SERIES 1300
OXYGEN DEFICIENCY MONITOR
USER MANUAL

CAUTION
Please read this manual before using the Series 1300 Oxygen Deficiency Monitor. Instructions within the manual are essential for the proper operation of this product.

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ALPHA OMEGA INSTRUMENTS

WARRANTY

Alpha Omega Instruments Corp. warrants that delivered products are free from defects in material and workmanship at the time of delivery to the FOB point specified in the purchase order. Liability under this warranty is limited to repairing or replacing, at Alpha Omega Instruments' option, items which are returned to it prepaid within four years (including sensor) from the date of shipment and found to Seller's satisfaction to have been defective.

Alpha Omega Instrument's four (4) year sensor warranty provides protection for four years from the date of shipment of the Series 1300 Oxygen Deficiency Monitor. Any sensor from a Series 1300 Oxygen Deficiency Monitor that fails under normal use must be returned to Seller prepaid and, if such sensor is determined by Seller to be defective, Seller shall provide Buyer with a replacement sensor. Buyer must provide the serial number of the monitor from which the sensor has been removed. If a sensor is found to be defective and a new one issued, the warranty of the replacement sensor(s) shall not extend beyond the initial warranty period of the Series 1300 Oxygen Deficiency Monitor, or for a period of one year, whichever is longer. After this, all replacement sensors will be warranted for a period of one year from the date of shipment. In no event shall Alpha Omega Instruments Corp. be liable for consequential damages.

NO PRODUCT IS WARRANTED AS BEING FIT FOR A PARTICULAR PURPOSE AND THERE IS NO WARRANTY OF MERCHANTABILITY.

This warranty applies only if:

(i) the items are used solely under the operating conditions and manner recommended in this manual, product specifications, or other product specific literature;

(ii) the items have not been misused or abused in any manner or unauthorized repairs were attempted thereon;

(iii) written notice of the failure within the warranty period is forwarded to Alpha Omega Instruments Corp. and, the directions received for properly identifying items returned under warranty are followed;

(iv) the return notice authorizes Alpha Omega Instruments Corp. to examine and disassemble returned products to the extent the Company deems necessary to ascertain the cause of failure.

The warranties stated herein are exclusive. THERE ARE NO OTHER WARRANTIES, EITHER EXPRESSED OR IMPLIED, BEYOND THOSE SET FORTH HEREIN, and Alpha Omega Instruments Corp. does not assume any other obligation or liability in connection with the sale or use of said products.

Disclaimer of Warranty

Alpha Omega Instruments Corp. makes no representation or warranties, either expressed or implied, by or with respect to anything in this manual, including, but not limited to, implied warranties of merchantability or fitness for a particular purpose. In no event will Alpha Omega Instruments Corp. be liable for any damages, whether direct or indirect, special, consequential, or incidental arising from the use of this manual. Some states in the USA do not allow the exclusion of incidental or consequential damages. Alpha Omega Instruments Corp. also reserves the right to make any changes to improve the performance of its products at any time and without notice.

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1 Overview

1.1 Explanation Of Graphic Symbols

The information listed below is essential to the proper operation of the monitor. Please review the following safety precautions prior to using the monitor. Cautionary notes are included throughout this manual.

WARNING MESSAGE

THIS SYMBOL IS INTENDED TO ALERT THE USER ABOUT GENERAL WARNINGS AND IMPORTANT OPERATING AND MAINTENANCE INSTRUCTIONS.

WARNING

HAZARDOUS VOLTAGE. CONTACT MAY CAUSE ELECTRIC SHOCK OR BURN.
TURN OFF & LOCK OUT SYSTEM BEFORE SERVICING.
THIS SYMBOL IS INTENDED TO ALERT THE USER TO POTENTIALLY DANGEROUS SITUATIONS.

1.2 Instrument Description

The Series 1300 Oxygen Deficiency Monitor allows for the simultaneous monitoring of breathing air oxygen using up to three (3) separate oxygen sensors. For monitoring of a single location, the Series 1300 supports either a “Local Sensor” (located within the main electronics enclosure) or a “Remote Sensor” (located in a separate remote electronics enclosure). For monitoring of multiple locations, up to two (2) “Remote Sensors” can be added to the “Local Sensor” for a total of three (3) monitoring locations. The standard input power to the Series 1300 instrument is 88-264VAC, 47-63Hz (Hertz). Available power options include 12VDC or 18-36VDC (24VDC) and must be specified at the time of order placement.

The Series 1300 Oxygen Deficiency Monitor is housed in a NEMA 1 equivalent enclosure rated for general purpose indoor use. Oxygen values for all sensors are displayed on a 4 line by 20 character liquid crystal display (LCD) with a total height of 0.81" (20.8 mm). Various display modes are available that allow for viewing all sensors simultaneously or having the sensor oxygen values cycle in a large font display mode. The front panel includes a membrane panel with seven buttons that provide access to the monitor's settings. The monitor is equipped with four alarm relays (see specifications) which are user configurable and can be set for fail-safe operation. Also included, is a built-in audible indication of an oxygen alarm condition.

The Series 1300 Oxygen Deficiency Monitor comes equipped with two direct current (DC) analog outputs. The analog outputs can be independently configured for 0-20mA or 4-20mA. Both are scalable over the operating range of the monitor. Using a terminating resistor on either of these outputs will provide an analog voltage up to 5 volts full scale up to a maximum of 1,000 feet.

The Series 1300 Oxygen Deficiency Monitor comes equipped standard with a data-logger and a serial interface commonly referred to as RS-232. The interface is compatible with EIA/TIA-232E. Optional addresses from 1 to 32 may be assigned to each monitor for communicating with up to 32 instruments on the RS-232[1] or RS-485 bus.

[1] The built in standard RS-232 by definition does not allow for more than one instrument on the same physical wires. An external RS-232 to RS-485 adapter or an “Ethernet Serial server” can be used to allow addressing multiple RS-232 units by converting the RS-232 signals to an alternate bus.

1.2.1 Features

Standard Features:

- Easy to use and configure.
- Capable of monitoring up to three oxygen sensors simultaneously.
- Automatically senses and configures new sensors.
- Multiple monitoring screens: detailed or large font versions.
- Alarm status is clearly displayed on the screen with pop-up for active alarms
- Scrolling collapsible menu system is easy to navigate.
- Wide range of configurable settings.
- Any sensor can be assigned to any output.

Standard Features (continued):

- Any Alarm can be assigned to any sensor.
- Any Alarm can activate any combination of relays, horns, and strobes.
- Isolated digital communications (RS-232 or RS485).
- Built-in data-logger.

Optional Features:

- Battery backup.
- Isolated process outputs.
- Extended memory Data-logger (capable of almost 4x more logging capacity).

1.3 Mounting

Wall Mount (WMT) is the basic configuration for the Series 1300 Oxygen Deficiency Monitor. All electrical connections are located on the bottom of the monitor. See APPENDIX A – Main Enclosure Template on page 66 for detailed dimensional drawings.

1.4 Oxygen Sensor

The Series 1300 Oxygen Deficiency Monitor features an ambient temperature electrochemical sensor with an Enhanced Electrolyte System (EES). The EES, significantly extends the useful life of the oxygen sensor as well as providing exceptional measurement stability.

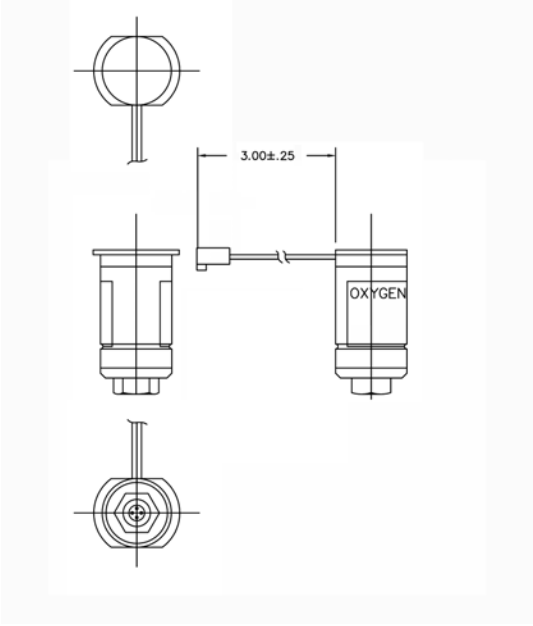


Figure 1 - Oxygen Sensor

1.5 Description Of Optional Equipment

The Series 1300 Oxygen Deficiency Monitor incorporates a host of standard features. For certain requirements, user's may desire to augment the capabilities of the monitor by ordering the monitor with one or more available options described below.

1.5.1 Battery Backup P/N 13-BAT

The Battery Backup option provides backup power to the Series 1300 Oxygen Deficiency Monitor during a temporary loss of main power. Please see section 8 Battery Backup for more information on this option.

1.5.2 RS-485 P/N 13-485

The factory installed RS-485 is an optional upgrade to the factory default of RS-232 and offers the ability to extend the distance from 50 feet maximum up to 4,000 feet between the monitor and the host system. This option also provides serial communications (both sending and receiving) between several monitors up to a maximum of 32 on one RS-485 three wire communications channel.

1.5.3 Replacement Oxygen Sensor P/N 13-SEN

This option consists of just the sensor (no enclosure or electronics). This option should be ordered in the event that the sensor is damaged or needs replacement due to end of life.

1.5.4 Remote Mounted Sensor Enclosure P/N 13-RSEN

This option consists of a NEMA 1 (IP 30) remote sensor enclosure containing the oxygen sensor and associated circuitry used to communicate with the read out electronics. The remote sensors may be added to the Series 1300 Oxygen Deficiency Monitor in the field by the user. See section 3.3 Remote Oxygen Sensors.

1.5.5 Analog Output Isolation P/N 13-ISO

Installed at the factory, this option provides galvanic isolation of both analog outputs. This eliminates any potential ground loops when connecting to earth grounded inputs or powering from DC where the power return could create a ground loop with the output grounds or the input and output grounds are tied to chassis ground. The isolation also allows for a higher maximum load resistance up to 1200 ohms (24V @ 20mA) as opposed to the 12V maximum of 300 ohms (6V @ 20mA).

1.5.6 Calibration Fixture P/N 13-CFN

The optional calibration fixture is recommended for checking the calibration of the Series 1300 Oxygen Deficiency Monitor. Ideally, the source of the calibration gas should be compressed air (clean, dry, and oil free). Most industrial gas suppliers can provide the compressed air in small hand-held cylinders. The calibration fixture is designed to easily install over the gas opening of the Series 1300 oxygen sensor making a tight seal. The fixture is equipped with ¼ inch tube fittings to deliver the compressed air through a 1/4" OD plastic tube (not supplied). The sample pressure to the fixture should never exceed 1.5 pounds per square inch (PSIG) at a corresponding sample flow rate of between 0.2 to 1.0 standard cubic feet per hour (SCFH) or 0.1 to 0.5 liters per minute (LPM).

1.5.7 12VDC Power P/N 13-12V

Allows for a user supplied regulated 12V as the main source of power to the instrument. Minimum power requirement is 25.2 Watts.

1.5.8 24VDC Power (18 To 36V) P/N 13-24V

Allows for 18 to 36VDC (nominal 24VDC) as the main source of power to the instrument. Minimum power requirement is 35 Watts.

1.5.9 Extended Logger P/N 13-LOG

Adds almost four times the logging capacity to the existing built in logger. This option is installed at the factory. Consult factory.

1.6 Standard Features

Analog Outputs: (2) DC mA (direct current milliampere) loop outputs.
User selectable for either 0 to 20mA or 4 to 20mA.
User configurable for any oxygen sensor.
Non-isolated Maximum load resistance: 300 ohms max @ 25C
Isolated Option Maximum load resistance: 1200 ohms max @ 25C

Alarm Relays: (4) SPDT (single pole-double throw) Form C contacts rated at:
10 A (250 VAC) / 5A (100 VDC).
Alarms are user configurable for automatic clearing or latching (requires manual clearing at the instruments panel).

Alarms: (9) individually configurable alarms that can be setup to activate any relay, any Horn/Strobe combination, and assignable to any sensor. Each alarm can be configured as either a “high alarm” or a “low alarm”.

Input Power: Universal **90-264 VAC, 47-63 Hz.**
12VDC optional and must specify at time of order.
24VDC (18-36VDC) optional and must specify at time of order.

RS Communications: RS-232 Communications standard. Compatible to EIA/TIA-232E. User selectable baud from 2400 to 115.2k bps. Optional assignable address from 1 to 32. Maximum of 50 feet from host system to monitor.

Data Logger: 1 to 60 second interval time. Selectable sensors. 0-30% O_2 logging.
Included real time clock allows selectable time stamp.
Individually select which available sensors to log.
Output in easy to graph character separated values (CSV) for importing into spreadsheets or data visualization programs.
See section Section 5 “Data Logger” for details.

Audible Alarms: Internal audible alarm rated at 85 decibels at 10 centimeters

Operating Temperature: 50° to 104°F (10° to 40°C)
0 to 90% relative humidity (RH), non-condensing

1.7 Optional Features

The Series 1300 Oxygen Deficiency Monitor can be ordered with the following options:

Analog Outputs: Isolated, longer driving distance.

Input Power: 12V@25.2W or 24V nominal @35W (18 to 36V).

RS Communications: RS-485 add on to extend the distance from host to monitor from 50 feet to 4000 feet. Also allows for up to 32 monitors on one bus.

Data Logger: Factory installed extended memory for longer logging (almost 4x).

Audible Alarms: Up to 8 horn and strobes (factory ready).

1.8 General Specifications[2]

Measurement Range:	Percent Oxygen: 0 to 30%.
Resolution:	0.1%
Sensor Type:	Long-life electrochemical sensor (5 years typical).
Accuracy:	±1% of full scale.
Response Time:	90% of full scale in < 20 seconds.
Start Up Time: **(after initial installation)**	< 1 minute.
Calibration Sample Flow Rate:	0.2 to 1.0 standard cubic feet per hour (SCFH) 0.1 to 0.5 liters per minute (LPM) Optimum flow using Alpha Omega Instruments calibration fixture.
Calibration:	Ambient air or oil-free compressed air.
Enclosures: **(Main & Remotes)**	Polycarbonate, equivalent to NEMA 1 (IP 30)
Main Enclosure Dimensions: **Nominal**	10.94 Inches (277.8 mm) – height. 6.3 Inches (160 mm) – width. 3.6 inches (91 mm) – depth.
Remote Enclosure Dimensions: **Nominal**	6.2 Inches (158 mm) – height. 5.83 Inches (148 mm) – width. 3.49 inches (89 mm) – depth. With calibration fixture: 7.3 Inches (158 mm) – height
Sample Delivery:	Open diffuser-no pump required.
Display:	4 Line by 20 character LCD.
Remote Sensor Max Distance:	Over 1000 feet (305 meters) using 22 AWG wire. Longer lengths available using larger diameter wire.

[2] General specifications are at standard temperature, pressure, and humidity. Unless specified otherwise.

2 Installation

DANGER

POTENTIALLY HAZARDOUS AC VOLTAGES EXIST WITHIN THE INSTRUMENT. IF NOT AVOIDED, THESE VOLTAGES COULD POTENTIALLY RESULT IN SERIOUS INJURY OR DEATH. DISCONNECT ALL SOURCES OF POWER AND EXTERNAL CONNECTIONS BEFORE REMOVING THE COVER TO THE MONITOR.

RISK OF SHOCK

TO AVOID THE RISK OF FIRE OR ELECTRIC SHOCK, DO NOT EXPOSE THE SERIES 1300 OXYGEN MONITOR TO RAIN, WATER SPRAY, OR ANY OTHER LIQUIDS.

2.1 Unpacking The Instrument

Upon opening the shipping container, carefully unpack the instrument to check if the outer surfaces have been damaged. If so, report the findings immediately to Alpha Omega Instruments who will, in turn, provide further instructions.

If there is no apparent damage, check the contents to ensure all items were shipped. In some cases, items may be back ordered.

NOTE: IF DAMAGE HAS BEEN FOUND, DO NOT PROCEED FURTHER, BUT INSTEAD, CONTACT THE FACTORY.

All damage and shortage claims must be made known to Alpha Omega Instruments within 10 days after receipt of shipment.

Carefully rotate the monitor and check to make sure no components have been loosened or dislodged.

If there are any loose or dislodged components (rattling of any kind), contact the factory for further instructions.

If there is no evidence of loose or dislodged components, the installation procedure can begin.

2.2 Electrical Installation

WARNING

ELECTRICAL INSTALLATION SHOULD BE PERFORMED BY A QUALIFIED PERSON AND SHOULD COMPLY WITH APPLICABLE FEDERAL, STATE, OR LOCAL ELECTRICAL SAFETY CODES.

The standard Series 1300 Oxygen Deficiency Monitor accepts a universal AC power input of 90-264 VAC, 47-63 Hz. In this configuration, the unit is shipped with a standard North American power cord NEMA style 5-15P. The power cord is wired to an AC terminal block labeled “TB1” within the enclosure. If the installation requires hard wiring, simply replace the power cord with the appropriately rated wire. Use of #18 AWG is recommended. See section Wiring on page 10.

For DC operation the terminal block labeled “TB1” will still be used, however the labeling will indicate the configured power.

2.3 Mechanical Configuration

The Series 1300 Oxygen Deficiency Monitor can be configured as a single stand alone enclosure with a single (local) sensor located within the main enclosure. The sensor is mounted at the bottom of the main enclosure and is exposed to the surrounding atmosphere the monitor has been installed in.

The Series 1300 Oxygen Deficiency Monitor can also be configured with a Remote Oxygen Sensor that is housed in it's own separate smaller enclosure. The Series 1300 Oxygen Deficiency Monitor can accept a maximum of two remote oxygen sensors that can be placed at different locations away from the main electronics.

The Series 1300 Oxygen Deficiency Monitor main enclosure is fabricated from a polycarbonate enclosure with a cover that is secured by six (6) screws. Access to the wiring and membrane switch control panel is available by removing the cover using a standard Philips type screw driver with a #2 style point. Please exercise caution when removing the cover as it is not hinged.

Mounting holes are also accessed by removing the cover. See the following pages for more information and also APPENDIX A – Main Enclosure Template on page 66 and APPENDIX B – Remote Enclosure Template on page 67 for mounting templates.

