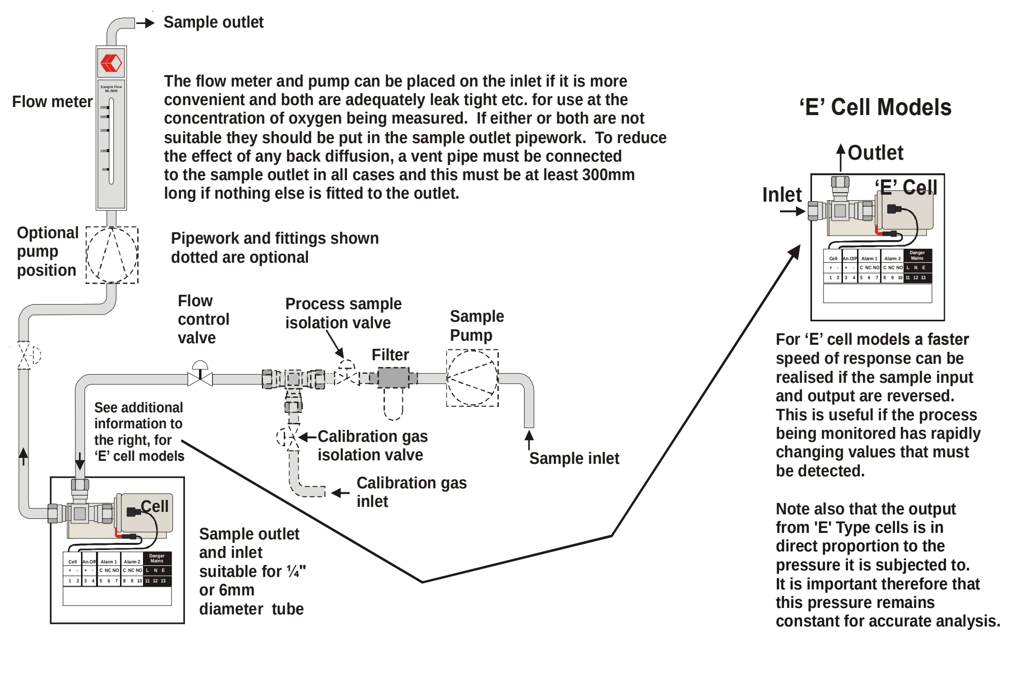
The standard sample connections are shown in Fig. 2. It is important that the sample being supplied to the analyser is clean and non-corrosive. Filters or chemical absorbers will be necessary for those samples that contain particulate matter or corrosive components. Additionally the dew-point of the sample should not be above the ambient temperature.

If site or process conditions require that the process is isolated from the analyser when the cell is changed then shut-off valves should be fitted to the inlet and outlet of the measuring cell. The inclusion of a three way valve on the inlet side can also be used to allow easy connection of a standard gas for calibration checks. It is particularly important that good pipework connections are made when low levels of oxygen are being measured.

For all parts per million (ppm) measurements the pipework up to the inlet of the measuring cell, should be all metal or hard plastic such as Nylon 6, un-plasticised P.V.C. etc. – PTFE, plasticised P.V.C. and other soft plastics ARE NOT SUITABLE. Flowmeters and pumps must be suitable for handling ppm levels if placed on the inlet to the cell; see comments on Fig. 2. Note that the cell is shipped with its inlet tube plugged. Do not remove this plug until you are ready to fit the cell to the instrument. This is particularly important for instruments fitted with L cells, irrespective of the positioning of flow meters etc.

It is important to fit a pipe of at least 300mm length to the sample vent/outlet connection to prevent back diffusion of air. It should be noted that back diffusion can occur even when the sample is flowing, and is due to the difference in oxygen partial pressure between the sample and air. The pipe should be short enough and of sufficient bore to prevent significant back pressure when the sample is flowing. Standard 6mm or ¼" tubing is ideal.

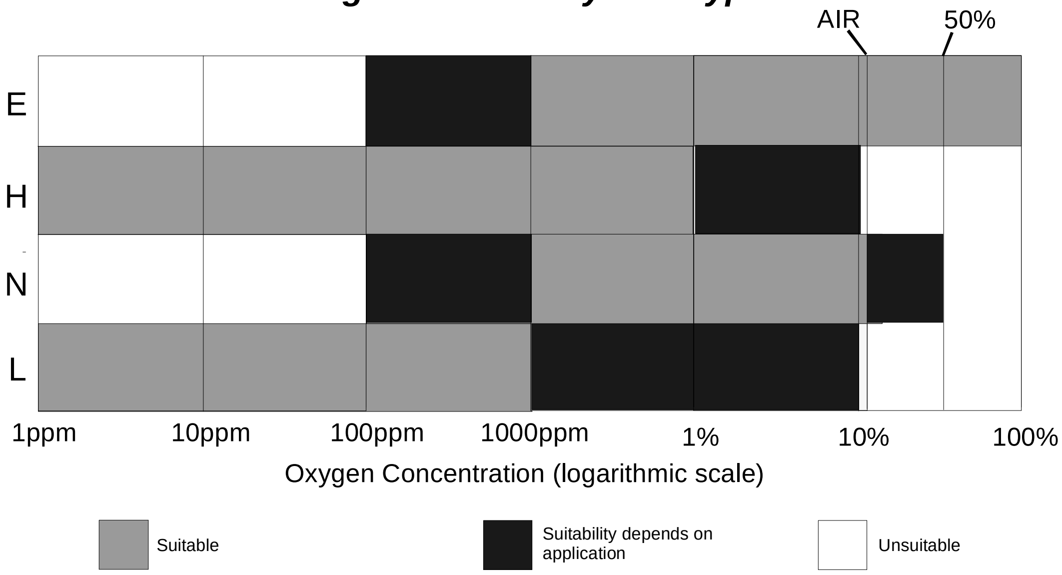
The cell must not be pressurised beyond 0.25BAR gauge or less than (-)250mm water gauge. Rapid pressure changes could damage the cell, and pulsation will give an erratic display.