2.3.1 Main Enclosure

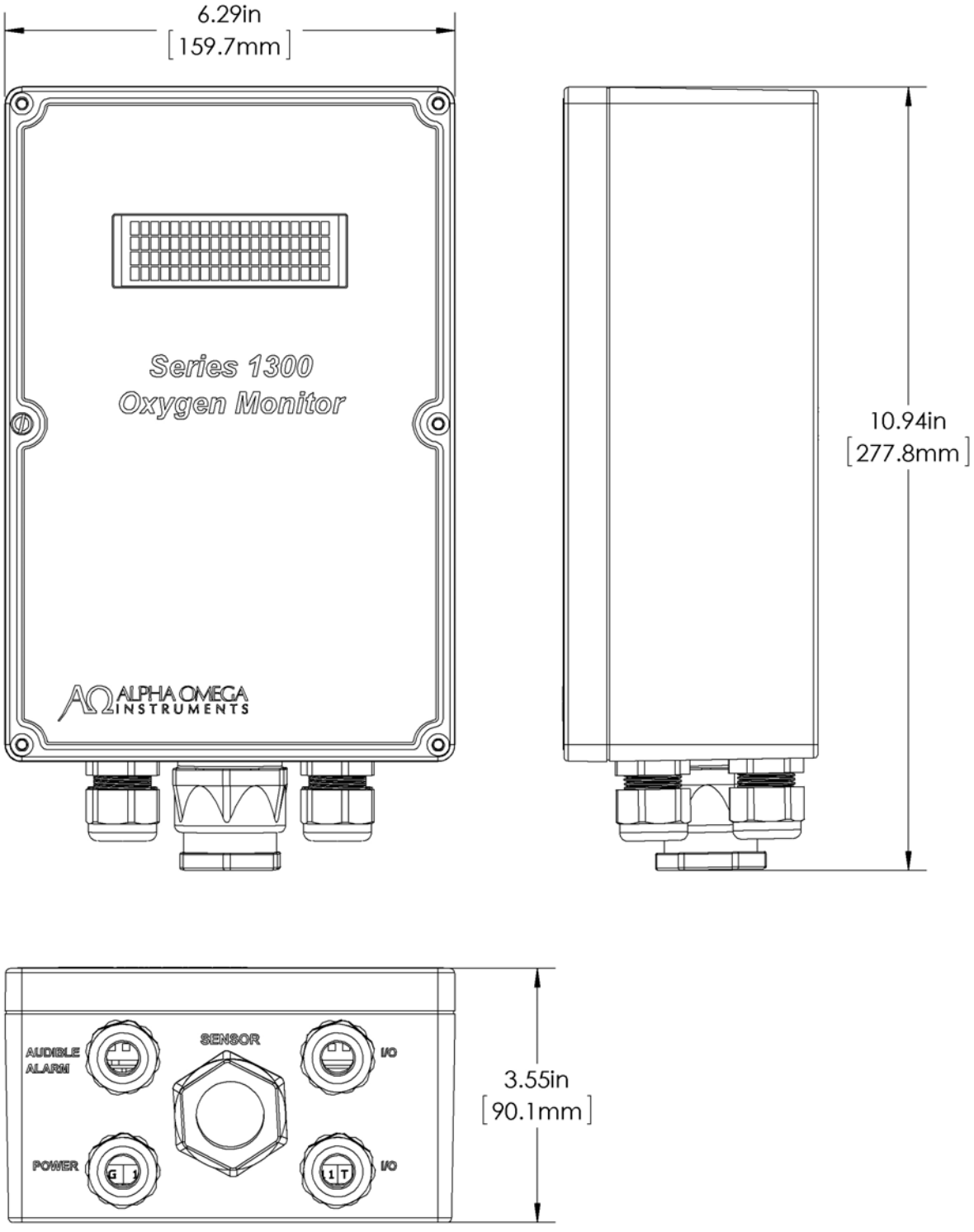


Figure 2 - Main Enclosure

See section 3 “Wiring“ on page 10 for wiring details.

WARNING

THE SERIES 1300 OXYGEN DEFICIENCY MONITOR AND THE REMOTE OXYGEN SENSOR ENCLOSURES SHOULD BE KEPT IN THEIR DESIGNED WALL MOUNTED ORIENTATION WITH THE SENSOR FACING DOWNWARDS.

2.3.2 Remote Oxygen Sensor Enclosure

The Remote Oxygen Sensor enclosure is configured similarly in a polycarbonate enclosure with a cover secured by four (4) screws. Remove the cover of the Remote Oxygen Sensor enclosure to gain access to both the printed circuit board connections and the mounting holes. See APPENDIX B – Remote Enclosure Template on page 67 for a mounting template.

Wiring will be through the strain relief located on the right side of the remote enclosure. See section 3.3 “Remote Oxygen Sensors” on page 14 for details.

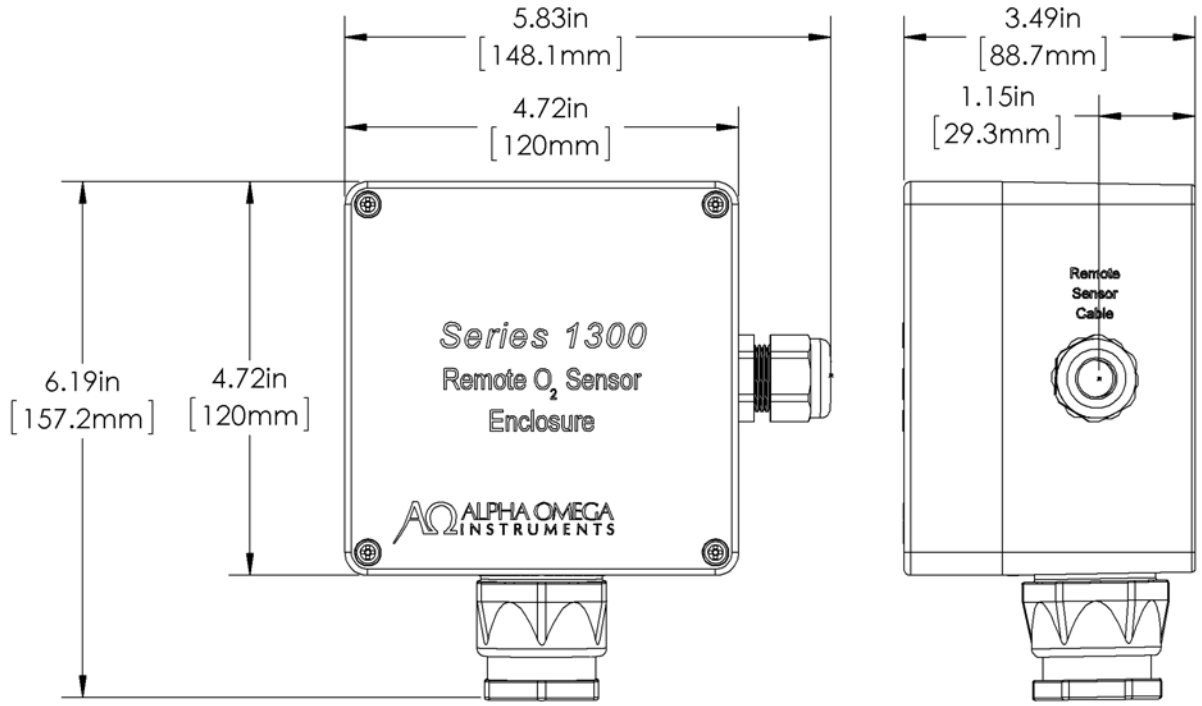


Figure 3 - Remote Oxygen Sensor Enclosure

CAUTION

DO NOT OPERATE THE SERIES 1300 OXYGEN DEFICIENCY MONITOR OR THE REMOTE OXYGEN SENSORS IN ANY POSITION OTHER THAN WITH THE SENSOR MOUNTED DOWNWARD AS SHOWN. A DIFFERENT ORIENTATION MAY ADVERSELY AFFECT THE OXYGEN VALUES.

3 Wiring

The Series 1300 Oxygen Deficiency Monitor main enclosure is designed to accept a number of inputs and outputs. Please reference Figure 4 below to wire to the following hardware. Note: Following this page are detailed instruction for each of the following items:

Oxygen Sensor	A single “Local Oxygen Sensor” mounted at the bottom center of the enclosure. This is a two (2) wire interface located on the left side, inside the main enclosure.	See section 3.1
Power	AC or DC power via terminal block (TB1). Labeled at the factory. Figure 4 - Bottom View 1 of Series 1300 below Shows the AC version labeled “L”, “N”, and “G” for Line, Neutral, and Ground respectively. For DC operation these will be “+”, “-”, and “G” respectively.	See section 3.2
Remote Sensors	One (1) or Two (2) Remote Oxygen Sensors via terminal block TB1, terminals 1 thru 6.	See section 3.3
Horn and Strobes	Up to eight (8) horn and strobes (where four can be powered directly without external power supplies) via terminal block TB1, terminals 7 thru 11.	See section 3.4
Analog Outputs	Removable printed circuit board (PCB) terminal block TB2	See section 3.5
Alarm Relays	Removable printed circuit board (PCB) terminal blocks TB3 & TB4	See section 3.6
Digital Communications	(RS-232 or RS-485) via terminal block TB1, terminals labeled “T”, “R”, and “G”.	See section 3.7

Figure 4 below shows a cut-away view of the internal terminal block TB1.

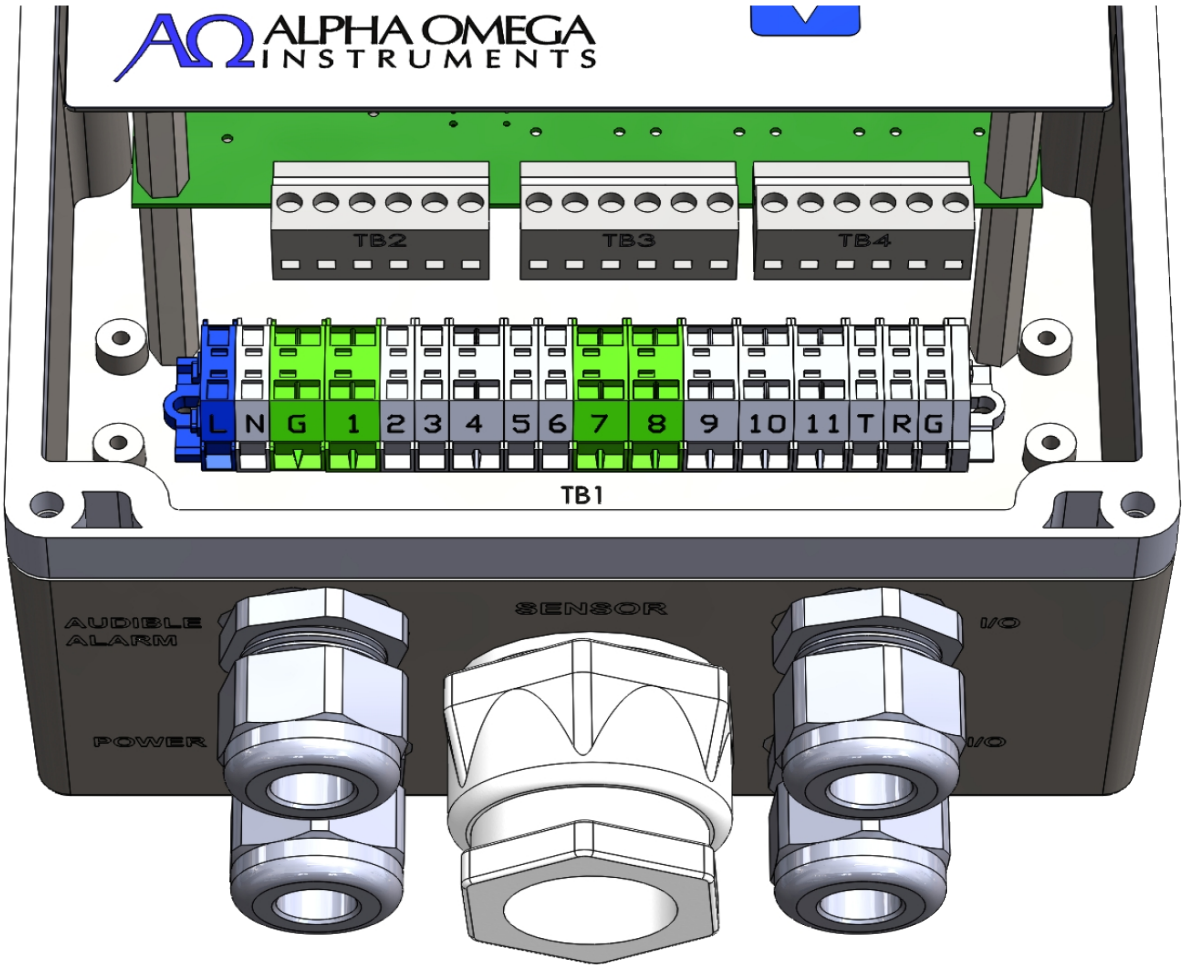


Figure 4 - Bottom View 1 Of Series 1300

Figure 5 below shows a cut-away line drawing showing the PCB terminal blocks TB2, TB3, and TB4.

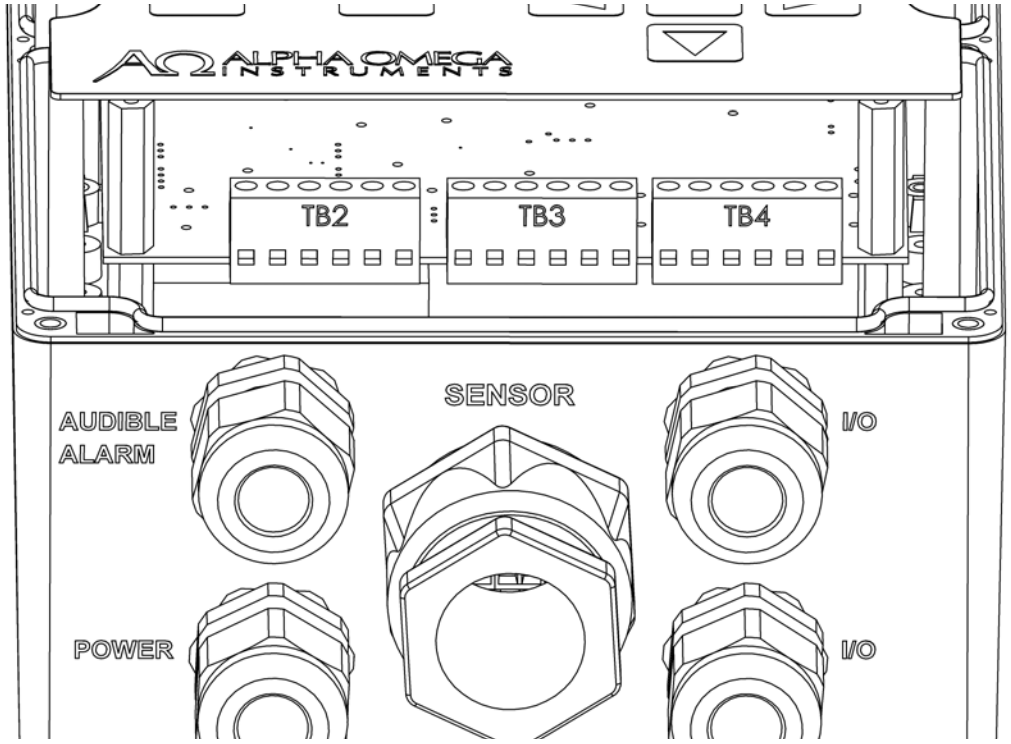


Figure 5 - Bottom View 2 Of Series 1300

3.1 Local Oxygen Sensor

If ordered with a Local Oxygen Sensor, the Series 1300 Oxygen Deficiency Monitor will have a large gland that is centrally located on the bottom of the enclosure as shown above. This hole will be plugged when the Series 1300 Oxygen Deficiency Monitor is ordered without a Local Oxygen Sensor.

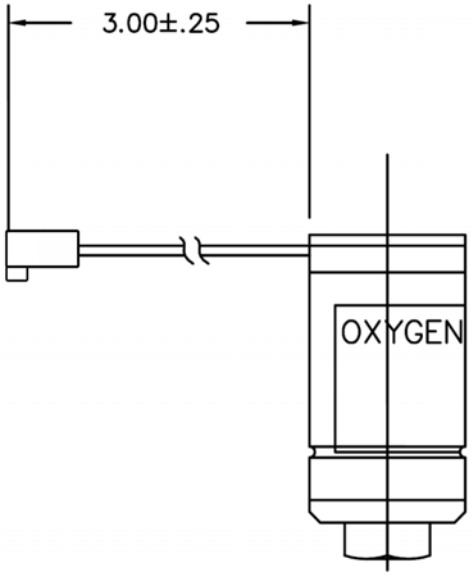


Figure 6 - Oxygen Sensor

3.1.1 Local Oxygen Sensor Installation

To install the replaceable local sensor, simply open the front cover and slide the sensor down into the large gland designed to hold the sensor. Gently tighten the nut while holding the sensor in place from the top and the bottom at the same time as shown.

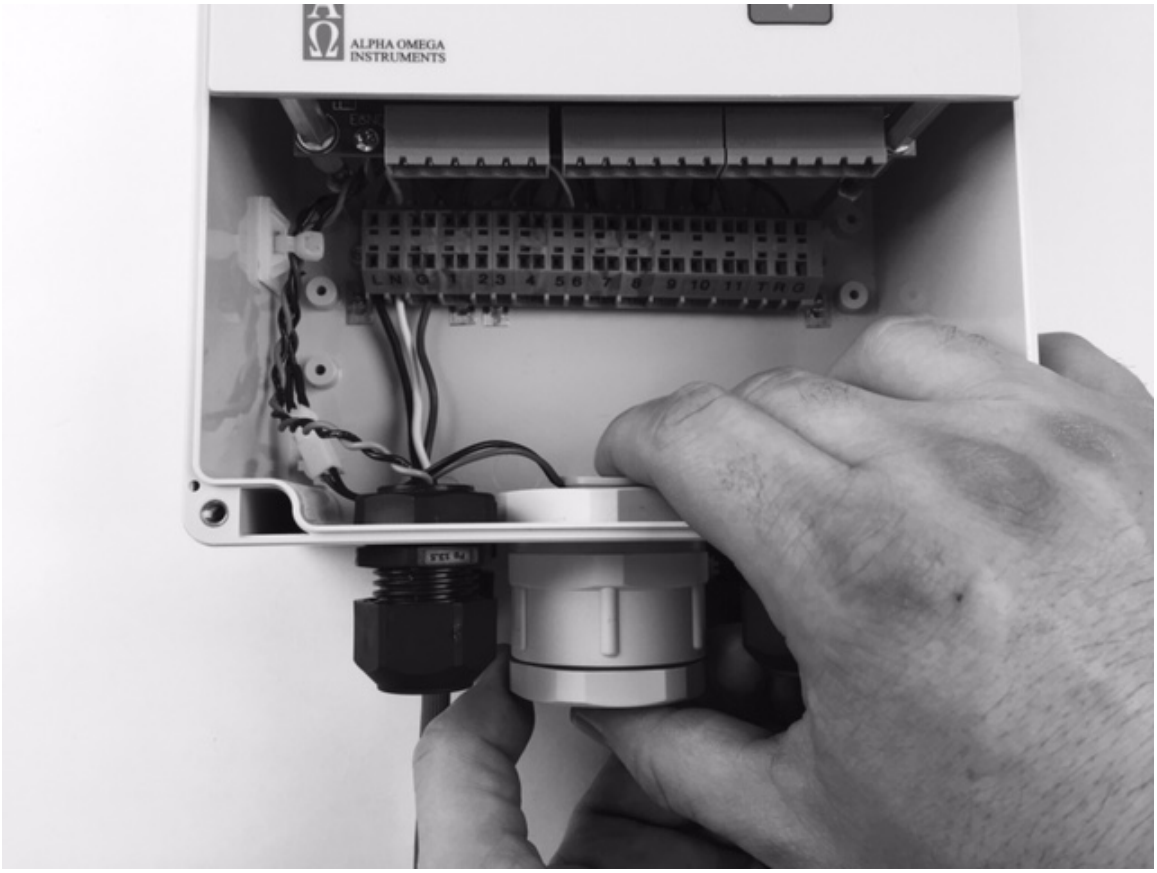
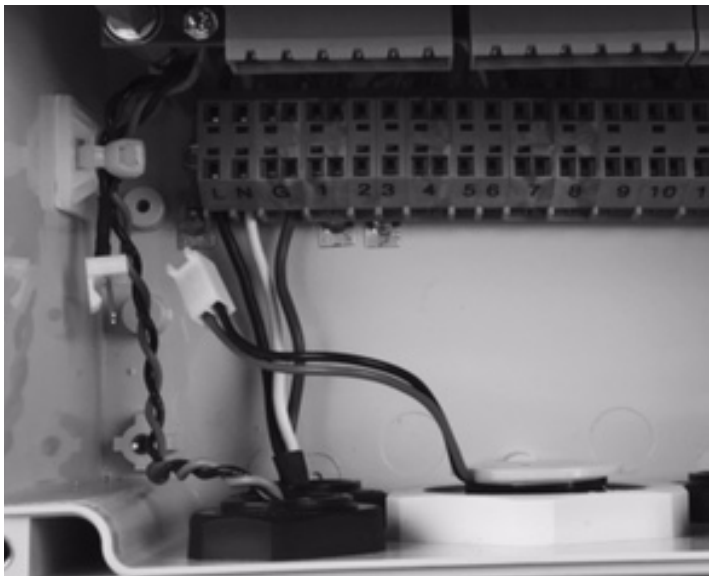


Figure 7 - Local Oxygen Sensor Installation

The sensors wired connector should then be pressed together with the mating connector already supplied inside the main enclosure down at the bottom on the left. The mating connector is in the form of a cable with a two pin male connection as shown below before and after connection:

Before



After

Figure 8 - Local Oxygen Sensor Installation & Wiring

3.2 Power (TB1)

Power the Series 1300 Oxygen Deficiency Monitor by wiring to terminal block TB1. Please Note that the terminal blocks are color coded. The two primary power connectors are blue and the ground returns are a yellow/green color.

Universal AC 90-264 VAC, 47-63 Hz.		**DC**		
TB1 Label	**AC Signal**	**TB1 Label**	**12V Signal**	**24V (18 to 36V) Signal**
L	Line	**+**	Positive (12V)	Positive (24V)
N	Neutral	**-**	Negative (12V Return)	Negative (24V Return)
G	Ground	**G**	Chassis Ground	Chassis Ground

Table 1 - Power Connections (Terminal Block 1)

3.3 Remote Oxygen Sensors

The interface to the “Remote Oxygen Sensor”s are located at terminal block TB1 (Refer to Figure 4) inside the main enclosure. The Remote Oxygen Sensors are connected using a twisted shielded pair of wires. The connections within the main electronics enclosure are located on a terminal block located in the bottom of the enclosure labeled “TB1”. See Table 2 below for reference. Terminals 1-6 are used to connect to the Remote Oxygen Sensors as shown in the table below. These connections are terminated at the Remote Oxygen Sensor enclosure by means of another terminal block (also labeled TB1) located within the remote electronics enclosure. See Figure 10 - Remote Oxygen Sensor Enclosure & PCB.

Connects from:	TB1 Label	Signal	Connects to:	TB1 Label	Detail
Main Electronics	1	Shield	Remote Oxygen Sensor 1	1	Shield
	2	Positive		2	Positive, source of current loop
	3	Return		3	Return, Negative return of current loop
	4	Shield	Remote Oxygen Sensor 2	1	Shield
	5	Positive		2	Positive, source of current loop
	6	Return		3	Return, Negative return of current loop

Table 2 - Remote Oxygen Sensor Connections (Terminal Block 1)

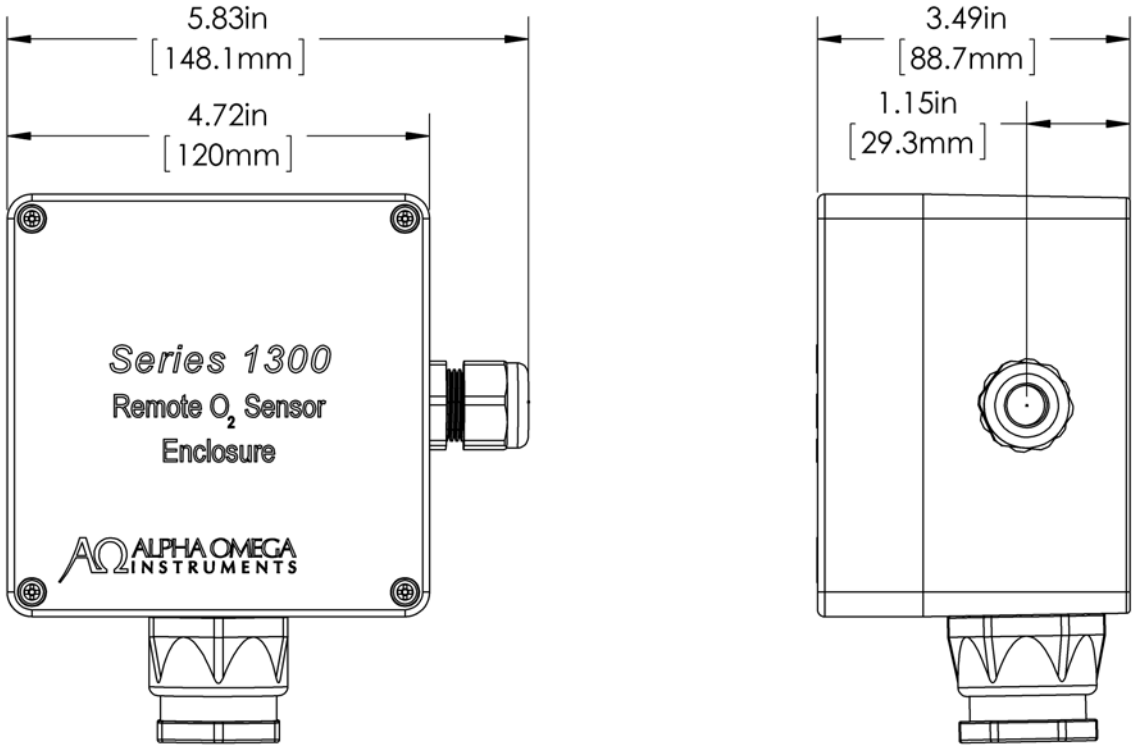


Figure 9 - Remote Oxygen Sensor Enclosure

Inside the Remote Oxygen Sensor enclosure is a PCB as shown in Figure 10 below.

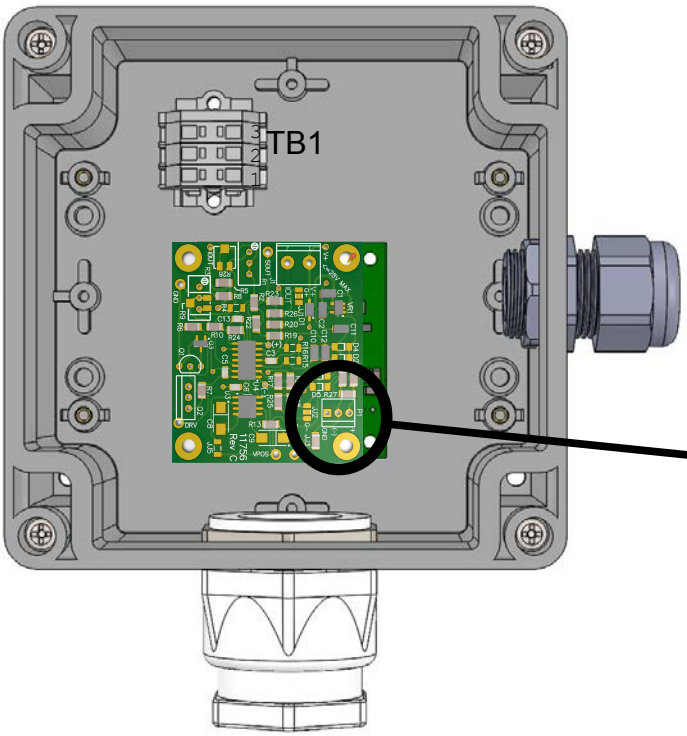


Figure 10 - Remote Oxygen Sensor Enclosure & PCB

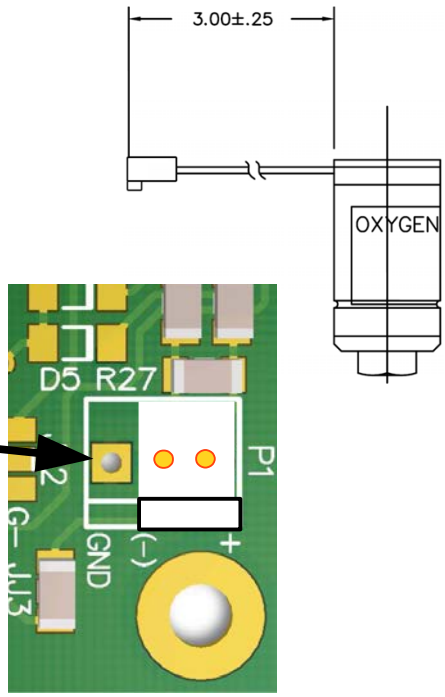


Figure 11 - Remote Oxygen Sensor

The sensor is connected to P1 with the red wire towards the edge of the PCB. The connector is a two (2) pin Molex style. Note that only the “+” and “-” pins are used.

3.3.1 Remote Oxygen Sensor Installation Procedure

Follow the procedure below for connecting the first Remote Oxygen Sensor.

CAUTION

REMOVE ANY POWER FROM THE INSTRUMENT BEFORE PERFORMING ANY WIRING ON THE MAIN INSTRUMENT OR THE REMOTE OXYGEN SENSOR.

NOTE: For best results it is recommended to use a twisted shielded pair to connect to the Remote Oxygen Sensors. Using #22 AWG (American Wiring Gauge) will allow distances up to 1000'. Longer lengths available with larger diameter wire (consult factory). In most cases the proper cable is specified at time of order and will be supplied by the factory.

Connecting Remote Oxygen Sensor #1 (refer to Table 2 - Remote Oxygen Sensor Connections (Terminal Block 1) on page 14 above):

1. Connect the SHIELD wire of the twisted pair shielded cable to TB1, terminal 1 of the main electronics. This wire should terminate at terminal block TB1, terminal 1 inside the Remote Oxygen Sensor. Make sure all wires are put through the strain relief first.
2. Connect the POSITIVE wire of the twisted pair shielded cable to TB1, terminal 2 of the main electronics. This wire should terminate at terminal block TB1, terminal 2 inside the Remote Oxygen Sensor.
3. Connect the RETURN wire of the twisted pair shielded cable to TB1, terminal 3 of the main electronics. This wire should terminate at terminal block TB1, terminal 3 inside the Remote Oxygen Sensor.

Repeat the above procedure to connect the second Remote Oxygen Sensor if applicable but substitute the terminals as follows:

1. Connect the SHIELD (TB1, terminal 4) of the main electronics to TB1, terminal 1 inside the 2nd Remote Oxygen Sensor.
2. Connect the POSITIVE (TB1, terminal 5) of the main electronics to TB1, terminal 2 inside the 2nd Remote Oxygen Sensor
3. Connect THE RETURN (TB1, terminal 6) of the main electronics to TB1, terminal 3 inside the 2nd Remote Oxygen Sensor

After connection to the Remote Oxygen Sensor(s) has been completed, power the instrument and wait for it to initialize. The display should now show each sensor being initialized. Please reference section 6 “Sensor Setup” on page 47 for more information on setting up the sensor(s).

NOTE: Remote Oxygen Sensors do not need to be connected to the unit sequentially. They will be detected based on the terminals they are connected to.

3.4 Horn And Strobe

The interface to the Horn and Strobes is located at terminal block TB1 (Refer to Figure 4) inside the main enclosure. The Series 1300 Oxygen Deficiency Monitor is capable of supporting up to 8 horn and strobes. The horn and strobes use a 3 wire connection[3] consisting of power, ground return, and data. The connections within the main electronics enclosure are located on a terminal block located in the bottom of the enclosure labeled “TB1”. See Table 3 below for reference.

Main Enclosure		Horn and Strobe PCB	
Terminal Block TB 1	Signal	Name on PCB	Detail
7	Shield		
8	Shield	“SH”	Shield
9	Positive	“V+”	Positive Power (typically 12V)
10	Data	“DAT”	Data communications line
11	Return	“GND”	Power Return

Table 3 - Horn And Strobe Connections (Terminal Block 1)

Follow the procedure below for connecting a horn and strobe that will be powered from the Series 1300 Oxygen Deficiency Monitor.

1. Connect the 1st wire of the shielded cable to TB1 terminal 9 (POSITIVE), inside the main enclosure. Terminate this wire to one of the terminals on the horn and strobe PCB labeled “V+”.
2. Likewise connect the 2nd wire of the shielded cable to TB1 terminal 10 (DATA). Terminate this wire to one of the terminals on the horn and strobe PCB labeled “DAT”.
3. Connect the 3rd wire of the shielded cable to TB1 terminal 11 (RETURN). Terminate this wire to one of the terminals on the horn and strobe PCB labeled “GND“.
4. Connect the shield of the shielded cable to TB1 terminal 8 (SHIELD). Terminate this shield to one of the terminals on the horn and strobe PCB labeled “SH”.

Note: it is only necessary to connect the shield at the horn and strobe PCB when daisy-chaining[4]. In a star-point configuration, simply leave it disconnected.

[3] Horn and Strobes can be wired directly to the relay contacts using only two (2) wires. The Series 1300 Oxygen Deficiency Monitor will not be able to warn the user of any disconnect or wiring problem without the use of the “DAT” line.

Follow the same procedure to connect multiple horn and strobe units to the Series 1300. The main enclosure and the horn and strobe unit both have multiple terminals that can accept more than a single wire twisted together if necessary. If daisy-chaining, then simply connect to the second set of terminals supplied on the horn and strobe unit.

When powered from 90-264 VAC, 47-63 Hz., the instruments default DC output power is capable of driving up to 4 horn and strobes simultaneously. If more than 4 are required, the additional horn and strobes need to be powered from either an independent DC power source or an upgraded power supply that can handle the extra horn and strobes. The maximum length of cable for a single horn and strobe wired with the recommended #18 AWG wire can be up to 1,000 feet away from the main electronics. However, each additional horn and strobe wired in SERIES (daisy-chained) on the SAME wire will reduce the maximum length by approximately half. The maximum voltage drop in any single chain of wire must be less than or equal to 3V. There must be a minimum of 9V at the end of the wire.

CAUTION

THE MAX CABLE CAPACITANCE OF 0.15UF MUST BE ADHERED TO OR THE HORN AND STROBES MAY NOT WORK CORRECTLY AND/OR CAUSE UNWANTED BEHAVIOR. PLEASE CONTACT THE FACTORY FOR ANY APPLICATIONS REQUIRING LONGER LENGTHS.

Figure 12 below shows a horn and strobe and the associated printed circuit board (PCB).

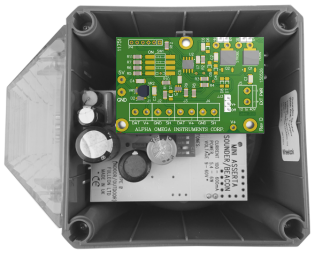


Figure 12 - Horn And Strobe With PCB

3.4.1 Horn And Strobe PCB

The printed circuit board has 8 terminals located on the front edge as shown in Figure 13 - Horn and Strobe PCB on page 17. The signals are labeled on the board as “DAT” for data, “V+” for positive power, “GND” for power return, and “SH” for shield. Each signal has two connections to allow daisy-chaining. If daisy-chaining multiple horn and strobes, the connectors are sized to allow for twisting two wires together before inserting into the screw terminal.

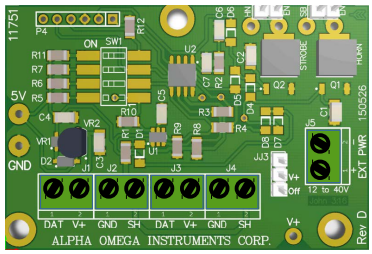


Figure 13 - Horn And Strobe PCB

[4] Daisy-chaining is when another Horn and Strobe is connected to the first in series. As opposed to being connected to the main enclosure in parallel (or star-point).

CAUTION

J1 TO J4 SUPPORT A MAXIMUM OF FOUR (4) HORN AND STROBES UNLESS USING A SPECIAL HIGH POWERED MAIN POWER SUPPLY. NEVER CONNECT AN EXTERNAL POWER SUPPLY TO THE "V+" TERMINALS.

Note, that if powering the instrument from an external power supply, it is imperative that the power supplied be sufficient for the number of horn and strobes connected at any given time. (5) or more horn and strobes will require remote power or a higher wattage upgrade to the internal power supply.

The additional external power needed to handle up to four (4) standard horn and strobes is approximately 20W. Therefore, using a 45W, 12V power supply would be able to power the Series 1300 Oxygen Deficiency Monitor as well as all eight (8) horn and strobes.

When externally powered, connect only the "DAT" and "GND" terminals back to the main electronics enclosure. The "V+" terminal can be omitted in this case as it is not powered from the main electronics. The external power supply connects to "EXT PWR" terminal located on the right hand side labeled "J5".

CAUTION

REMOVE POWER BEFORE PERFORMING ANY WIRING ON THE INSTRUMENT OR HORN AND STROBE(S). IF EQUIPPED WITH BATTERY BACKUP, INSURE THE BATTERY TERMINAL INSIDE THE MAIN ENCLOSURE IS DISCONNECTED.

3.4.2 Horn And Strobe Daisy Chain Configuration

This configuration shows how the wiring can be configured in a serial fashion or "daisy chain". The source wiring comes in on one set of connectors and the next horn and strobe is wired to the other set of connectors as shown below.