General sampling system arrangement **Fig. 2**

1.8 Cell Characteristics

Ranges Covered by Cell Types



1.8.1 E cells

Are partial pressure cells and as such are affected by changes in atmospheric pressure. They are mainly used for high concentrations or lower concentrations when mildly acid gases are present and accuracy is not critical. They are not significantly affected the density of the sample or the presence of hydrogen. For best accuracy however it is best to calibrate with a mixture of gases similar to those in the process gas. The minimum resolution of E cell instruments is 0.01% (100ppm). For improved accuracy below 0.1% (1000ppm) the alternative cells would be better assuming other factors do not dictate otherwise.

Suitable sample components for the E cell are: Nitrogen, all Inerts, Hydrogen, Carbon Dioxide, Hydrogen Sulphide, Carbon Monoxide, Hydrocarbons up to C4Hn. For all others, check with Hitech or their agents.

1.8.2 H, N and L cells -

Have an output that is not affect by changes in atmospheric pressure but is affected by changes in sample density. The default background gas is nitrogen and the reading changes approximately according to the following formula:

$$\sqrt{\frac{\text{Density of calibration gas}}{\text{Density of sample gas}}}$$

Example: if the calibration gas was oxygen in nitrogen and the sample applied had a density 1.5 higher, the oxygen reading on the process gas would be $\sqrt{}\ 1 \div 1.5 = 0.8$ lower than on the calibration gas. If the sample density changes significantly in normal use then some form of compensation or use of an E type cell should be considered. It important for best accuracy that instruments fitted with these cells are calibrated on a gas of similar composition to the process gas.

Suitable sample components for N and L cells are: Nitrogen, True inert or noble gases, Hydrocarbons up to C4Hn. For all others, check with Hitech or their agents.

The H cell is suitable for: Hydrogen, Nitrogen, True inert or noble gases, Hydrocarbons up to C4Hn. For all others, check with Hitech or their agents. Typically they are only used for samples containing hydrogen. Care should be taken to ensure that any changes in the hydrogen content do not cause unacceptable errors due to density changes.

1.9 Cell installation

1.9.1 H, N and L type cells

The cells are shipped with the leads shorted and the sample tube plugged with a rubber bung. This ensures that a cell is purged down to low levels and ready to be applied to the measurement of low levels of oxygen (less than 1000ppm) with the minimum of delay. The bung should be left in place until the system is ready for the cell to be fitted. If it is intended to apply the cell immediately to the measurement of low oxygen concentrations then the sample should be left flowing during the cell change operation. The bung should be removed from the cell and the cell coupled to the holder as rapidly as possible. THIS ASSUMES THAT THE SAMPLE THAT WILL INEVITABLY ESCAPE WILL NOT CONSTITUTE ANY SORT OF HAZARD. IT IS THE RESPONSIBILITY OF THE USER TO ENSURE THIS.

To fit the cell, first slacken the compression nut on the cell sample tube. Remove the rubber bung from the inlet tube, and put the inlet tube into the compression fitting. Tighten the compression nut - do not over tighten, ½ to ¾ of a turn beyond finger tightness is adequate. Finally connect the cell signal leads to the terminal block - see Fig. 2 and section 3.4 for details.

WARNING - Do not leave an ‘L’ type cell exposed to oxygen concentrations above 5% connected to the instrument for extended periods as this will cause premature depletion of the cell. Instead, leave the cell disconnected or apply a sample of low oxygen concentration. This applies whether the instrument is on or off. When fitting a cell intended for immediate use at concentrations of 1000ppm or less it is advisable to:

A) have low level gas flowing through the system prior to fitting the cell.

B) unseal and fit the cell as fast as possible.