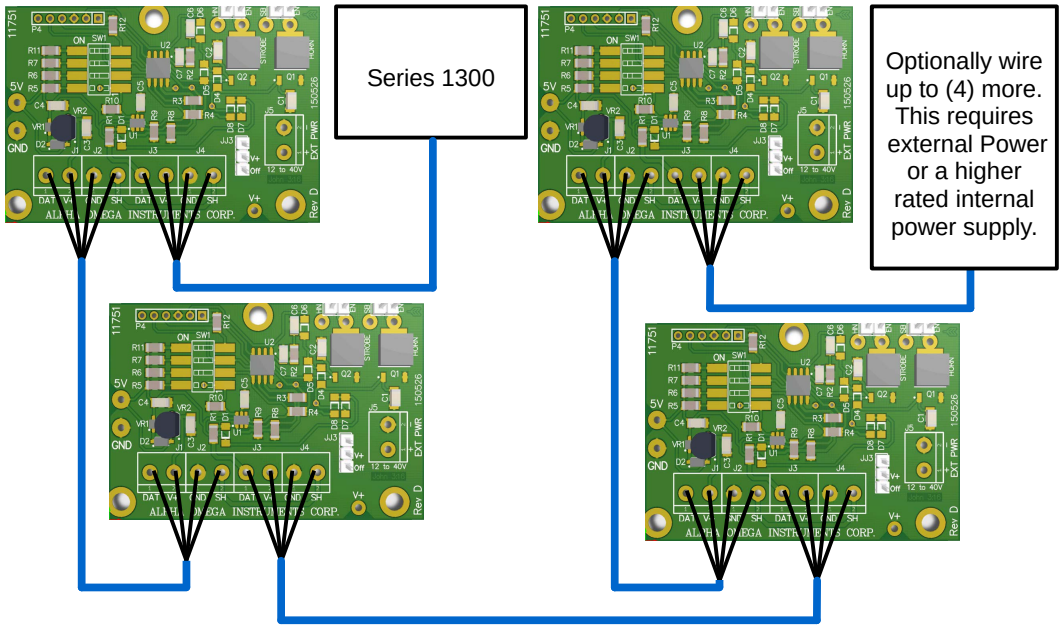


Figure 14 - Wiring Horn And Strobes In Series (Daisy Chained)

As shown above, using four (4) horn and strobes and #18 AWG cable wire, the maximum distance to the last horn and strobe in the chain is 250 feet.

3.4.3 Horn And Strobe Star Configuration

Shown below is a Series 1300 Oxygen Deficiency Monitor wired to four (4) horn and strobes.

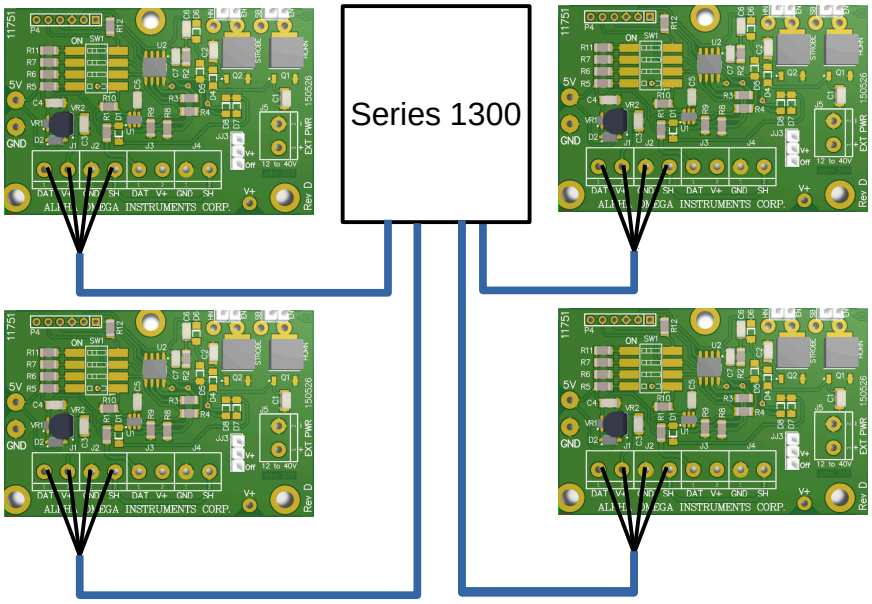


Figure 15 - Wiring Horn And Strobes Individually

As shown above, using four (4) horn and strobes and #18 AWG cable wire, the maximum distance fore each single horn and strobe is 1,000 feet.

3.4.4 Horn And Strobe External Power

Adding more than four (4) horn and strobes with the standard power supply requires external power. Shown below is the wiring for externally powered horn and strobes. Note the added 12V power supply that is connected to a separate connector.

CAUTION

DO NOT CONNECT EXTERNAL POWER TO THE V+ TERMINAL. EXTERNAL POWER SHOULD ONLY BE APPLIED TO THE "EXT PWR" CONNECTOR LABELED "J5"

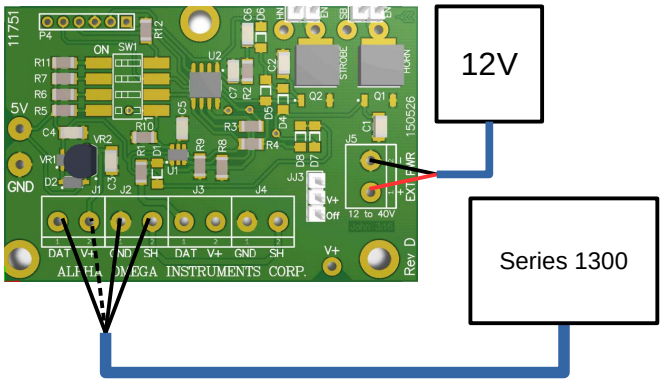


Figure 16 - Externally Powered Horn And Strobes

Wiring of the V+ is optional and shown as a dashed line in the picture.

3.4.5 Horn And Strobe Relay Wiring

The horn and strobe can be wired through any alarm relay as shown. The Horn and Strobe can be individually enabled by adding a jumper plug where shown labeled “HN” for Horn and “SB” for Strobe. Placing a jumper on the ENABLE pin(s) – labeled “EN” – will activate that particular output as soon as power is applied.

NOTE

IT IS NOT NECESSARY TO CONNECT ANY OTHER WIRES IN THE TWO WIRE RELAY ACTIVATED MODE AS SHOWN BELOW IN FIGURE 17 - WIRING HORN AND STROBES USING A RELAY.

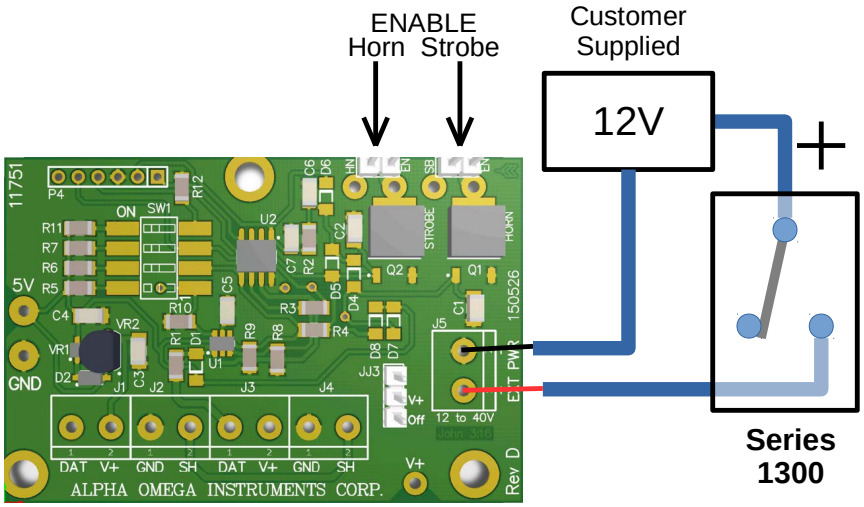
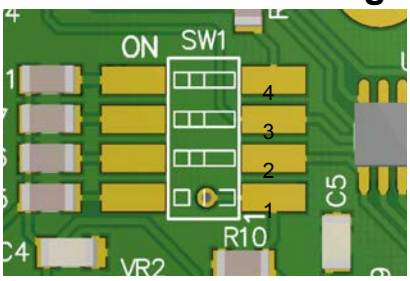


Figure 17 - Wiring Horn And Strobes Using A Relay

CAUTION

THE SERIES 1300 TWO WIRE CONFIGURATION SHOWN ABOVE DOES NOT ALLOW FOR THE INSTRUMENT TO ALERT THE USER OF ANY WARNINGS ASSOCIATED WITH HORN AND STROBES.

3.4.6 Horn And Strobe Switch Settings



SW1 Switch Bank

SW1.4	Not Used
SW1.3	Bit 2
SW1.2	Bit 1
SW1.1	Bit 0

Figure 18 - SW1 Detail On Horn And Strobe PCB

Each horn and strobe requires a **unique** address and this address is configured using a DIP style switch bank labeled “SW1” located on the printed circuit board mounted within the horn and strobe enclosure. To turn an individual switch “ON”, simply move the switch position away from the text label “SW1” and towards the text label “ON”. See FIGURE X below and Table 4 below for details on setting the correct address.

SW1 – Horn and Strobe PCB (11751)			
SW1.1	SW1.2	SW1.3	Address/Number
OFF	OFF	OFF	1
ON	OFF	OFF	2
OFF	ON	OFF	3
ON	ON	OFF	4
OFF	OFF	ON	5
ON	OFF	ON	6
OFF	ON	ON	7
ON	ON	ON	8

Table 4 - Horn And Strobe PCB Switch Settings

CAUTION

EACH HORN AND STROBE UNIT MUST BE SET FOR A DIFFERENT ADDRESS BEFORE CONNECTING IT TO THE MAIN ENCLOSURE OR AN ERROR WILL OCCUR AND POSSIBLY SET OFF UNWANTED ALARMS!

All horn and strobes are detected based on the address assigned by the switch settings on each horn and strobe PCB. Table 4 above shows all the possible configurations and the corresponding addresses.

After installation of the horn and strobe(s) has been completed, power the instrument and follow the on screen instructions for enabling the horn and strobes. The system will keep displaying alert messages until either the horn and strobe is enabled or it's removed. Once all horn and strobes are enabled, consider setting up the horn and strobe activations under the “Main Menu“. See page 37 under “Activating Alarm Relays and Horn and Strobes“.

3.4.7 Horn And Strobe Maximum Distance

Each single horn and strobe can be up to 1,000 feet away from the main electronics. Any additional horn and strobe on the same cable reduces the maximum length as shown below.

Configuration	# of horn and strobes on a single cable	Cable Wire Gauge #22	Cable Wire Gauge #18	Cable Wire Gauge #16
Star[5]	1	450 feet	1000 feet	1800 feet
Daisy Chain	2	200 feet	550 feet	900 feet
Daisy Chain	3	150 feet	350 feet	600 feet
Daisy Chain	4	100 feet	250 feet	450 feet

Note: combinations of the above are acceptable. Example, using #18 AWG cable wire, three (3) horn and strobes at 350 feet max and one (1) horn and strobe at 1,000 feet will work. The appropriate wire is typically supplied by the factory based on the customer's application. Using smaller wire diameters will significantly reduce the wiring lengths. Example, #22 AWG with 4x Horn and Strobes is 100 feet Max.

[5] Four (4) separate horn and strobes can be wired at 1000 feet each as long as they are wired in a “Star” configuration where each cable is connected to a single horn and strobe and is terminated at the main enclosure.

3.5 Analog Outputs

Access to the Series 1300 Oxygen Deficiency Monitor's analog outputs and alarm relays is accomplished through the user interface connectors within the main electronics enclosure. These connectors are shown in the graphic in Figure 4 on page 10 and are labeled “TB2”, “TB3”, and “TB4”. Table 5 shows the pin outs and the connections associated with these signals. located on the printed circuit board.

Terminal Block	Pin	Signal	Description
TB2	1	Analog Output 1	Return
	2		Positive
	3		Shield
	4	Analog Output 2	Return
	5		Positive
	6		Shield

Table 5 - Analog Output Connections

3.6 Alarm Relays

The Series 1300 Oxygen Deficiency Monitor is equipped with four (4) single pole double throw (SPDT) relays. To configure the alarm relays, please refer to section 4.4 Alarm System on page 29.

Access to the Series 1300 Oxygen Deficiency Monitor's alarm relays is accomplished through the user interface connectors within the main electronics enclosure. These connectors are shown in the graphic in Figure 4 and are labeled “TB2”, “TB3”, and “TB4”. Table 6 below shows the pin outs and the connections associated with the relays.

Terminal Block	Pin	Signal	Description
TB3	1	Relay 1	Normally Closed Contact
	2		Common Contact
	3		Normally Open Contact
	4	Relay 2	Normally Closed Contact
	5		Common Contact
	6		Normally Open Contact
TB4	1	Relay 3	Normally Closed Contact
	2		Common Contact
	3		Normally Open Contact
	4	Relay 4	Normally Closed Contact
	5		Common Contact
	6		Normally Open Contact

Table 6 - Relay Connections

3.6.1 Fail Safe

Fail safe is individually selected for each of the (4) relays. When enabled (“ON”), the relay will be energized when there is no active alarm associated with the relay. The factory default for fail safe is “OFF”.

Contacts shorted for each Active Alarm Relay	Alarm ON	
	Fail-safe ON	Fail-safe OFF (shipped from factory)
Relay 1	NC (TB3-1) to COM (TB3-2)	NO (TB3-3) to COM (TB3-2)
Relay 2	NC (TB3-4) to COM (TB3-5)	NO (TB3-6) to COM (TB3-5)
Relay 3	NC (TB4-1) to COM (TB4-2)	NO (TB4-3) to COM (TB4-2)
Relay 4	NC (TB4-4) to COM (TB4-5)	NO (TB4-6) to COM (TB4-5)

Table 7 - Fail Safe Logic

Table 7 illustrates the various wiring configurations for the four alarm relays in the Series 1300 Oxygen Deficiency Monitor based on whether the alarm relays are going to be configured for fail-safe or non fail-safe operation. Please refer to Relay Fail-safe Operation on page 32.

3.7 RS-232/485 Communications

RS Communications is a three (3) wire interface for both RS-232 and RS-485. Refer to the table below for wiring.

Terminal Block TB 1 Label	Signal RS-232 / 485	Connects to: RS-232 / 485
T	TxD / +	RxD / +
R	RxD / -	TxD / -
G	Isolated Ground	

Table 8 - RS232/485 Communications Wiring

Note: If you have an RS485 output and have trouble communicating, try swapping over the input and output lines. Some are called T+ / T- or maybe A / B. Whatever the case, the communications link will not work unless these are correct. The COM (or ground) pin MUST be connected to insure proper communications.

4 Operation

The Series 1300 Oxygen Deficiency Monitor is ready to be used out of the shipping container. Simply verify that the proper power is available and wire accordingly (See section 3 Wiring on page 10). The monitor has been calibrated at the factory and re-calibration is not required at initial start up. When powering the instrument for the first time, any sensors will be automatically detected and initialized. This initial detection and initialization will take approximately 30 minutes. This is a one-time initialization.

4.1 Power ON

The Series 1300 Oxygen Deficiency Monitor has non-volatile flash memory so that all the values set by the user via the front panel will be maintained. Upon powering the Series 1300 Oxygen Deficiency Monitor, the monitor will show “BOOTING” on the screen for approximately fifteen (15) seconds then immediately start to display the oxygen level detected by all attached sensors. This assumes the instrument has been initialized. When using the data logger, the instrument may pause with a message “Logger updating” which indicates a power outage while logging. The logger will recover automatically. The longer the power was interrupted the longer the initialization will be. The first screen that displays the oxygen values is called the “Home” screen. See sections 4.3.1.1 and 4.3.1.2 starting on page 25.

4.2 Panel Description

The front panel of the Series 1300 Oxygen Deficiency Monitor contains a 4 Line liquid crystal display (LCD) and seven (7) membrane panel buttons, “STATUS”, “ESCAPE”, UP, DOWN, LEFT, RIGHT, and “ENTER”. There is an audible indicator located inside one of the strain reliefs on the bottom of the monitor. The 4 Line LCD display shows the concentration of oxygen in the environment being measured in terms of percent oxygen and also displays messages or alerts from the microprocessor.

4.3 Navigating The Screens

The Series 1300 Oxygen Deficiency Monitor has many distinct display screens.

1. The "Home" screen displays the sensor values. This is the DEFAULT screen and all other screens will time-out after being idle for approximately 2 minutes and display the Home screen.
2. The “Alert” screen displays sensor and monitor status information.
3. The “Active Alarms” screen displays a summary of active alarms and the current oxygen values of sensors currently in alarm condition.
4. The “Alarm Status” screen displays the detailed status of each of the (9) available alarms.
5. The “Main Menu” screen displays user adjustable parameters in an easy to use scrollable menu system.
6. The optional “Battery Status” screen. This screen will only be available when the “Battery Backup” option is ordered.

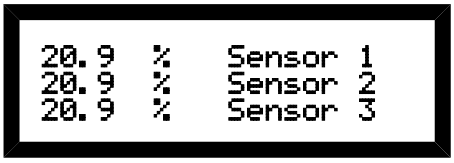
4.3.1 Home Screen

The "Home" screen is the primary DEFAULT display and shows the output in percent oxygen of each enabled sensor that is connected to the Series 1300 Oxygen Deficiency Monitor. The user can select different display options on this screen using the UP and DOWN buttons. These different display options will show the same information but do so in different ways. For example, one mode shows a larger font size for easier viewing from a distance that will alternate between active sensors. Another

includes 1 to 3 sensors, each on a separate line. Pressing ESCAPE multiple times will quickly revert to the “Home” screen and cancel any other screen or parameter editing.

4.3.1.1 Three Line "Home" Screen

The three line version will display each sensor on a line by itself as shown below. Note: positions are fixed.



Press UP or DOWN to cycle through “Home” screens.

Figure 19 - Three Line Home Screen

4.3.1.2 Large Font Home Screen

The large format version will cycle through any valid sensors and display the sensors name in the last line on the bottom of the screen.

Press UP or DOWN to cycle through “Home” screens.

Figure 20 - Large Font Home Screen

The sensor names will be displayed on the LCD justified based on how many sensors are installed. For instance, if two sensors are installed, one will be left justified and the other right justified. When three sensors are installed, then one will be left justified, the second will be centered, and the third will be right justified. This allows for easier identification from a distance. The logical order of the sensors is Remote 1, Remote 2, and Local. Therefore if Remote 1 and Local sensors are installed, these become sensor 1 and sensor 2 logically and appear on the screen as described above.

4.3.2 Alert Screen

The “Alert” screen automatically displays information related to the following items (prioritized):

Priority	Alert Type	Detail	Notes
1	Sensor status	Sensor very low or removed	
2	Bus, horn and strobe status	Hardware malfunction	
3	Bus, horn and strobe status	Horn and Strobe removed	
4	Bus, horn and strobe status	Disabled/Detected horn and strobe	
5	Bus, horn and strobe status	Address changed	
6	Sensor status	Oxygen sensor needs replacing	
7	Bus, horn and strobe status:	Newly added horn and strobe	
8	Battery status	Battery missing	*When equipped at the factory with optional battery backup.
9	Battery status	Low Battery (below 9.5V)	
10	Power status	No main power	

When the “Alert” screen appears, the instrument will sound a short chirp from the audible alarm to indicate a message has been displayed. Use the LEFT and RIGHT buttons to navigate between the “Home” and “Alert” screens. ESCAPE also reverts to the “Home” screen.

As shown below in Figure 21, the screen will display either “A T T E N T I O N!” when a message is displayed, or “N O A L E R T S” when the system status is normal. Table 9 - Alert Screens shows each Alert screen with a simulated output.