1.9.2 E type cell

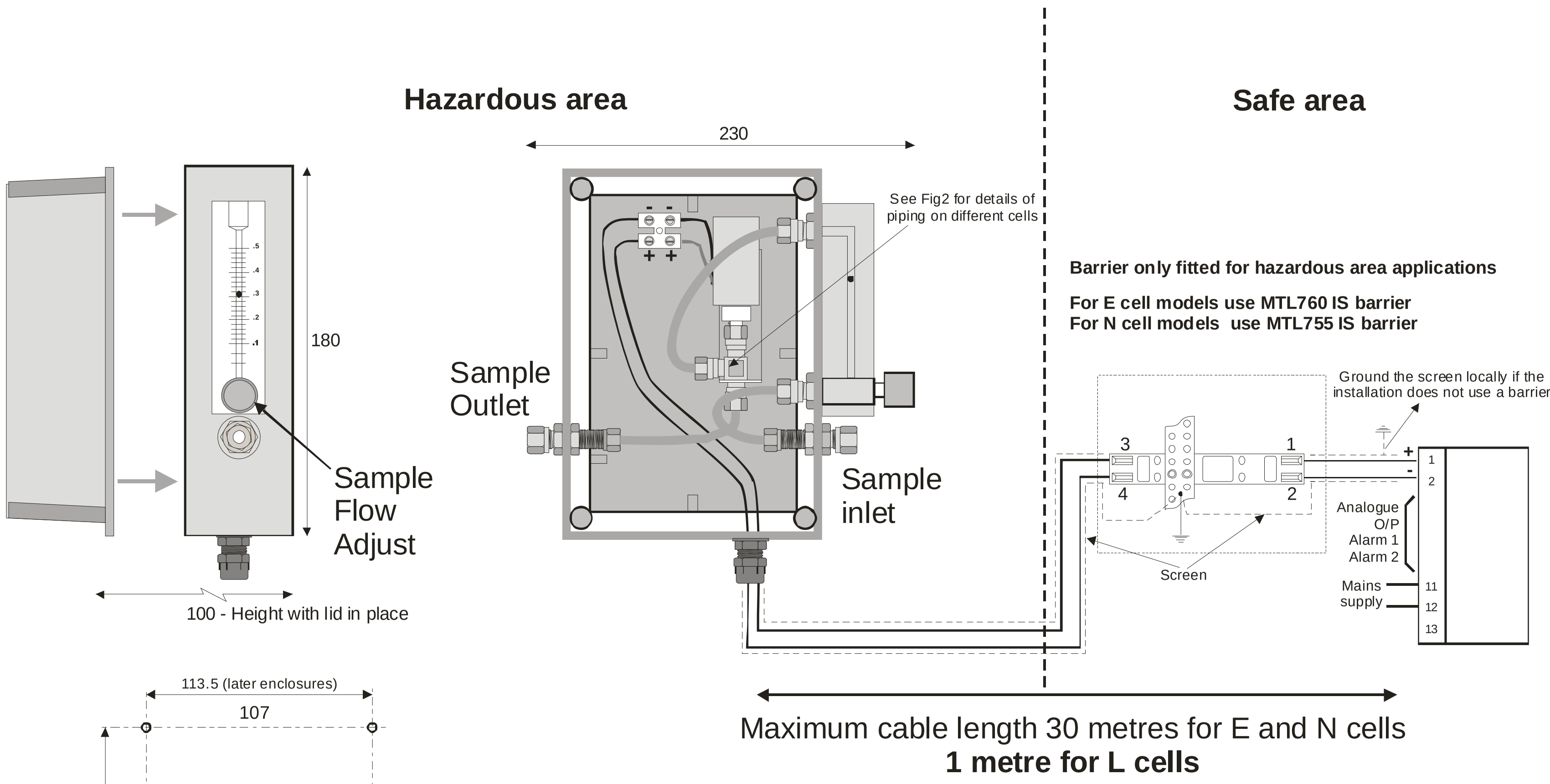
The E type cell is shipped with the connecting port open and with the connecting wires insulated; they should not be shorted. The method of installation is the same as for other cell types.

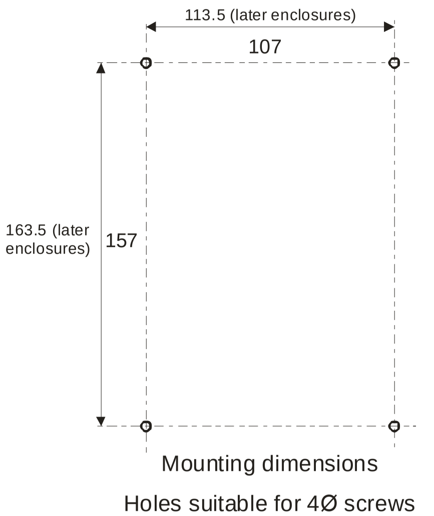
1.10 Alarm contacts

The contacts are rated for signal applications. Where AC voltages are to be switched, the use of suitable snubbers across the contacts is recommended to ensure reasonable contact life. Typical values are 0.047µF to 0.22µF with 47 ohms to 100 ohms in series with the capacitors. N.B. Mains rated capacitors must be used.

1.11 Mounting and connecting remote sensor version

Dimensional and electrical connection details are shown in Fig. 3. The G1010X version is supplied with a suitable zener barrier to allow the cell to be installed in a hazardous area. The cell conforms to the requirements of “simple apparatus” as defined by EN50020. To reduce the risk of electrical noise interference the maximum cable length between the cell housing and the display unit is best restricted to 30 metres for ‘E’ and ‘N’ type cells and 1 metre for ‘H’ and ‘L’ type cells. For those applications requiring a greater separation the TX version is available.





Sample inlet/outlet
Standard - Captive seal compression fittings suitable for 6mm or ¼" pipe.
Stainless Steel - Double ferrule compression suitable for 1/8" O.D. pipe.
Maximum inlet pressure - 5 bar

Enclosure
Grey polycarbonate to IP67 - dimensions are in millimetres
Overall dimensions are approximate

Remote Sensor Details Fig. 3

Section 2 COMMISSIONING

2.1 Applying power

When the analyser is fully connected, it may be powered up. When power is applied, the analyser briefly sets the alarms and analogue output to the fault condition – both alarms on and analogue output at approximately 115% (~5.6V or 22.5mA) – and then automatically enters normal measurement mode. Depending on which cell is fitted, the analyser may initially indicate a high oxygen reading. After a few minutes the reading will settle to a level dependent on the sample being supplied to the cell. The analyser is calibrated prior to shipment and may be used immediately. To check calibration see section 5.

2.2 Programming

The user programmable features are accessed by pressing and holding the Edit button for approximately 8 seconds when the instrument is in normal measurement mode. Each subsequent momentary press of the Edit button scrolls the display through a sequence of adjustable parameters. The order of the sequence is as follows:

Alarm 1 Set point → Alarm 1 Mode → Alarm 1 Hysteresis → Alarm 2 Set point → Alarm 2 Mode → Alarm 2 Hysteresis → Analogue Output top scale value → Return to measurement mode.

2.2.1 ALARM 1 - Set point

This is the first parameter to be displayed when the **Edit** button is pressed and held for eight seconds. The display will show “E xxxx”, and the Alarm 1 LED will flash. “xxxx” is the value of the alarm set point and the flashing LED indicates that it is the set point of alarm 1. To the right of the display a % or ppm symbol is displayed to indicate the units of the value displayed. To change the value of the set point, press the up/down arrows until the display shows the required value. Observe the “%” and “ppm” symbols to ensure the correct setting. The value changes slowly when the button is first pressed, enabling the least significant number to be changed by giving the buttons a short “click”. If the button is kept depressed, the rate accelerates rapidly to enable large changes in value to be achieved quickly. Once the required value is displayed, press the **Edit** button once to store the value in the analyser’s memory. Simultaneously the display will change to show “E x” and the Alarm 1 LED will continue to flash.

2.2.2 ALARM 1 - Mode

The symbol displayed in the “x” position indicates the mode of the alarm as follows; 0 - Alarm off; H - High; L - Low. Press the arrow buttons to change the mode and press the **Edit** button once to store the setting. The display will change to show “EH xx” and the Alarm 1 LED will continue to flash.

2.2.3 ALARM 1 - Hysteresis

The number displayed In the “xx” position indicates the value of the hysteresis for alarm 1. The value is given in percentage of the set-point or alarm level and is variable from zero to 10%. Press the arrow buttons to set the required value and then the **Edit** button to store the value. The display will then change to repeat the above sequence for alarm 2; indicated by the alarm 2 LED flashing.

2.2.4 ANALOGUE OUTPUT - Top scale value

When the **EDIT** button is pressed following alarm 2 hysteresis entry, the display will show “EPxxxx”, where “xxxx” is the oxygen concentration at which the analogue output (0 to 5v or 4 to 20mA) is at top scale. Neither alarm LED is flashing. Press the up/down arrow keys to change the value of oxygen concentration equivalent to the top scale value of the analogue output. The ranges of values depend on the particular model as shown below. Once the required value is selected, press the **Edit** button to store the value and return to measurement mode.

E type cell instruments 5% to 100%

N type cell instruments 50ppm to 50%

L and H type cell instruments 50ppm to 10%

2.3 Cell failure detection

All types of cell used on the G1010 fail to a low output or concentration reading. By setting one of the alarms to a "Low" configuration and a concentration that the process could not reach in normal operation, an effective cell failure alarm can be set up.

2.4 Applying the sample

Establish a sample flow of between 100 and 300ml/min. The analyser will respond immediately and move towards displaying the concentration of oxygen in the sample. The speed of response varies according to how far the oxygen concentration in the sample is from the gas in contact with the sensor at start up (usually air). Figs 4 & 5 show the typical response time from an air condition for N and L type cells. The E cell has a response rate similar to the N cell. The H cell's response varies according to the hydrogen content and typically falls between the N and L cell. Once a cell is purged down, it responds in a few seconds to large changes of oxygen concentration within the instrument's span. Short time excursions to high levels of oxygen, such as may be experienced during calibration, are recovered from in a matter of a few minutes.

2.5 Error 'HELP' Messages

If a data error is detected by the microprocessor it is reported by displaying 'HELP' followed by a number. The meaning of these messages is as follows.
HELP 1 - After finding user calibration data corrupt the backup was found to be corrupt too. Return to factory.
HELP 2 - Will not be seen. Factory calibration data is corrupt. If the backup is OK it will be silently restored.
HELP 3 - After finding factory setup data corrupt the backup was found to be corrupt too. Return to factory.
HELP 4 - User calibration and/or setup data is corrupt. Press the UP (↑) key to recover. Factory default values are loaded for alarms, output range, cell calibration etc. After a few seconds the instrument will automatically go into the EDIT menu. After working through the edit screens (alarm settings and output range) in the normal way, the instrument goes automatically into the CALIBRATE mode. After calibrating at the high and low points, the instrument reverts to normal operation.