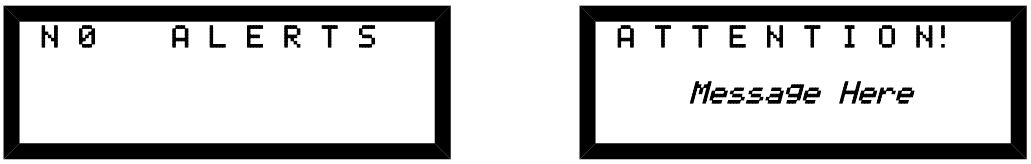


Figure 21 - Main Alert Screens

4.3.2.1 Navigating The Alert Screens

Generally the “Alert” screen accepts the ENTER button to “fix” the alert or the ESCAPE button to ignore it temporarily. The message will differ slightly based on the alert displayed. Some alerts are simply notifications such as a wiring problem. Others require the user to “fix” the alert by pressing the ENTER button which will jump to the correct place in the menu to handle the message. The following section describes these situations.

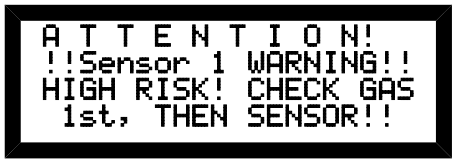
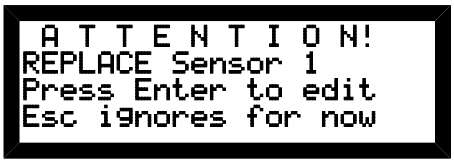
	
1) Oxygen Reading Very Low Or Sensor Removed	*2) Horn And Strobe Hardware Malfunction*
	
3) Horn And Strobe Removed	*4) Horn And Strobe Detected*
	
5) Horn And Strobe Address Changed	*6) Sensor Needs Replacing*
	
6) This Shows Multiple Sensors Needing Replacement:	*8) Low Battery**
	
*9) No Battery**	*10) No Main Power**

Table 9 - Alert Screens

**Shown Only With Factory Installed Battery Backup Option*

4.3.3 Active Alarms Screen

The following screens show an example of an “Active Alarms” screen. The “Active Alarms” screen displays alarm information for sensors that are in active alarm. The screen alternates between an alert screen displaying the word “ALARM” and the screen displaying the summary information about the active alarms. The alarm shown below is a “Local” sensor alarm at 20.0% oxygen:

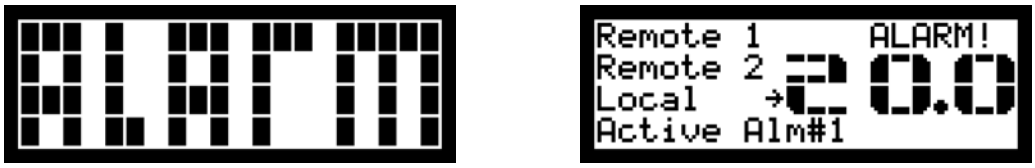


Figure 22 - Active Alarms Screen

On the left, up to (3) sensors can be displayed at once. An arrow to the right of the active sensor will point to the oxygen value that is associated with this sensor. Each time the display is updated it will cycle to the next sensor that has an active alarm. In the example shown, the arrow is next to the “Local” sensor name and it is reading “20.0”% oxygen. The screen will also display all of the active alarm numbers on the last line. This is a quick view of all the active alarms. In this example, there is a single alarm shown as “1” just after the text “Active Alm#”. Pressing the ESCAPE button will return to the “Home” screen. Pressing any other button while on this screen will show the “Alarm Status” screen.

Note: when navigating the “Main Menu”, the “Active Alarms” screen is slightly modified to allow the user to see the oxygen concentration of (1) to (3) sensors simultaneously as shown below:

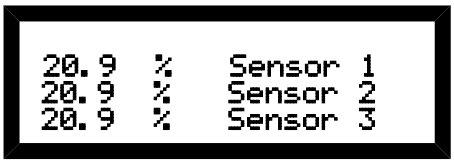


Figure 23 - Modified Active Alarms Screen

4.3.4 Alarm Status Screen

The “Alarm Status” screen displays the status of each alarm. The “Alarm Status” screen is accessed by pressing the STATUS button while viewing the “Home” screen or by pressing any button except the ESCAPE button while viewing the “Active Alarms” screen.

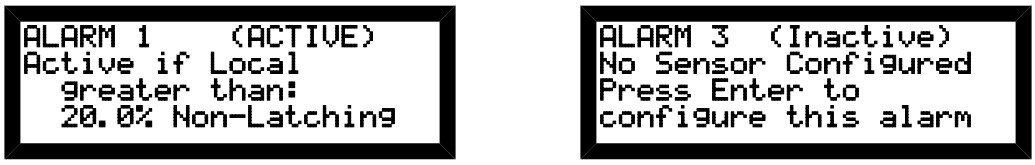


Figure 24 - Alarm Status Screens

Each status screen will display only the information relevant to that particular alarm. Pressing the ESCAPE button while viewing the “Alarm Status” screen will exit the "Alarm Status" screen and return to the "Home" screen. Pressing the ESCAPE button during an alarm condition will return to the “Home” screen for approximately two (2) minutes. Pressing the ENTER button while in the “Alarm Status” screen will display the alarm settings within the “Main Menu”, allowing the user to change the alarm parameters. Use the UP and DOWN buttons to select from any of the (9) alarms to view.

4.3.5 Main Menu Screen

The “Main Menu” screen displays all of the user adjustable parameters available on the instrument. The menu system is comprised of a simple scrolling menu that shows the individual items that can be set or viewed by the user. Pressing the UP or DOWN buttons, the user can scroll up or down until eventually the menu will return to the top. The Main Menu has a tree structure where items are contained in sub-menus that can be expanded or collapsed to improve navigation (see Navigating the Menu on page 36).

Note: when exiting the menu by pressing the ESCAPE button, the position in the menu is retained the next time the menu is displayed. Pressing ENTER from the “HOME” screen will return to the same place in the menu that was previously being viewed. Pressing the RIGHT button will open a sub-menu and pressing the LEFT button will close the sub-menu.

Figure 25 - Main Menu Screen

NOTE

IF THE PASSCODE IS SET TO ANYTHING OTHER THAN “1300” THE MAIN MENU ITEMS WILL BE HIDDEN. TO ACCESS THE HIDDEN MENU SIMPLY SET THE PASSCODE BACK TO “1300”.

To enter the “Main Menu”, while on the "Home" screen, press the ENTER button. Use the UP and DOWN buttons to navigate the “Main Menu“. Using the LEFT, RIGHT, or ENTER buttons will expand and collapse the “Main Menu”'s main headings, allowing for quicker navigation of the menu. To change a parameter in the menu, first navigate to the parameter and then press the ENTER button to enter into edit mode for that parameter. The cursor will blink while in edit mode. While in edit mode, press the UP, DOWN, LEFT, and RIGHT buttons to change the parameter. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting. To exit the menu press the ESCAPE button while not in edit mode. (NOTE: If an alarm is active while viewing the “Main Menu” screen, the screen will flash a message indicating an alarm condition).

4.4 Alarm System

The Series 1300 Oxygen Deficiency Monitor is equipped with up to nine (9) highly programmable user friendly alarms. When an alarm event takes place (is active), several indications are provided by the Series 1300 Oxygen Deficiency Monitor:

1. The front panel LCD will display the “Active Alarms” screen.
2. A continuous audible alarm will sound for any activated alarm.
3. The relay(s) associated with the activated alarm will change state based on their fail-safe setting(s).
4. The horn and strobe(s) associated with the alarm in question will activate.

The alarms can be associated with any oxygen sensor (local or remote) that is connected to the monitor. The alarms have user selectable set points as well as high and low triggers for the set points. The alarms have the ability to latch if an alarm condition has occurred. A latched alarm requires that the user manually clear the alarm indication if the alarm condition no longer exists. The alarms can be associated with any number of the four (4) available relays and optionally up to eight (8) horn and strobes. The alarms can be programmed to activate the horn, strobe, or both the horn and strobe[6].

[6] A Series 1300 Oxygen Deficiency Monitor can control up to four (4) horn and strobes without the need for external power. With external power the instrument can control up to eight (8) horn and strobes

NOTE: If an alarm is active while viewing or editing a parameter while in the “Main Menu” screen, the “Active Alarms” screen will show for a brief time and then toggle back to the previous screen. This is to keep the user informed of any active alarms. Pressing any key during any alarm will pause the display for a short time and allow for menu navigation and edits. After a period of inactivity the “Active Alarms” screen will reappear. The audible alarm will also change to a “chirp” or a series of short beeps while pressing any keys.

4.4.1 Alarm System Menu Settings

The following table gives a summary of the alarm settings in the menu and the relevant manual pages. The figure below it shows the logical steps to set an alarm.

Option	Description	Reference
Sensor	Select the associated sensor input to be monitored for the alarm.	Page 39 - Setting the Alarm Sensor
Set point	Enter the value at which the alarm will be set to monitor.	Page 40 - Setting the Alarm Set point
HI/LO	Select either a “High Alarm” or “Low Alarm” (whether to activate the alarm if above or below the set point respectively).	Page 40 - Setting the Alarm High or Low
Latching	Select whether to latch the activated alarm rather than having it clear automatically when the oxygen value that caused the alarm returns to a non-alarming value.	Page 40 - Setting the Alarm Latch
ACTIVATES:	Menu for activating Optional horn and strobes and Alarm Relays.	Page 40 - Activating Alarm Relays and Horn and Strobes

Table 10 - Overview Of Alarm Settings

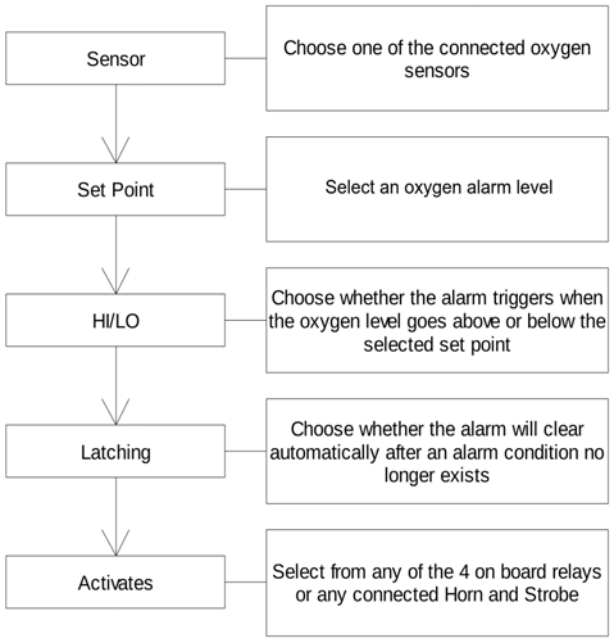


Figure 26 - Setting An Alarm

4.4.2 Default Alarm Settings

When shipped from the factory with all three (3) sensors active, the alarms are set to the following defaults:

Sensor Association	Default Alarm Number	Default Alarm Value	HI/LO High / Low alarm trip point
Local Sensor	1	20.0	LO
Local Sensor	2	19.5	LO
Remote Sensor 1	3	20.0	LO
Remote Sensor 1	4	19.5	LO
Remote Sensor 2	5	20.0	LO
Remote Sensor 2	6	19.5	LO

Table 11 - Default Alarm Settings

If the instrument is ordered with a single (1) sensor, the default alarms will be alarms 1 and 2 at the same alarm values of 20.0% Low and 19.5% Low respectively. The alarms are user configurable by following the procedures in the following sections.

4.4.3 Default Alarm Activation Behavior

If using the alarms to activate either the relays or optional horn and strobes, be sure to edit the alarms in the Main Menu by means of the “ACTIVATES” option. See section 4.8.4.6 “Activating Alarm Relays and Horn and Strobes” on page 40 for details.

4.4.4 Low Alarms Vs High Alarms

A “low alarm” will activate if the sensor's output falls below the set alarm value. A “high alarm” will activate when the sensor's oxygen value matches or exceeds the set alarm value.

4.4.5 Alarm Latching

Alarm latching is a feature that allows the activated alarm to “latch” or remain activated even after the cause of the alarm (either a “high alarm” or “low alarm” was detected) has been resolved. When the “Latching” parameter is set to “ON”, the user is required to manually clear the alarm indication even if the alarm condition no longer exists. When latching is set to “OFF”, the activated alarm will automatically be deactivated if the specified sensor's oxygen value returns to a state outside of the alarm set point value.

Example: Alarm 1 is set for Remote Sensor 1 at a value of 18% low. The oxygen sensor detects a drop in the oxygen value and the alarm condition is met, activating Alarm 1. The oxygen value later returns to a value above 18%. At this time the alarm indication is still active because it has been latched. Pressing the STATUS button will enter into the “Alarm Status” screen. Pressing the UP and DOWN buttons will allow locating the “(Active)” alarm as indicated in the display. The user must now access the “Alarm #” parameters in the “Main Menu” and enter into edit mode on any of the associated alarm parameters and either confirm or edit the value of the parameter to clear the latched alarm state.

The simplest way to clear a latched alarm is to press ENTER on the active alarm in the “Alarm Status” screen, then press ENTER multiple times until the latch is cleared. This effectively enters the menu at the activated alarm sensor setting. Entering to edit and then entering to confirm will clear the latch.

Note: If the alarm condition is still valid and an attempt is made to reset the alarm, the alarm will not be reset and will continue to be active.

When the “Latching” parameter is set to “OFF”, the alarm indication will clear whenever the alarm condition no longer exists.

For Example: Alarm 1 is set for Remote Sensor 1 at a value of 18% low. The oxygen sensor detects a drop in the oxygen value and the alarm condition is met, triggering Alarm 1. The oxygen value later returns to a value above 18%. At this time all alarm indications will clear because the alarm “Latching” parameter is set to “OFF”.

4.4.6 Relay Fail-safe Operation

The alarm relays can be placed into fail-safe (“ON” mode) in which the alarm relays will be energized in a non-alarm condition and the relays will NOT be energized during an alarm condition. This would be the same relay state (not energized) that would be achieved if the power source were interrupted. The factory default fail-safe setting is "OFF". See section Relay Fail-safe Operation for information on setting the fail-safe parameter.

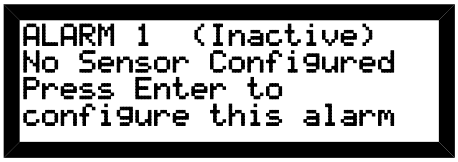
Enter into the “Main Menu” by pressing the ENTER button while on the “Home” screen. Navigate the menu until you reach the menu heading “FAILSAFE SETUP” and press the RIGHT or ENTER button to expand the “FAILSAFE SETUP” sub-menu. Under the “FAILSAFE SETUP” sub-menu heading there is a list of four (4) alarm relays, navigate to the appropriate relay number and press the ENTER button to edit the parameter. Use the UP and DOWN buttons to change this parameter to either “ON” or “OFF”. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting.

4.4.7 Navigating Alarms

Navigate the alarms by pressing the ESCAPE button repeatedly until the Home screen is showing. Then press the STATUS button to see the “Alarm Status” screen.

High Alarm

Low Alarm



Disabled Alarm (No Sensor selected)

Table 12 - Alarm Status Screens

Scroll up and down while in the “Alarm Status” screen to the desired alarm number to be viewed.

Pressing the ESCAPE button will return to the Home screen.

To edit the currently viewed alarm number, press the ENTER button to jump to the selected alarm in the “Main Menu”. Under the “Alarm #” heading there is a list of parameters, press the ENTER button on the desired parameter to edit.

4.5 Horn And Strobe

The Series 1300 Oxygen Deficiency Monitor has a dedicated interface for connecting to horn and strobes provided by Alpha Omega Instruments. This interface is a three (3) wire connection consisting of a 12VDC Power connection, a 12V Ground connection, and a communications data line. This interface allows up to 8 horn and strobes to be connected to the Series 1300 Oxygen Deficiency Monitor[7]. The horn and strobe units have a user settable address based on switch settings within the horn and strobe enclosure (see section “Horn and Strobe Switch Settings” on page 20 for details on setting the horn and strobe address). When a horn and strobe unit is connected to the Series 1300 Oxygen Deficiency Monitor the unit is automatically detected and the user is prompted with the “Alert” screen similar to Figure 27 below.

Figure 27 - Horn And Strobe Detected

Horn and Strobe names have a default setting of “H&S #”. Where “#” represents 1 through 8. Pressing the ENTER button on this screen will show the user the “Enabled?” parameter in the horn and strobe menu for the horn and strobe address that was detected. Here the user can enable the detected horn and strobe by selecting “YES” and then pressing ENTER. Confirm the choice by pressing ENTER. Pressing ESCAPE will cancel and return to the menu. An alert will continue unless the detected horn and strobe is either enabled or removed.

NOTE

THE HORN AND STROBE “ENABLE?” PARAMETERS ARE HIDDEN DURING NORMAL OPERATION. THESE PARAMETERS ARE ACCESSIBLE ONLY THROUGH THE “ALERT” SCREEN AND BECOME AVAILABLE WHEN A DEVICE HAS BEEN CONNECTED OR DISCONNECTED FROM THE SERIES 1300 OXYGEN DEFICIENCY MONITOR. THE ITEMS UNDER THE “ACTIVATES” MENU ARE ALSO POPULATED BASED ON AVAILABLE HORN AND STROBES.

If a horn and strobe is enabled but is not connected, this can indicate that either the horn and strobe has become disconnected due to a wiring problem or the horn and strobe was set to enabled by the user and is not connected. The following is detected and the user is prompted with the “Alert” screen similar to Figure 28 below.

Figure 28 - Horn And Strobe Removed

Pressing the ENTER button on this screen with take the user to the “Enabled?” parameter in the horn and strobe menu for the horn and strobe address that was detected, here the user can disable the missing horn and strobe. This will eliminate the alert.

[7] An AC powered Series 1300 Oxygen Deficiency Monitor can control up to four (4) horn and strobes without the need for external power. With external power the instrument can control up to eight (8) horn and strobes. 12VDC powered instruments can allow for all 8 horn and strobes. Call factory for details.

4.5.1 Horn And Strobe Naming

The user also has the ability to name each of the enabled horn and strobes. Naming a horn and strobe allows the user to use a more descriptive name such as “Horn Lab2” or “Strobe #9” rather than “H&S 1” for instance. This name will be shown throughout the menu when selecting the named horn and strobe for Alarm activation as well as enabling or disabling the horn and strobe. Naming is already described in section 4.8.7.1 - “Naming the horn and strobe” on page 42.

4.6 Analog Outputs

The Series 1300 Oxygen Deficiency Monitor is equipped with two (2) standard, non-isolated, analog outputs (galvanically isolated analog outputs are available as a factory option). Each output can be selected to operate with any sensor connected to the monitor. The analog outputs can be set to correspond to a custom low to high range within the measurement range of the sensor. The standard monitor is shipped from the factory as shown below:

Output	Associated Sensor	“Scale Low”	“Scale High”	mA Offset
Analog Output 1	OFF	0%	30%	4mA
Analog Output 2				

Table 13 - Analog Output Factory Default Settings

Regardless of how the analog outputs are scaled, the monitor will always maintain the capability of displaying the sensor's oxygen concentrations over the instrument’s entire range of 0 to 30%. Therefore alarms are independent of the output scaling and will continue to operate.