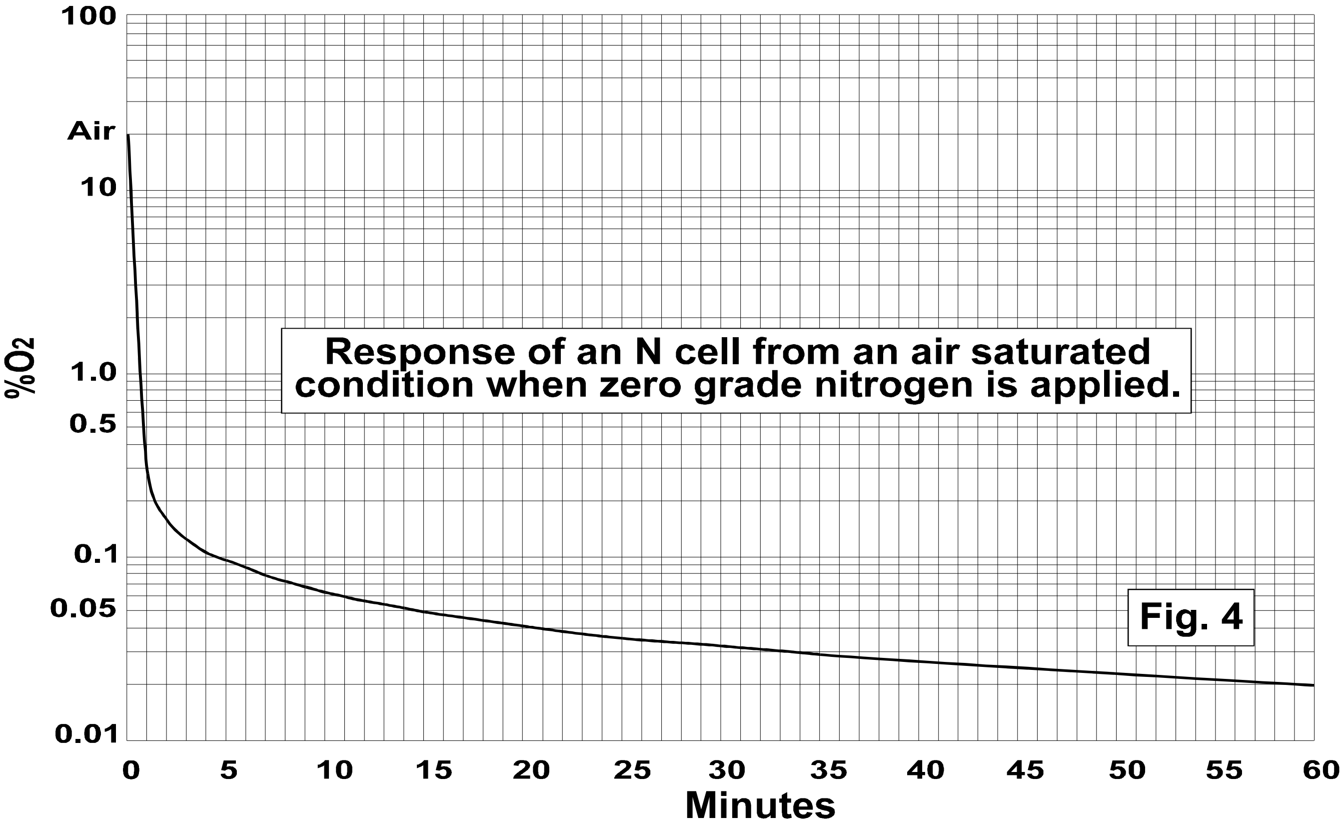

100
Air
10
1.0
0.5
0.1
0.05
0.01
%O2
0
5
10
15
20
25
30
35
40
45
50
55
60
Minutes
Response of an N cell from an air saturated condition when zero grade nitrogen is applied.