The analog output offset setting determines whether the associated current output is either 0-20mA or 4-20mA (“live zero”). The “live zero” allows equipment monitoring the current loop to know that something is wrong when the current falls below 4mA. The “zero” part of the “live zero” is really a misnomer in that the “zero” is really the lowest reading (or “Scale Low”) that is programmed in the menu. The 0mA setting on the other hand allows for easy scaling when using a resistor to convert the current to a voltage. These options provide great flexibility in controlling the range of the analog outputs (see 1.6 Standard Features on page 4 for specifications on maximum load resistance).

4.6.1 Analog Output Sensor Association

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “OUTPUTS SETUP”. Press the RIGHT arrow button or ENTER to see the parameters under this title. Navigate to the title “Analog Out 1” (or “Analog Out 2”) and press the ENTER button. Under the “Analog Out #” heading there is a list of parameters. Navigate to the “Sensor” parameter and press the ENTER button to edit the parameter. This parameter can be set for any enabled sensor using the UP and DOWN buttons. When finished, press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. Both analog outputs can be associated with the same sensor and with different scales.

4.6.2 Analog Output Range

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “OUTPUTS SETUP”. Press the RIGHT arrow button or ENTER to see the parameters under this title. Navigate to the title “Analog Out 1” (or “Analog Out 2”) and press the ENTER button. Under the “Analog Out #” heading there is a list of parameters. Be sure the Sensor parameter does NOT read “OFF” or the analog output range cannot be defined and will

not show in the menu. Once a sensor is selected, navigate to the “Scale High” parameter and press the ENTER button to edit the parameter. Use the UP, DOWN, LEFT, and RIGHT buttons to change this parameter for any number between the value of the “Scale Low” parameter and the maximum operating range of the sensor. This parameter represents the sensor value at which the analog output will be at its highest (20mA). When finished, press the ENTER button to save this parameter or press either the Alarm 1 or Alarm 2 buttons to cancel all changes. Navigate to the “Scale Low” parameter and press the ENTER button to edit the parameter. Use the UP, DOWN, LEFT, and RIGHT buttons to change this parameter for any number between the value of the “Scale High” parameter and zero. “Scale Low” represents the sensor value at which the analog output will be at its lowest (0mA or 4mA depending on the output's “Offset” setting). When finished, press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes.

Notes:

1. The “Scale High” value cannot be set lower than the “Scale Low” value. Likewise, the “Scale Low” value cannot be set higher than the “Scale High” value. If you are unable to adjust either parameter to the desired value, check that the other parameter's value is not interfering.
2. Whenever changing the Analog Output Sensor Association, always check and rescale the “Scale High” and “Scale Low” parameters to avoid having the old sensors associated settings “left over” from a previous setting.

4.6.3 Analog Output Offset

Enter into the “Main Menu” by pressing the ENTER button while on the “Home” screen. Navigate the menu until you reach the menu heading “OUTPUTS SETUP”. Press the RIGHT arrow button or ENTER to see the parameters under this title. Navigate to the title “Analog Out 1” (or “Analog Out 2”) and press the ENTER button. Under the “Analog Out #” heading there is a list of parameters. Be sure the Sensor parameter does NOT read “OFF” or the analog output range cannot be defined and will not show in the menu. Once a sensor is selected, navigate to the “Offset” parameter and press the ENTER button to edit the parameter. Use the UP and DOWN buttons to change this parameter to either 0mA or 4mA. When finished, press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes.

4.6.4 Voltage Output Mode

To use the analog outputs as voltage outputs, choose whether or not to use an offset first and select this as described in the previous paragraph. First determine the desired voltage output. For this example we selected a range of 0-5 volts. Make sure the Analog Output Offset is set to 0mA. Use the formula below to calculate the required resistance needed to create 5V:

$$\frac{Desired\,V\,(5)}{20\,mA} = 250\,Ohms$$

The desired 5 Volts divided by 20mA (0.020 Amperes) yields a resistance of 250 ohms. This is the resistance necessary to terminate the analog output to obtain a 0-5V full scale output. Please remember that the maximum resistance across the output (including the wiring) is 300 ohms max @ 25C using standard 12V supply.[8]

Using the previous example, a simple way of changing to a 1 to 5V output with a “live” zero is by simply selecting “4mA” as the analog output offset as described previously.

Note: The isolation option also allows for a higher maximum load resistance. See 1.6 Standard Features on page 4 for specifications on maximum load resistance.

[8] 1200 ohms max @ 25C if using isolated analog outputs.

4.7 Navigating The Menu

This section describes how to navigate through the “Main Menu”. These instructions are general and any special cases will be described throughout the manual when appropriate.

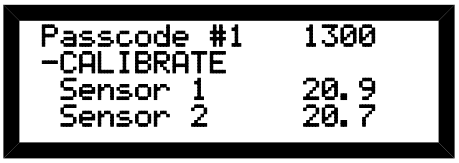
Pressing the ESCAPE button several times will show the “Home” screen. Pressing the ENTER button from this screen will then show the “Main Menu” screen as shown.	
Pressing the UP and DOWN buttons will allow the user to navigate by scrolling to the desired item that is highlighted by two small arrows on the left and the right of the line. Line items that have a plus sign indicate that the item is collapsible and can be “opened” by pressing either the ENTER button or the RIGHT Arrow button. When open the plus sign will change to a minus sign as shown. Likewise, to collapse the item with a minus sign, simply press the ENTER button again or press the LEFT Arrow button.	
Note that if the item does not have a plus or minus sign then pressing ENTER will access the item for editing and the display will show to following.	
When calibrating, the menu will warn the user, as shown, with the following display.	
When setting the alarms, the menu will show the alarm logic during editing. Example as shown.	

Figure 29 - Main Menu

4.7.1 Timing Out

After approximately two (2) minutes of inactivity, the Series 1300 Oxygen Deficiency Monitor will revert back or “time out” and return to the "Home" screen.

When the instrument times out while setting a parameter, the parameter value will revert to that which was previously set. This is equivalent to canceling any input by pressing the ESCAPE button. This feature helps to prevent the user from inadvertently keeping the monitor off-line for a prolonged period of time or changing a parameter to an undesirable value.

4.8 Main Menu

The following table is a copy of the menu items with descriptions and available options. Please see detailed information about each item on the following pages.

NOTE: Some items may not be shown depending on options and/or unused entries.

MENU ITEM	*DESCRIPTION*	*OTHER DETAIL*
M A I N M E N U	Start of the Main Menu	
Passcode	Hides the menu if not set to “1300”	
CALIBRATE	Calibration menu	
[Available Sensors]...	Default or User defined sensor labels	
SENSOR SETUP		
[ALL Sensors]...	User defined sensor labels	Defaults: “Remote-1”, “Remote-2”, and “Local”
Edit:	Edit the name for the selected sensor	
ALARM SETUP		
Alarm 1...9		
Sensor	Sensor that triggers the alarm. If set to “OFF” then all associated parameters will be hidden.	If sensor is OFF then nothing else shows below in sub-menu
Set point	Value at which the alarm will trigger	
HI/LO?	Trigger above (HI) or below (LO) the set point	
Latching?		
ACTIVATES	sub-menu	
Horn & Strobes:X	sub-title showing number of active H&S	“(0)” indicates none available
H&S 1...8	Alarm can trigger the Horn, Strobe, Both, or None	These show if connected and enabled
Relays:	sub-title	
Relay 1...4	Alarm can trigger any combination of relays	
FAILSAFE SETUP		
Relay 1...4	FAILSAFE “ON” will energize the relay when NOT in alarm	
OUTPUTS SETUP		
Analog Output 1,2		
Sensor	Selects the sensor to transmit on the output. If set to “OFF” then all associated parameters will be hidden.	If sensor is OFF then nothing else shows below in sub-menu
Scale High	Set the highest range of the analog output	Typically 30%
Scale Low	Set the lowest range of the analog output	Typically 0%
Offset	Optionally remove the default 4mA loop offset	Typically 4mA
HORN & STROBES		

MENU ITEM	*DESCRIPTION*	*OTHER DETAIL*
[Available H&S]	User defined H&S labels	
Name	Edit the name for the selected horn/strobe	
Address	The fixed address of the name above	Informational only
DATALOGGER		
Sensors to Log	Sub menu	
Log Sensor[X]...	Select YES to log this sensors data	Disabled sensors are not shown
Logger Setup	Sub menu	
State	Current state of the logger	STOP, RUN, PRINT
Mode		LIVE, START/STOP, CONTINUOUS
Sample (Secs)	Sample rate of data logger in seconds up to 60	
Timestamp	Add time stamp to data-logger output file	
Clock Set	Sub menu	
Year		
Month		
Day of Month		
Time		
MISCELLANEOUS		
Baud Rate	Selectable baud rates	
Line Ending	Select line ending (CR/LF is default)	CR, LF, CR/LF, LF/CR, USER, OFF
Addressing	Typically for RS-485 (up to 32 units on line)	Colon precedes the address #
Address	RS485 address # from 1 to 32	use :X where X is the address
RS Echo Enable		
FIELD ELEVATION		
Info 1	SEE INSTRUCTIONS	
Info 2	ON INSIDE COVER	
Sensor [X]...	One time cal for change in elevation	ONLY done when the instrument is moved to another location at a significant change in elevation.
SYSTEM INFO		
Info 1-4	Version, Company, Serial Number, Code Info	
Mmm DD YYYY	Compile Date Month, Day, and Year	
HH:MM:SS	Compile Time	
M A I N M E N U	Loop back around to Main Menu	

Table 14 - Main Menu

4.8.1 Passcode

Setting this number to anything other than “1300” will result in the menu being hidden. This is a simple way to hide the settings from accidental changes. To allow the menu to be visible again, simply change it back to the number “1300”.

4.8.2 CALIBRATE

Navigate to the desired sensor name and press the ENTER button to edit this parameter. The value for this parameter can be changed using the UP, DOWN, LEFT, and RIGHT buttons. Note that the display will also show the “live” value on line 3. This allows viewing the actual oxygen sensor concentration while selecting the new calibration value. This allows the signal to be monitored for stability before performing the actual calibration. When the desired calibration value is showing in the display, simply press the ENTER button. Press the ENTER button a second time to confirm the Calibration or press the ESCAPE button to cancel and revert back to the original calibration value. A typical calibration will be performed at “20.9”. This assumes a fresh room air at 20.9% concentration of oxygen. However, it may be necessary to change this number if the calibration is performed using a cylinder of gas. See section Calibration Procedures on page 48 for more details on calibrating.

4.8.3 SENSOR SETUP

The only parameter needed for setting up the sensor is the sensor's name.

4.8.3.1 Sensor Naming

Each sensor's name can be changed from the factory default name to something more descriptive like “Oxygen 1” or “Lab O2%” for instance. This name will be shown throughout the menu when selecting the Sensor for Alarms, Output settings, and Calibrations.

To change the name of a Sensor enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “SENSOR SETUP“ and if not expanded press ENTER to open the sub menu. Navigate to the desired sensor name to be changed and press ENTER again to open the parameter called “Name:”. Press the ENTER button to edit the name parameter. The name parameter can be set for letters, numbers, and symbols up to 8 characters long. Press the ENTER button to save this parameter or the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button again to confirm the changes or press the ESCAPE button to cancel.

4.8.4 ALARM SETUP

Under this sub-menu the user can define how each individual alarm will trigger based on the selected sensor. The alarm can be set for a “low alarm” or a “high alarm”. A “low alarm” will activate if the sensor's output falls below the set alarm value. A “high alarm” will activate when the sensor's oxygen value matches or exceeds the set alarm value. The triggering allows for any combination of outputs. This includes Relays, Horns, and Strobes. Each menu item is described below.

4.8.4.1 Setting The Alarm Sensor

If used, each alarm must have a sensor associated with it. Simply select the sensor to be used for the alarm or set it to “OFF”. Setting it to “OFF” will disable it and also hide it's selections from showing on certain screens to avoid accidentally setting alarm parameters that are not available.

Press the STATUS button while on the “Home” screen to view the “Alarm Status” screen then use the UP and DOWN buttons to select the desired Alarm number. Navigate to the “Sensor” parameter and press the ENTER button to edit the parameter. This parameter can be set for any sensor connected to the monitor or to “OFF” using the UP and DOWN buttons. Setting the sensor to “OFF” disables the

alarm function and will hide the alarm parameters. Press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button to confirm changes or press the ESCAPE button to cancel all changes. Alarms can be associated with the same sensor.

NOTE: When the sensor is set to “OFF” no other associated parameters are listed.

4.8.4.2 Setting The Alarm Set Point

The Alarm Set Point is the value at which the alarm will trigger.

Press the STATUS button while on the “Home” screen to view the “Alarm Status” screen then use the UP and DOWN buttons to select the desired Alarm number. Navigate to the “Set point” parameter and press the ENTER button to edit the parameter. Use the UP, DOWN, LEFT, and RIGHT buttons to change this parameter to any value within the operating limits of the selected sensor type. Press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button to confirm changes or press the ESCAPE button to cancel all changes.

4.8.4.3 Setting The Alarm High Or Low

A “low alarm” will activate if the sensor's output falls below the set alarm value. A “high alarm” will activate when the sensor's oxygen value matches or exceeds the set alarm value.

Press the STATUS button while on the “Home” screen to view the “Alarm Status” screen then use the UP and DOWN buttons to select the desired Alarm number. Navigate to the “HI/LO” parameter and press the ENTER button to edit the parameter.

This parameter can be set for “LO” which means that the alarm will activate if the specified sensor's oxygen value is “less than or equal to” the alarm set point value. It can also be set to “HI”, which means the alarm will activate if the specified sensor's oxygen value is “greater than” the alarm's set point value.

Press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button to confirm changes or press the ESCAPE button to cancel all changes.

4.8.4.4 Setting The Alarm Latch

Press the STATUS button while on the “Home” screen to view the “Alarm Status” screen then use the UP and DOWN buttons to select the desired Alarm number. Navigate to the “Latching” parameter and press the ENTER button to edit. UP and DOWN will toggle the parameter. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting.

4.8.4.5 Clearing A Latched Alarm

To manually clear an activated alarm that was latched, enter the sub-menu for the alarm that is latched and either edit or confirm any one of the associated parameter values to clear the latched alarm state.

4.8.4.6 Activating Alarm Relays And Horn And Strobes

Press the STATUS button while on the “Home” screen to view the “Alarm Status” screen then use the UP and DOWN buttons to select the desired Alarm number. Navigate down to the line that reads “ACTIVATES:”. Under the “ACTIVATES:” heading there is a list of enabled horn and strobes as well as the four (4) alarm relays. NOTE: if no horn and strobes are enabled, only the line that reads “Horn & Strobes:0” will appear to indicate that there are no horn and strobes available to select.

Navigate to the appropriate parameter and press the ENTER button to edit the parameter. If available, the horn and strobes can be set to activate the “HORN” which activates only the Horn, “STROBE” which activates only the Strobe, “BOTH” which activates both the horn and strobe, or “NONE” which disable the selected horn and strobe from the selected alarm. The alarm relays can be set for “YES” or “NO”. Setting the relay to “YES” will toggle the relay from it's original fail-safe state upon activation of the alarm. See Relay Fail-safe Operation on page 32 for more detailed information on fail-safe settings. Setting the relay to “NO” will disable the relay for the selected alarm.

4.8.5 FAILSAFE SETUP

Turns fail-safe on or off for the specified relay. Navigate to the desired relay and press ENTER to access the parameter to change. Pressing the UP and DOWN buttons will toggle the parameter from “ON” to “OFF”. Press ENTER on the desired setting, then ENTER to confirm or press ESCAPE to cancel the change and revert to the previous setting. See Relay Fail-safe Operation on page 32 for more detailed information on fail-safe settings.

4.8.6 OUTPUTS SETUP

The “OUTPUTS SETUP” menu item allows for configuring the analog outputs for the desired sensor to be used, the lowest range of percent oxygen (“Scale Low”), and the highest range of percent oxygen (“Scale High”). See Analog Outputs on page 34 for more detailed information about scaling the analog outputs.

4.8.6.1 Sensor

Select the sensor to be used for the selected Analog Output..

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “OUTPUTS SETUP” and navigate into the sub menu of either “Analog Out 1” or “Analog Out 2”. Under each of these headings is a list of parameters. Navigate to the “Sensor” parameter and press the ENTER button. Using the UP and DOWN buttons, select the desired sensor or select “OFF”. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting. The same sensor can be selected for both analog outputs.

NOTE: When the sensor is set to “OFF” no other associated parameters are listed.

4.8.6.2 Scale Low & Scale High

This allows changing the default output scaling of the analog outputs.

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “OUTPUTS SETUP” and navigate into the sub menu “Analog Out 1” or “Analog Out 2”. Under the selected heading there is a list of parameters. Navigate to the “Scale Low” parameter and press the ENTER button to edit the parameter. Use the UP, DOWN, LEFT, and RIGHT buttons to change this parameter for any number between the value of the “Scale High” parameter and zero. “Scale Low” represents the sensor value at which the analog output will be at its lowest (0mA or 4mA depending on the output's “Offset” setting). When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting.

Navigate to the “Scale High” parameter and press the ENTER button to edit the parameter. Use the UP, DOWN, LEFT, and RIGHT buttons to change this parameter for any number between the value of the “Scale Low” parameter and the maximum operating range of the sensor type selected. This

parameter represents the sensor value at which the analog output will be at its highest (20mA). When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting.

The “Scale High” value cannot be set lower than the “Scale Low” value. Likewise, the “Scale Low” value cannot be set higher than the “Scale High” value. If you are unable to adjust either parameter to the desired value, check that the other parameter's value is not interfering.

Whenever changing the Analog Output Sensor, always check and rescale the “Scale High” and “Scale Low” parameters to avoid having the previous sensor's settings “left over” from a previous setting.

4.8.6.3 Analog Output Offset

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “OUTPUTS SETUP” and navigate into the sub menu “Analog Out 1” (or “Analog Out 2”). Under the selected heading there is a list of parameters. Navigate to the “Offset” parameter and press the ENTER button to edit the parameter. Use the UP and DOWN buttons to change this parameter to either 0mA or 4mA. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting. See Analog Outputs on page 34 for more information.

4.8.7 HORN & STROBES

The user has the ability to name the horn and strobe.

4.8.7.1 Naming The Horn And Strobe

Similar to the sensor name, the Horn and Strobe name can be changed from the factory default. This name will be shown throughout the menu when selecting horn and strobes.

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “HORN & STROBES” and navigate to the “Name” parameter for the desired horn and strobe. Press the ENTER button to edit the name. This parameter can be set for letters or numbers up to 8 characters long. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting.

4.8.8 DATA LOGGER

The data-logger sub-menu has all the items necessary to configure the built in data logging feature. See section Data Logger on page 45 for complete details on the various settings and their functions.