Fig. 4

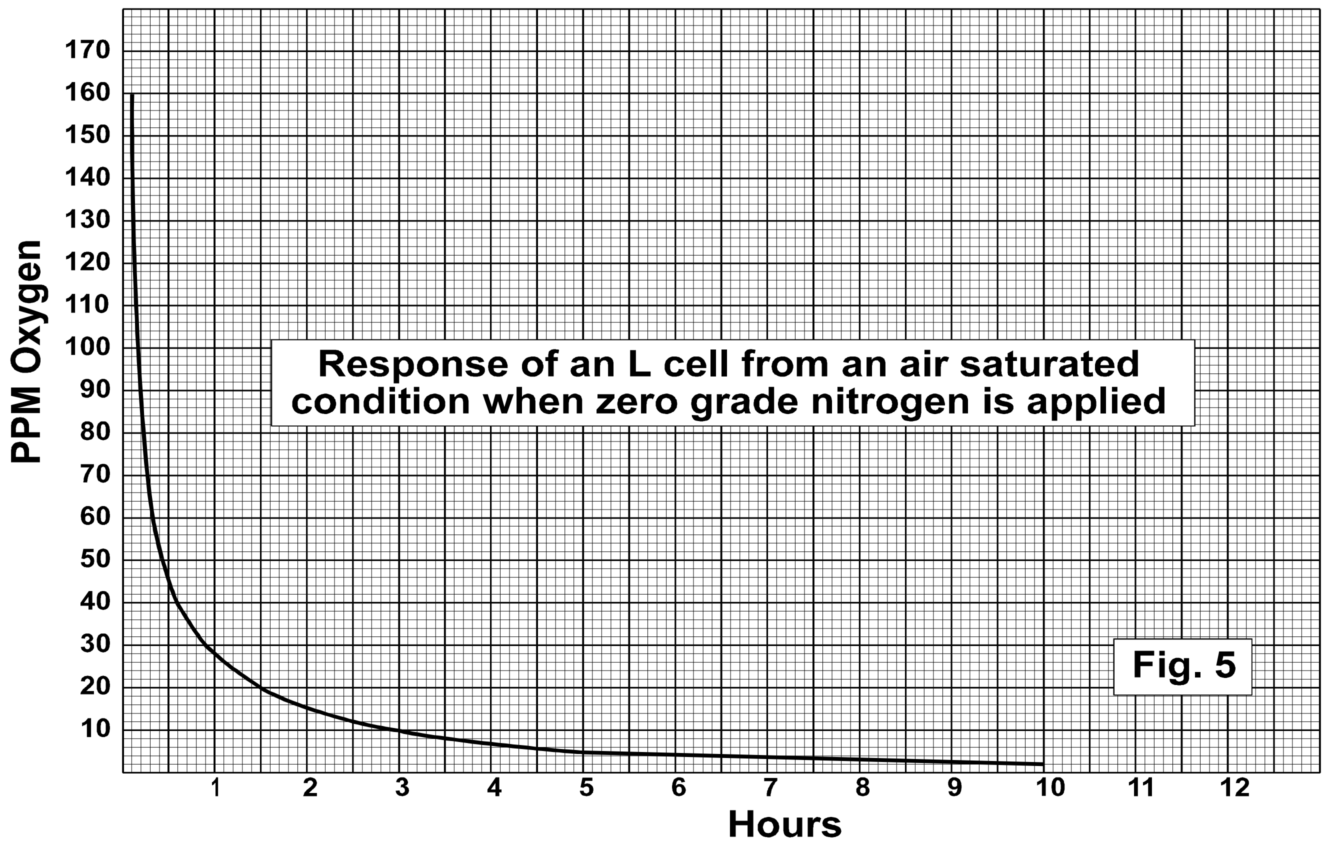

170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
PPM Oxygen
1
2
3
4
5
6
7
8
9
10
11
12
Hours
Response of an L cell from an air saturated condition when zero grade nitrogen is applied

Fig. 5

Section 3 MAINTENANCE AND CALIBRATION CHECKS

CAUTION: Disable all analyser-dependent plant control functions before commencing calibration and maintenance procedures.

Some of the procedures described when replacing/connecting a cell assume that the escape of the sample into the atmosphere will not constitute any sort of hazard such as asphyxiation, flammability etc. It is the responsibility of the user/operator to ensure this. If a hazard will result then the method should be modified accordingly. Consult Hitech or their representatives for advice if in doubt.

3.1 Typical cell life

- E Type: 5 years in ideal conditions - (moist inert gas at 15°C). 2 to 3 years can be expected as a minimum.
- N Type: 100,000 oxygen % hours or 2 years, whichever is the sooner
- H Type: 80,000 oxygen % hours on nitrogen and 25,000 oxygen % hours in hydrogen or 2 years, whichever is the sooner.
- L Type: 16,000 oxygen % hours or 2 years, whichever is the sooner.

Each cell is date labelled when supplied; this date should be used to establish the expiry date. See the Storage of the Measuring Cell in Section 5.

3.1.1 Cell failure modes

All known cell failure modes result in a loss or lowering of output.

3.2 Calibration

The calibration routines detailed below all assume that the cell's zero offset has been entered as detailed in detailed in 4.3.1.1.1 for N,H & L cells or in 4.3.1.2.1 for E cells. Instruments as delivered and fitted with their original cell will have had this offset entered. When installing a replacement cell it is important to follow these procedures.

3.2.1 Calibration interval

It is recommended that the calibration is verified every month. This frequency of verification is for typical industrial applications. When the application is critical, the frequency of verification should be increased in line with local safety standards.

3.2.2 Connecting the calibration gas, piping etc

See section 3.5 for advice on pipe work etc. Refer to Fig 2 for details of a typical installation. For analysers measuring part-per-million oxygen, any regulators in the gas stream should have a low volume and a metal diaphragm. Most pressure gauges etc. contain cavities that trap air/oxygen and can take several hours to purge down; they should be avoided or due allowance made for this effect.

3.2.3 Calibration of instruments fitted with 'N' and 'E' Type cells

3.2.3.1 Calibration gas level

For optimum accuracy it is best to calibrate with a gas of the same composition and oxygen concentration as the normal sample. Refer to section 2.8.2 if calibrating an 'N' type instrument and the density of the calibration gas and sample gas are significantly different. If calibrating on ambient air, take into account the dilution effect of its humidity using the table below.

Temp °C	20% RH	40% RH	60% RH	80% RH	100% RH
0	20.9% O_2	20.9% O_2	20.9% O_2	20.8% O_2	20.8% O_2
10	20.9% O_2	20.8% O_2	20.8% O_2	20.7% O_2	20.7 % O_2
20	20.9% O_2	20.8% O_2	20.7% O_2	20.6% O_2	20.5% O_2
30	20.8% O_2	20.6% O_2	20.4% O_2	20.2% O_2	20.1% O_2
40	20.6% O_2	20.3% O_2	20.0% O_2	19.7% O_2	19.4% O_2

3.2.3.2 Calibration method

Flow the calibration gas through the analyser and wait for the reading to become stable. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the **Cal** button until the display shows “H xxxx”; where H indicates that the high calibration point is selected. Use the up/down arrow buttons to set the reading to that of the calibration gas, and then press the **Edit** button momentarily to confirm the calibration. The display will now show “H xxxx”, where xxxx is the correct concentration of the test gas. Press the **Cal** button momentarily to return to measurement mode. This completes the calibration and the analyser is ready for use. Re-enable any disabled control functions.

3.2.4 Calibration of instruments fitted with ‘L’ and ‘H’ Type cells

WARNING: Typically, these instruments will be measuring parts per million (ppm) concentrations of oxygen, and care must be taken not to expose ‘H’ and ‘L’ type cells to ambient air for more than a few minutes while changing pipes etc. This is because the time taken to purge the cell down to low ppm levels depends on how much oxygen the cell has absorbed. If the cell has only been exposed briefly to air, the purge time will be quite short. If, however, the cell has been exposed to air for several hours, the purge time may become far longer. See Fig. 5. Refer to section 2.8.2 if calibrating an ‘L’ or ‘H’ type instrument and the density of the calibration gas and sample gas are significantly different.

The method used to calibrate ppm analysers depends on the concentration to be measured during normal service.

3.2.4.1 Calibrating instruments typically measuring more than 50ppm oxygen

Ideally use a standard gas with a concentration of oxygen approximately that of the typical in-service concentration. However it is possible to use concentrations up to 10% oxygen.

Flow the calibration gas through the analyser and wait for the reading to stabilize. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the **Cal** button until the display shows “H xxxx”; where H indicates that the high calibration point is selected and xxxx is the measured concentration. Use the up/down arrow buttons to set the reading to that of the calibration gas, and then press the **Edit** button momentarily to confirm the calibration. The display will now show “H xxxx”, where xxxx is the correct concentration of the test gas. Next, press the **Cal** button momentarily to return to measurement mode. This completes the calibration and the analyser is ready for use. Re-enable any disabled control functions.

3.2.4.2 Calibrating instruments typically measuring less than 50ppm oxygen

For these analysers, the ‘zero’ or low point of the analyser should be set using a gas of similar concentration to the typical in-service concentration.

Flow the calibration gas through the analyser and wait for the reading to stabilize. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the **Cal** button until the display then shows "H xxxx"; where H indicates that the high calibration point is selected. Next, press and hold the **Cal** button again until the display show 'L xxxx', indicating that the low/zero calibration point is selected. Now use the up/down arrow buttons to set the reading to that of the calibration gas, and then press the **Edit** button momentarily to reset the calibration and return to measurement mode. The display will now display the concentration of the test gas.

The next stage is optional, and for analysers typically measuring less than 20ppm. It is not recommended except for the first calibration following the fitting of a replacement sensor.

Flow the calibration gas, which should have a concentration of at least 100ppm oxygen, through the analyser until the reading is stable. If the reading is the same as the concentration of the calibration gas, no adjustment is necessary, and the analyser may be put back in normal service. Otherwise, press and hold the **Cal** button until the display shows "H xxxx"; where H indicates that the high calibration point is selected. Use the up/down arrow buttons to set the reading to that of the calibration gas, and then press the **Edit** button momentarily to reset the calibration. The display will now show "H xxxx", where xxxx is the correct concentration of the test gas. Next, press the **Cal** button momentarily to return to measurement mode. This completes the calibration and the analyser is ready for use. Re-enable any disabled control functions.

3.3 Cell replacement - overview

Before proceeding identify which cell is to be replaced, then read and fully understand the following appropriate procedure.

For best accuracy it is necessary to re-calibrate the instrument following a cell change. The calibration procedure depends on the type of cell fitted to the instrument. See section 4.2 for additional information on calibration before proceeding.

Each instrument is built to accept a particular type of cell and cannot be used with one of a different type.

Replacement cells have their zero offset value written on the data label. It is necessary enter this value into analyser when fitting the new cell. The procedure used depends on the type of cell.

3.3.1 Replacing/Connecting the cell

Read the 'CAUTION' note at beginning of this section before proceeding
The instrument does not have to be turned off during this operation, although care should be taken to ensure that any control equipment that is attached is disabled. Disconnect the old cell's signal leads from terminals 1 and 2 of the connector on the rear of the instrument. Slacken the compression nut on the cell sample tube and withdraw the old cell. Replacement is the reverse of removal; refer to the following instructions for details of each type of cell.