Item	Detail	Reference
State	Change the current state of the logger. This parameter can be set to “RUN”, “STOP”, or “PRINT”.	See section Data Logger on page 45
Mode	Change the mode of the logger. This parameter can be set to “LIVE”, “START/STOP”, or “CONTINUOUS”.	
Sample (Secs)	Change the data-loggers sample seconds. This parameter can be set from 1 to 60 seconds.	
Timestamp	Select whether or not to have the data-logger include a time stamp in it's output.	
Year	Set the real time clocks calendar year setting.	
Month	Set the real time clocks calendar month setting.	
Day of Month	Set the real time clocks calendar day of the month setting.	
Time	Set the real time clocks calendar time setting.	
Log Sensors	Select each sensor to be logged.	

Table 15 - Data Logger Settings

4.8.9 MISCELLANEOUS

The Series 1300 Oxygen Deficiency Monitor has basic system settings available for the user to edit. These settings include the baud rate, line endings, RS Echo, and serial addressing.

Item	Detail	Reference
Baud Rate	Change the baud rate for RS-232 & RS-485 interface.	See section 11 Serial Communications on page 59
Line Endings	Control what the instrument uses for line endings.	
RS Echo	This option if turned ON, will echo the characters when Addressing is set to OFF.	
Addressing	For use with multiple instruments on the same serial bus.	

Table 16 - Miscellaneous Settings

4.8.10 Field Elevation Adjustment

Please note that the Series 1300 Oxygen Deficiency Monitor automatically compensates for elevation when a new sensor is installed and therefore NO Field Elevation Adjustment is necessary.

A Field Elevation Adjustment is designed to compensate for any large ambient pressure changes resulting from a change in altitude. It is assumed that the sensor is relatively new and that the oxygen level present at the sensor being adjusted is at normal breathing air (or more specifically 20.9% oxygen by volume). To perform a field elevation adjustment:

1. Make sure the instrument has been powered for at least 30 minutes and that the sensor is exposed to ambient air (specifically 20.9% oxygen) for at least 10 minutes.
2. Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “MISCELLANEOUS” and then navigate into the sub menu “FIELD ELEVATION”. Scroll down below the warning and under the “FIELD ELEVATION” heading there is a list of enabled sensors. Navigate to the appropriate sensor name and press the ENTER button to initiate the field elevation. The value of 20.9 will show in the display. This value cannot be changed.
3. Press the ENTER button to accept the 20.9% value. Press the ENTER button a second time to confirm a Field Elevation Adjustment. Pressing the ESCAPE button at any time before confirming will cancel the Field Elevation. At this point the oxygen value should be reading 20.9% in the display.

Note: For optimum results upon **initial installation**, the monitor should be powered on for at least one (1) hour prior to all calibrations to allow all components to reach equilibrium at the prevailing ambient temperature. Subsequent calibrations after initial installation can be performed within minutes. See section 7 “Calibration Procedures” on page 48 for details.

IMPORTANT: Field elevation adjustment should only be done after the instrument is moved to an altitude that is more than 100 feet higher or lower than the initial installation location. Alpha Omega recommends that customers document the date, time, location and person performing the field elevation adjustment.

4.8.11 System Information (“SYSTEM INFO”)

The following information is shown in the system menu:

System Menu Item	Description
Factory Code	Temporary Code for service (only needed on request from factory)
User Code	User code received from factory to allow temporary factory access
Last Message	Status messages (see 10.3 Table 20)
Serial Number	Instrument
Sensor Serial numbers	Original Sensor(s)
PCB Serial Number	Main system printed circuit board
Date	Compiled Code Date
Time	Compiled Code Time

Table 17 - System Information

5 Data Logger

The data logger allows the capture of sensor information at user programmable intervals. The data logger may be configured to record any number of valid sensors connected to the instrument. The logger allows 3 different logging modes and easy download to a terminal program through the built in RS232 communications. To access the data logger features, enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “DATA LOGGER” and press the RIGHT or ENTER button to expand the “DATA LOGGER” sub-menu. Under the “DATA LOGGER” sub-menu heading there is a list of parameters. Navigate to the appropriate parameter and press the ENTER button to edit the parameter. Use the UP and DOWN buttons to change the parameter value. When finished, press the ENTER button then press ENTER again to confirm or press the ESCAPE button to cancel and revert to the previous setting. Below are a list of available parameters for operating the data logger.

5.1 Logger Operation

The data logger is very easy to use but is configurable for a number of options as described in this section.

5.1.1 Logger State

The data logger has 3 different states as shown below. These states allow the user to start and stop the data logger as well as download the data stored in the logger's memory.

STOP	Logger is stopped and will not log data
RUN	Data Logger is running and storing selected sensor data as the programmed interval
PRINT	The data stored by the data logger is sent out on the RS232 communications line

When entering “PRINT” operation be sure that the communications port is open and the terminal program is set to receive the information. Due to the large amount of data that can be produced over a long term logging session, it is recommended that the data be captured to a file. The time to download the file may be up to 10 minutes if the logger is completely full.

Note: the “PRINT” command will output the data and then automatically enter the “STOP” state.

Note: the “RUN” command will NOT allow any other logger commands EXCEPT “STOP” and “PRINT”.

Note: the “PRINT” command will output “logger empty” if no data has been logged. The previously logged data is available and can still be printed until a new “RUN” command is executed.

5.1.2 Logger Mode

Before the logger is set to “RUN”, the mode of operation should be set. The logger has 3 modes of data collection as follows:

LIVE	Stores data to both the instrument as well as outputs the data to the RS232 port.
START/STOP	The data will log until memory is full. When memory is full the logger will stop storing new information
CONTINUOUS	The data logger will store data and continuously overwrite the oldest data in memory.

5.2 Sample Interval

Before the logger is set to “RUN”, the sample interval should be set. The value can be set from 1 to 60 seconds. Data will be stored for the selected sensors every sample interval based on the data logger mode.

The approximate number of samples is determined by the number of sensors logged and the interval length. Estimates are shown in the table below:

Number of Sensors	Interval of 1 second	Interval of 60 seconds
1	26.88 hours	67.2 days
2	13.44 hours	33.6 days
3	8.96 hours	22.4 days

For the optional extended memory logger, the length of time will be:

Number of Sensors	Interval of 1 second	Interval of 60 seconds
1	72.391 hours	180.978 days
2	36.196 hours	90.489 days
3	24.130 hours	60.326 days

5.3 Date And Time

When the data logger is set to PRINT, the Series 1300 Oxygen Deficiency Monitor will use the date and time set here to calculate the time stamp. If the optional time stamp is turned off, there is no reason to set the time.

Parameter	Description	Format	Where:
Year	Set the Year	20YY	YY is 00-99
Month	Set the Month	MM	MM is 1-12
Day	Set the Day of the month	DD	DD is 1-31
Time	Set the Time	HH:MM	HH is 0-23, MM is 0-59

5.4 Sensor Selection

Before the logger is set to “RUN”, the Series 1300 Oxygen Deficiency Monitor is capable of supporting up to 3 oxygen sensors. Each of these sensors can be independently set for data logging.

Sensor#1	Select YES to log this sensor, NO to ignore
Sensor#2	Select YES to log this sensor, NO to ignore
Sensor#3	Select YES to log this sensor, NO to ignore

6 Sensor Setup

The Series 1300 Oxygen Deficiency Monitor can operate with up to three (3) oxygen sensors connected simultaneously. The Series 1300 can support one (1) oxygen sensor mounted locally to the main electronics enclosure and up to two (2) oxygen sensors mounted remotely.

Upon installation and if adding a sensor to an existing instrument, when a sensor is connected to the instrument is it automatically detected and the display will indicate “Wait” with a count-down timer of 30 minutes. The name if previously set will also show or if blank it will default to “SensorX” where X is the number of the sensor channel. Sensor 1 is the 1st Remote sensor, Sensor 2 is the 2nd Remote sensor, and Sensor 3 is the Local sensor.

All instruments are are shipped with their sensors unplugged and therefore need to be plugged in before use.

6.1 Sensor Removal

Assuming there is NO ALARM, if a connection to an enabled sensor is lost the “Alert” screen will display the following message with the first detected sensor:

This will repeatedly show for a short time then revert back to the "Home" screen.

WARNING

THIS MESSAGE CAN SERVE AS A WARNING THAT A SENSOR MAY HAVE BEEN UNINTENTIONALLY DISCONNECTED. ONLY DISABLE A SENSOR IF IT HAS BEEN INTENTIONALLY REMOVED FROM THE SYSTEM. ANY SUBSEQUENT CONNECTION OF THIS SENSOR WILL RESULT IN RECOGNIZING IT AS A NEW SENSOR.

Pressing the ENTER button at this alert screen will bring the user to the “Enabled?” parameter in the “SENSOR SETUP” menu. This is where the sensor can be disabled. Note: if temporarily removing a sensor for examination, DO NOT disable it here. If disabled, the instrument will detect any newly connected sensor as a NEW sensor. Therefore, if in the case of a temporary removal, simply ignore the alert (press the ESCAPE button) and place the sensor back into service when finished. The alert will automatically stop once the sensor is detected again.

If the sensor is being removed permanently or it is being replaced, then press the ENTER button to edit this parameter to disable it. Use the UP or DOWN buttons to change this parameter to “NO” and press the ENTER button to accept the new value. Press the ENTER button a second time to confirm the change or press the ESCAPE button to cancel all changes. This will remove the sensor and allow adding a new sensor.

DO NOT remove an old sensor, then ignore the “Enabled?” alert screen to only follow it by adding a new sensor. This will not allow the instrument to detect the new sensor and may require extra calibrations and result in more alerts.

7 Calibration Procedures

All Series 1300 Oxygen Deficiency Monitors have been fully calibrated at the factory prior to shipment. Upon first time installation, the sensors will need to be plugged in and the instrument will wait 30 minutes for each new sensor that is plugged in and then automatically calibrate for the ambient conditions. Therefore there is typically NO need for any elevation adjustment unless moving an instrument from one location to another with a significant change in elevation.

7.1 Routine Calibration Check

Routine maintenance is kept to a minimum. As is the case with all gas monitors, it is advisable to periodically check the overall system calibration. The frequency of these checks is often determined by in-house calibration protocols. If none exists, Alpha Omega Instruments Corp. recommends that a calibration check be made on average once every 3-6 months. In time, if this frequency is extended, it should never go beyond checking the monitor at least every six months. Given the importance of the requirement, calibration checks are prudent. It is advisable that a written log be kept to document the frequency of calibration checks and or changes. Individual calibration procedures are detailed on the following pages.

7.2 Oxygen Calibration

A single calibration point at 20.9% oxygen concentration by volume is all that is required provided the calibration is performed correctly. No zero gas adjustment is required.

Note: For optimum results the instrument should be powered on for at least 30 minutes prior to all calibrations to allow all components to reach equilibrium at the prevailing ambient temperature. Subsequent calibrations can be performed within minutes. The sample gas should be exposed to the sensor (or flowing) for at least 10 minutes prior to calibration.

7.2.1 Calibration With Ambient Air

The Series 1300 Oxygen Deficiency Monitor has a measurement range of up to 30% and is designed to monitor ambient breathing air at 20.9%. This is the desired calibration concentration. 20.9% oxygen by volume is a convenient calibration source since it is what we typically breath in an open air environment. However, if using ambient air, it is essential that the quality of the ambient air used for calibration NOT BE TAINTED by other gases in the surrounding environment. If the composition of the air is unknown then it is imperative that the sensor be calibrated in a location that is not affected by any leakage of stored gases. A large office environment or an area exposed to fresh outside air is ideal.

7.2.2 Calibration With Other Gases

If a fresh air supply is not available, it is recommended that an oil free certified standard, or primary standard of cylinder gas containing a concentration of 20.9% oxygen/balance of nitrogen be used for calibration. Please do not use plant air, or any other types of compressed air as oxygen concentrations may contain a value other than 20.9%, and therefore could result in an incorrectly calibrated monitor. Most major gas manufacturers are able to prepare certified or primary standard grade binary calibration gases containing a mixture of 20.9% oxygen with the balance of nitrogen.

IMPORTANT: The Alpha Omega Instruments Optional Calibration Fixture is required when using a pressurized gas to check calibration. The Calibration Fixture (P/N 13-CFN) is available from the factory and is designed to thread into the sensor gland in place of the existing nut so that it can be used and then removed for later reuse. Simply install it in place of the existing nut that holds the

sensor inside the gland located at the bottom of the enclosure. The fixture is equipped with inlet and outlet quick connect fittings that all the user to connect a source of gas with a control valve to maintain the sample flow to the inlet of the calibration fixture between 0.2 and 1 SCFH (0.1 and 0.5 LPM). Please refer to section 7.4 Optional Calibration Fixture below for more information.

7.2.3 Procedure For Checking Oxygen Calibration

To Perform a Routine Calibration Check

1. Make sure the instrument has been operating for a minimum of 5 minutes.
2. When measuring a fresh source of ambient air, the reading from the front panel should be at 20.9%, ±0.3% (this is the stated error specification of the Series 1300 Oxygen Deficiency Monitor).
3. If the monitor is reading within acceptable limits, no further action is required. If the monitor is not reading within these limits, perform a calibration adjustment as described in the next section.

7.3 Calibration On Ambient Air

Important: If using a pressurized gas sample for calibration, please refer to section Optional Calibration Fixture before proceeding.

To perform a calibration adjustment on ambient air:

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “CALIBRATE”. Under the “CALIBRATE” heading there is a list of enabled sensors. Navigate to the appropriate sensor name and press the ENTER button to edit the parameter. Adjust the value for 20.9% and press the ENTER button to store this parameter or press the ESCAPE button to cancel all changes. Press the ENTER button a second time to confirm the Calibration.

7.4 Optional Calibration Fixture

To perform a calibration check using a cylinder of gas containing 20.9% oxygen, use the Optional Calibration Fixture (P/N 13-CFN). The Calibration Fixture attaches to the bottom of the oxygen sensor mounting gland. Refer to section 16 APPENDIX E – Remote with Calibration Fixture on page 73 for a view of the Calibration Fixture. Please note that the Optional Calibration Fixture works on both Local and Remote sensors.

To Attach the Optional Calibration Fixture:

1. Temporarily remove and save the existing sensor retaining nut.
2. Replace the retaining nut with the Calibration Fixture.
3. Using 3/16” ID flex tubing, insert the tubing into one of the two quick-connect gas fittings. Make sure that the tubing delivering the calibration gas is free of cracks, splits, and defects. Before connecting the gas delivery tube to the inlet of the calibration fixture, place a flow meter in line.
   Important:
4. Establish a sample flow rate of approximately 0.2 to 1 SCFH (0.1 to 0.5 LPM) before connecting the tubing to the calibration fixture. This prevents inadvertent over pressurization that may permanently damage the sensor (not covered under warranty).

Once the calibration gas is flowing to the sensor, allow the reading to come into equilibrium before proceeding with any adjustments. The factory recommends that the calibration gas should be flowing to the sensor for at least 10 minutes before the readings are monitored to determine if equilibrium conditions have been established. When checking the accuracy of the Series 1300 Oxygen Deficiency Monitor, Alpha Omega Instruments highly recommends using an oxygen concentration of 20.9%. **In all cases, be sure to obtain a steady reading for at least 10 minutes before making**

adjustments to the calibration. Once equilibrium has been established, perform the procedure described in section 7.3 Calibration on Ambient Air on page 49.

After using the Calibration Fixture, be sure to remove it and re-install the sensor retaining nut before operating the monitor.

WARNING

WARNING! RE-CALIBRATING A SENSOR TO 20.9% OXYGEN WHILE EXPOSED TO A VALUE OTHER THAN 20.9% WILL CAUSE THE INSTRUMENT TO PRODUCE A FALSELY ACCEPTABLE READING DURING A POTENTIALLY DANGEROUS OXYGEN DEFICIENT SITUATION.

7.5 NO Zero Adjustment

Alpha Omega Instrument's electrochemical oxygen sensor has been zero adjusted at the factory. One of the features associated with the oxygen sensor is its specificity for oxygen molecules. When no oxygen is present in the sample gas, the output of the sensor is zero. As a result, zero calibration is not recommended.

7.6 Change Oxygen Sensor Notice

If the oxygen sensor has been calibrated outside of a predetermined range, the instrument will display the "Alert" screen which will show "ATTENTION!" "REPLACE Sensor Name" on the display. The "Alert" screen will appear for about 15 seconds once every 30 minutes after the initial message. Use either the LEFT or RIGHT button while on the "Home" screen to navigate to the "Alert" screen. This message is used to inform the user that a calibration has been performed beyond a predetermined value and is indicating that the output of the sensor has deteriorated to the point that the oxygen sensor should be replaced. Be aware that this message will also appear if the sensor has been accidentally calibrated to a value beyond a predetermined point. For example, if the oxygen sensor was being exposed to a 90% gas and was accidentally calibrated to a value of 20%, the "REPLACE Sensor Name" alert will appear, simply recalibrating the oxygen sensor to the correct value will clear the alert. A typical example of a deteriorated sensor is when the oxygen sensor is displaying a value of 12% when exposed to a 30% gas. A calibration to 30% at this point will show the "REPLACE Sensor Name" alert.

7.6.1 Replacing A Sensor

Follow the procedure below for properly replacing an oxygen sensor.

1. While the instrument is powered, disconnect the sensor from the instrument. From the main electronics enclosure, simply locate the sensors cable and disconnect near the left side wall tie down. For a remote sensor, locate the remote electronics board and simply disconnect the sensor cable from the printed circuit board.
2. Disconnecting the sensor will cause the instrument to alert the user in the form of an "Alert" screen message. Example:

Under normal operation, this warning would indicate a low oxygen value, however when removing a sensor, simply ignore this message and press the Enter button to go to the Main Menu to disable the sensor by proceeding to the "Enabled?" parameter in the "SENSOR SETUP" menu. Press the

ENTER button to edit this parameter. Use the UP or DOWN buttons to change this parameter to “NO” and Press the ENTER button to accept the new value. Press the ENTER button a second time to confirm the change or press the ESCAPE button to cancel all changes. Pressing ESCAPE will cause the instrument to continue the alert until the **ORIGINAL** sensor is placed back on. **DO NOT install a new sensor while the instrument is in the alert mode as this will bypass the automatic sensor configuration. ALWAYS DISABLE AN OLD SENSOR BEFORE REPLACING!**

3. Unscrew the sensor mounting gland in a counter clockwise direction to loosen it, this will allow the sensor to be removed **from the top side (inside of the enclosure)** of the mounting gland.
4. Remove the old sensor and replace with a new one.
5. Slide the sensor inside the mounting gland from the top side of the gland (inside of the enclosure).
6. Before connecting the sensor's cable, secure the mounting nut by turning it in a clockwise direction. The sensor may rotate until tight. Make sure the nut is tight so the sensor does not slip down. The top of the sensor should be flush with the top of the inside cable gland nut.
7. Reconnect the sensor cable to either the local cable connector or the remote electronics board connector.
8. Replace the cover and wait for the sensor(s) timer(s) to count down. When finished the sensor(s) will be ready for use and should read 20.9% oxygen. No calibration is necessary if installed in a location with fresh ambient air.

8 Battery Backup

The Battery Backup option is designed to power the Series 1300 Oxygen Deficiency Monitor in the event that power is temporarily interrupted. To accomplish this, the instrument is fitted with a battery pack and a battery monitoring printed circuit board. This is a factory installed option.