3.3.1.1 Replacing N, H and L cells

These cells are shipped with the leads shorted and the sample tube plugged with a rubber bung. This ensures that the cell is purged down to low levels and ready to be applied to the measurement of low levels of oxygen (less than 1000ppm) with the minimum of delay. The bung should be left in place until the system is ready for the cell to be fitted. If the cell is to be immediately applied to the measurement of low oxygen concentrations, the sample should be left flowing during the cell change operation. The bung should be removed from the cell and the cell coupled to the holder as quickly as possible.

3.3.1.1.1 Setting zero offset on N, H and L type cell analysers

The label on the cell is marked with the cell's offset at zero oxygen concentration. The offset figure is given in units of parts per million (ppm) oxygen and is negative; for example (-)3.5PPM. To set the zero offset, proceed as follows:

Disconnect the signal leads of the old cell from terminals 1 and 2 of the instrument's terminal block and leave the input open circuit, i.e. with nothing connected to terminals 1 and 2.

Apply power to the instrument if it has been disconnected, and allow 2 minutes, or until the reading is steady, for the electronics to stabilise.

Press and hold the **Cal** button until the display shows "H xxxx". Release the button and then press and hold it again until the display shows "L xxxx". "L" indicates that the lower concentration calibration is selected and xxxx is an oxygen concentration figure; note it probably will have a negative sign in front of it. Next use the up/down arrow buttons to set the display to read the cell oxygen concentration offset figure given on the new cell - note that this a negative figure and it is important that the display is set accordingly. When the correct figure has been set on the display, press the **Edit** button once for approximately 2 seconds and release. This puts the figure into the instrument's memory and the "L" will disappear and instrument will return to ordinary measurement mode. Connect the cell leads. The instrument is now ready for use. Re-enable any disabled control functions.

3.3.1.2 Replacing E cells

E cells are shipped with the sample port open and the leads insulated to prevent them touching. The insulation sleeve must be removed before the signal leads are connected to the input of the instrument following the setting of the cells zero offset.

3.3.1.2.1 Setting zero offset on E cell type analysers

The label on the E cell is marked with the cell's offset at zero oxygen concentration. The offset figure is given in units of percent oxygen and is negative; e.g.(-)0.35%. A short length of wire is also supplied with the cell, the use of which is described later.

To set the zero offset proceed as follows:

Remove any cell leads connected to terminals 1 and 2 of the instrument's terminal block and connect the short length of wire across the terminals so as to form a shorting link.

Apply power to the instrument if it has been disconnected, and allow 30 seconds for the electronics to stabilise.

Press and hold the **Cal** button until the display shows "H xxxx". Release the button and then press and hold it again until the display shows "L xxxx". "L" indicates that the lower concentration calibration is selected and xxxx is an oxygen concentration figure; note it probably will have a negative sign in front of it. Next use the up/down arrow buttons to set the display to read the cell oxygen concentration offset figure given on the new cell - note that this a negative figure and it is important that the display is set accordingly. When the correct figure has been set on the display, press the **Edit** button once for approximately 2 seconds and release. This puts the figure into the instrument's memory, the "L" will disappear and instrument will return to ordinary measurement mode. Remove the shorting link and discard it. Connect the cell leads. The instrument is now ready for use. Re-enable any disabled control functions.

3.3.1.3 Safety and disposal of depleted cells

The cells contain a 4-molar potassium acetate solution which is corrosive. Normally the solution only leaks out as a result of mechanical damage (crushing or piercing), or by electrical misuse; e.g. by attempting to input an electrical charge. The cells also contain small amounts of lead, lead oxide, platinum, silver, carbon and antimony, some of which are toxic and/or mutagenic. If the contents of the cells come into contact with the skin or other parts of the body, the affected area should be washed with copious amounts of water and medical advice sought. As the cells contain some toxic compounds, they must be disposed of according to local waste management requirements and environmental legislation, irrespective of their physical condition. They must not be burnt as they will evolve toxic fumes.

Section 4 SPARES AND REPAIRS

4.1 Ordering parts

The replacement cell is the only user serviceable part. All other parts are designed for a MTBF of 100,000 hours. If any failure occurs, the instrument should be returned to Hitech Instruments Ltd, or their local representative, for repair. When ordering spare cells or raising queries on the instrument, it is important that the serial number or job number, is quoted. These numbers are found on the data label on the right-hand side of the instrument.

4.2 Storage of measuring cell

The E cells have a maximum useful life of 5 years including any storage time. The oxygen cells type N and L have a maximum storage life of 6 months if the full usable life is to be realised. Each cell is dated in manufacture and "storage" starts from that time. The first two digits give the month and the second two the year. i.e. 1086 is October 1986. Ideally the cell should be stored in a refrigerator with any sealing bungs etc. intact and undamaged. It is advisable, when the projected replacement date can be anticipated, to order a new cell from Hitech or their agents one month prior to this date. This ensures that a fresh cell is available at replacement time.