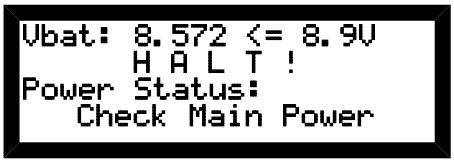
	WARNING
	BATTERIES ARE CHARGED AND NOT CONNECTED BEFORE LEAVING THE FACTORY. AFTER ALL WIRING IS COMPLETED AND JUST PRIOR TO APPLYING MAIN POWER, PLEASE OPEN THE COVER AND CONNECT THE BATTERY CONNECTOR BEFORE USE. THE INSTRUMENT SHOULD TURN ON AND START TO INITIALIZE. APPLY THE MAIN POWER TO INSURE THE BATTERY REMAINS CHARGED.

The battery pack used for this option utilizes Nickel Metal Hydride technology and is kept charged via an internal trickle charge circuit. This circuit will continue to charge the battery while the main power source is available.

Should the main source of power be removed, the Series 1300 Oxygen Deficiency Monitor will continue to run on the remaining battery backup power until such time the battery pack cannot adequately power the instrument. At this time, the Series 1300 Oxygen Deficiency Monitor will initiate a temporary “HALT” condition.

8.1 Battery Backup HALT

The “HALT” condition is the time just before the Series 1300 Oxygen Deficiency Monitor will automatically shut down the instrument to avoid over-discharging the battery pack. During the “HALT” condition, the Series 1300 Oxygen Deficiency Monitor will display a “HALT” screen as shown below.



HALT Condition (<8.6V)

No user entry will be accepted in this condition. The “HALT” screen will remain visible until the power reaches the point where the instrument must be shut down OR either the main source of power is available again or the battery recovers past 8.9V for some reason. If the main source of power becomes available before the automatic shut down, the instrument will automatically revert to normal operation and begin charging the battery.

8.2 Battery Backup Time

The battery backup time is dependent on the system configuration. Items which will decrease the battery backup time include:

1. Active alarms that energize any of the four selectable alarm relays.
2. Active alarms that energize any horn and strobes.
3. Connection of any 4-20mA process outputs.

CAUTION

CHARGE THE BATTERIES FOR AT LEAST 16 HOURS BEFORE USE TO INSURE THE MAXIMUM OPERATION TIME. BATTERIES ARE DISCONNECTED AT THE FACTORY BEFORE SHIPPING.

If main power were to fail, the monitor will continue to operate for a minimum of 30 minutes if properly charged for 16 hours. This includes all relays energized, both process outputs at their maximum outputs, and all four (4) horn and strobes energized at their highest rated outputs.

WARNING

THE SERIES 1300 OXYGEN DEFICIENCY MONITOR WILL POWER UP TO FOUR (4) ALPHA OMEGA INSTRUMENTS SUPPLIED HORN AND STROBES. ANY EXTERNALLY POWERED ALARM DEVICES (NOT DIRECTLY POWERED BY THE SERIES 1300) WILL NOT BE BACKED UP BY THE SERIES 1300 BATTERY BACKUP.

NOTE

MINIMUM OPERATING TIME IS BASED ON A BATTERY THAT HAS BEEN SUBJECT TO A MINIMUM 16 HOUR CHARGE TIME.

Minimum operating times can be much lower if not fully charged. See Table 18 - Battery Backup Minimum Operating Times below for actual worst case measured values.

CHARGE TIME	*MINIMUM OPERATING TIME*
4 Hours	25 minutes
8 Hours	35 minutes
16 Hours	40 minutes
16 Hours	6 Hours (No Alarms)

Table 18 - Battery Backup Minimum Operating Times

8.3 Battery Status Screen

When the battery backup option is factory installed there are various messages that will display on the “Alert” screen during certain events.

1. When AC power to the instrument is disconnected or lost due to a power outage the “Alert” screen will read “MAIN POWER LOST” to inform the user that the instrument is now running under battery power. Pressing the ENTER button while on the “Alert” screen will display the current battery voltage level, pressing the ESCAPE button will exit back to the “Home” screen. The “Alert” screen will show for five (5) seconds seconds at a time every fifteen (15) seconds.
2. When the battery voltage has dropped to a critical level the instrument will enter into a “HALT” condition in which it will no longer operate, the message “HALT” will be displayed on the screen and an indication of critical voltage level. The instrument will shut down shortly after this message is displayed.
3. When the instrument is powered from AC power and the battery is disconnected or the voltage is below a critical level the “Alert” screen will read “CHECK BATTERY”. Pressing the ENTER button while on the “Alert” screen will display the “Battery Status” screen. The “Battery Status“ screen will show the current battery voltage level along with the charging status of the battery. Pressing the ESCAPE button will exit back to the “Home” screen. The “Alert” screen will show for 30 seconds at a time every 60 seconds until the specific alert is addressed.

The Battery Status Screen can have the following informational screens.

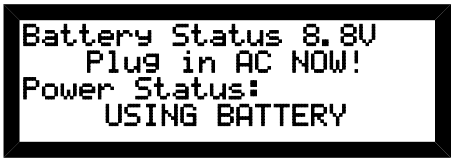
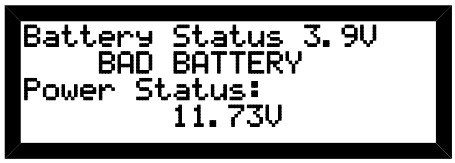
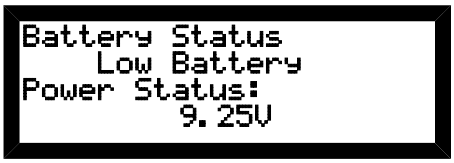
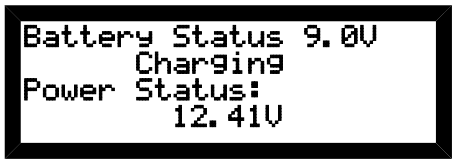
 No Battery detected	 Battery is very low and is about to halt the system (8.6 to 8.9V)
 Critically Low Battery (4 to 6V)	 Low Battery (<9.5V)
 Powered and Charging	 On Battery Power (9.5 to 11.0V)

Table 19 - Battery Status Screens

To enter the “Battery Status” Screen, either press the arrow buttons until the “Battery Status” Screen appears or press the ENTER button when on the “Alert” Screen during a battery alert message.

9 Warnings

This section discusses some of the circumstances that may be present and must be addressed before making a decision when using the Series 1300 Oxygen Deficiency Monitor. Please read the following sections carefully to insure that the monitor is being used properly and safely.

9.1 Alarm Warnings

Each alarm warning is unique, but the most common alarm for an Oxygen Deficiency Monitor monitor is the “Low Alarm” setting. When this alarm is set properly, the user or users are alerted to a deficiency in the amount of oxygen in the immediate area of the sensor. This may indicate an unsafe condition for the user and should be taken seriously as injury or death could result if not properly handled.

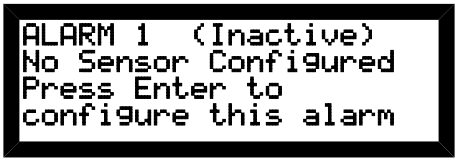
Low Alarm

Scenarios abound but when an alarm sounds, it is prudent to evacuate the area and assess the situation.

Same this is true for a “High Alarm”. Even though there is sufficient oxygen to breath, the oxygen levels may have gone over the maximum reading of the monitor and could result in a highly flammable situation.

High Alarm

Most dangerous of all is the case where ALL alarms are either disabled because of bogus settings, or worse, none have been configured properly for a sensor as shown below.



Disabled Alarm (No Sensor selected)

9.2 Sensor Removal Warnings

There are three scenarios when the Series 1300 Oxygen Deficiency Monitor will alert to dangerous low oxygen levels.

9.2.1 Scenario 1 – Dangerous Low Oxygen Level

This scenario is indicating a dangerous low oxygen level. Take appropriate action.

9.2.2 Scenario 2 – Disconnected Oxygen Sensor

If the alert has been determined not to be low oxygen event, please verify that the alert is a result of a disconnected oxygen sensor.

- **Do not enter the area in question without checking the oxygen level (verify oxygen level with a separate working oxygen monitor).**
- Physically check the oxygen sensor as this alert could be a result from damage to the sensor, a potential electrical problem (example would be a damaged cable), or a non-functioning sensor.
- If scenario 1 & 2 have been verified not to be the cause of the alert, more likely the user is removing a sensor.

9.3 Horn And Strobe Warnings

There are two warnings associated with the horn and strobe.

9.3.1 Horn And Strobe Removal

Warning, disabling a horn and strobe could lead to an unsafe condition.

9.3.2 Horn And Strobe Address Change

The following screen should never appear. This message indicates that the address for the horn and strobe has changed while powered. It is imperative to check the installation and configuration of all horn and strobes to determine the cause of this failure.

Pressing Enter here will not do anything.

WARNING

CHANGING A HORN AND STROBE ADDRESS WHILE POWERED COULD LEAD TO AN UNSAFE CONDITION.

10 Maintenance and Troubleshooting

10.1 User Maintenance

The Series 1300 Oxygen Deficiency Monitor requires minimum user maintenance. The user should check that the calibration of the monitor is in accordance with established calibration protocols. If no protocol exists, Alpha Omega Instruments recommends that the monitor be calibrated every 3-6 months.

10.2 Serviceable Items

End user serviceable items located inside the chassis include the oxygen sensor and the optional battery pack used for the battery back-up option.

For Battery replacement/installation, please see APPENDIX G – Battery Backup on page 78 for more information.

RISK OF SHOCK

WARNING: ELECTRICAL SHOCK HAZARD: DANGEROUS VOLTAGES ARE PRESENT WITHIN THE INSTRUMENT. REMOVE ALL POWER SOURCES WHEN INSTALLING OR REMOVING CONNECTIONS AND WHEN PERFORMING ANY WORK INSIDE THE INSTRUMENT ENCLOSURE.

10.3 System Messages

The Series 1300 Oxygen Deficiency Monitor will store a system message in memory in the event that something happened or there was a problem like a syntax error on the RS interface. This can be useful to diagnose any problems by checking that there are no known problems.

The system messages that can appear in the system menu are listed in Table 20. Some messages will respond with a hexadecimal number and can be relayed to the factory for further help.

Message	Description	Information
M:ias	Invalid annunciator state	Ignored and corrected, notify factory
M:dit	Display, invalid type	Ignored, shows error on display. Notify factory
M:ece	Elevation calibration error	Verify proper calibration before using instrument (no change to calibration)
M:cpe	Cursor position error	Corrected automatically
M:ime	Initialization memory error	Memory is restored from non-volatile copy, notify factory
M:u#l	Unit number line undefined	Ignored, notify factory
M:u#t	Unit number token undefined	Ignored, notify factory
M:sas	Serial addressing syntax	Command Ignored, check addressing syntax X: or XX: is valid where X is number from 1 to 32
M:sbo	Serial buffer over-run	Automatically recovers by clearing buffer. Limit input to 80 characters.
M:srs	Serial read syntax error	Check format, wrong number of characters
M:sws	Serial write syntax error	Check format, wrong number of characters
M:sic	Serial, invalid char	Command Ignored, check data entry for errors or strange characters (Allowed characters: 0-9, a-z, A-Z, otherwise ASCII decimal codes 8 (Backspace), 10 (Line Feed), 13 (Carriage Return), 32 to 127 (20H to 7FH).
M:sit	Serial, Invalid token	Command Ignored, check syntax and data address
M:swt	Serial write type invalid	Command Ignored, check syntax and data address
M:ak1	Horn and Strobe comm.	Check wiring and/or addressing on Horn and Strobes
M:ak2	Horn and Strobe comm.	Check wiring and/or addressing on Horn and Strobes
M:dll	Data line low	Check wiring of Horn and Strobes
M:nnf	Unknown flag	Ignored
M:chi	Erroneous high calibration flag	Ignored
M:fbt	Menu initialization error	Ignored, notify factory
M:drp	Default running page error #	Ignored and corrected, notify factory
M:ndf	Invalid default flag	Ignored, notify factory
M:rps	Replace Sensor Numbers	Informational only
M:ash	Horn and Strobe Comm.	Check wiring to Horn and Strobes
M:mem	Memory mismatch	Contact Factory
M:pwd	User code mismatch	Ignored
M:bus	Bad serial bus request	Contact Factory

Table 20 - System Messages

11 Serial Communications

NOTE: For safety reasons the instrument cannot be calibrated using serial communications.

The serial communications option allows complete control of the Series 1300 Oxygen Deficiency Monitor via the serial port by means of a simple protocol that can be used either manually or through the use of programming. Manually entering data is very easy and follows simple rules. Please see section 11.5 Standard Commands below for more information.

11.1 Baud Rates

RS-232/RS-485 Serial communication baud rates are 115200, 57600 (default), 38400, 28800, 19200, 9600, 4800, and 2400.

11.1.1 Setting The Baud Rate

Enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “Misc Settings”. Under the “Misc Settings” heading there is a list of parameters. Navigate to the “Baud Rate?” parameter and press the ENTER button to edit the parameter. Use the UP and DOWN buttons to change this parameter to any of the available baud rates listed above. Press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button to confirm changes or press the ESCAPE button to cancel all changes.

Note: The baud rate will change immediately, therefore any communications equipment connected to the RS232/485 output should also be set accordingly to continue communicating correctly and avoid garbled data.

11.2 Line Endings

Under the same menu heading as above, the user has the option to change the default line ending for all communications via RS232 or RS485. The factory default is set for a carriage return and a line feed (CR/LF). This default should work in almost all cases. If the need arise to change the line ending because of an incompatibility with another system that expects different line endings, simply select the desired line ending.

11.3 RS Echo

This option simply echos everything received at the serial port. This may be helpful if entering values manually or if it is necessary to see comments that were sent as the instrument strips out any comments after a semi-colon.

11.4 Addressing

Addressing refers to a “multi-drop” scenario where more than one instrument is connected to a bus. This can be RS485 or a serial server. With more than one instrument on the same bus, it becomes necessary to address the individual instruments specifically to avoid having more than one instrument respond to a command that is sent to every instrument. By setting Addressing to ON simply tells the instrument to only respond to commands if the specific address chosen is prefixed to the command. The address is actually just a number from 1 to 32 and is available to change when the Addressing option is set to ON. If set to OFF, then no option to change the address is available.

To enable addressing for the instrument, enter into the “Main Menu” by pressing the ENTER button while on the "Home" screen. Navigate the menu until you reach the menu heading “Miscellaneous”. Under the “Miscellaneous” heading there is a list of parameters. Navigate to the “Addressing” parameter and press the

ENTER button to edit the parameter. Use the UP and DOWN buttons to change this parameter to either “YES” or “NO”. Press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button to confirm changes or press the ESCAPE button to cancel all changes.

11.4.1 Address

With addressing enabled the option to change the instrument's address becomes available just below the “Addressing” option. Navigate to the “Address” parameter and press the ENTER button to edit the parameter. Use the UP and DOWN buttons to change this parameter value from 1 to 32. Press the ENTER button to save this parameter or press the ESCAPE button to cancel all changes. If the parameter value was changed, press the ENTER button to confirm changes or press the ESCAPE button to cancel all changes.

Communicating with an instrument with addressing turned on requires the prefix of “**#[#]:**” where #[#] is a number between 1 and 32 representing the instrument's address.

For example: to communicate with an instrument that has an address set to “15”, the command to read the name of Sensor #1 would be:

```
15:*14081
```

The returned information should read the programmed name. In this case “Sensor1”:

```
14081='Sensor1'
```

NOTE: Instruments with addressing disabled will respond to commands without the addressing prefix. When addressing is disabled, only one instrument should be connected to the communications bus.

11.5 Standard Commands

There are only 2 commands for reading and writing all data to the Series 1300 Oxygen Deficiency Monitor. It is recommended to use a serial terminal program to easily interact with the monitor. Some programs available for free are RealTerm (www.realterm.sourceforge.net), Termite (http://www.compuphase.com/software_termite.htm), and CoolTerm (http://freeware.the-meiers.org/). Please note that these programs are only listed here as an optional free method to talk to the monitor. Alpha Omega Instruments Corp. has no affiliation with any of the software authors. There is no guarantee that the programs listed will be available or operate in accordance with desired functions. Alpha Omega Instruments Corp. offers NO WARRANTY and strongly suggests that the end user determine an adequate communications method and test it accordingly to their specific installation requirement.

11.5.1 Read

The Read command is the “*” symbol or asterisk. To read a value simply type the command followed by the parameter's address and press <ENTER> on the keyboard.

The syntax should look like the following:

```
*Address
```

For example, to read the “Passcode” to see if the menu is available, enter the following command:

```
*13086;Read the Passcode (Note: the semi-colon denotes an optional comment)
```

The returned information should read:

```
13086='1300'
```

Please refer to the following pages for a list of parameters and acceptable data that can be read from and written to the monitor. Specifically the table on the next page.

11.5.2 Write

The Write command is the “at” symbol or “@”. To write a value simply type the command followed by the parameter's address then the “=” symbol and the value for the parameter and press <ENTER> on the keyboard.

The syntax should look like the following:

```
@Address=Value
```

For example, to change the name of Sensor #1 to “LAB #1”, enter the following command:

```
@14081=LAB #1
```

11.6 RS485

RS485 requires that each instrument only respond to commands that are specific to that particular instrument. Therefore it is necessary to “address” them to avoid having responses coming from multiple instruments on the same RS485 bus. Note: RS232 can also be used with the following commands but must be connected by means of a special serial server that isolates the instruments to eliminate the restrictions in the RS232 protocol.

11.7 RS Security

There is a bit documented in the Variable Registers Table below that when set to '1' will disallow any RS communications and when addressing is OFF will prompt the user with the string “Secured”. This is useful to insure that accidental RS communications do not affect the monitor after it has been completely setup. To exit this mode, simply set the corresponding bit at the address documented below to '0'. The monitor will respond if addressing is OFF with a string “UN-Secured”.

11.8 Variable Registers Table

Address	Function	Data Type	Parameter Description	Notes
12545	R	Bit (0-1)	Sensor 1 Enabled (Remote 1)	
12546	R	Bit (0-1)	Sensor 2 Enabled (Remote 2)	
12547	R	Bit (0-1)	Sensor 3 Enabled (Local)	
12557	R/W	Bit (0-1)	Alarm 1 Type	0 = Low, 1 = High
12558	R/W	Bit (0-1)	Alarm 1 Latching	0 = NON-Latching, 1 = Latching
12559	R/W	Bit (0-1)	Alarm 2 Type	0 = Low, 1 = High
12560	R/W	Bit (0-1)	Alarm 2 Latching	0 = NON-Latching, 1 = Latching
12561	R/W	Bit (0-1)	Alarm 3 Type	0 = Low, 1 = High
12562	R/W	Bit (0-1)	Alarm 3 Latching	0 = NON-Latching, 1 = Latching
12563	R/W	Bit (0-1)	Alarm 4 Type	0 = Low, 1 = High
12564	R/W	Bit (0-1)	Alarm 4 Latching	0 = NON-Latching, 1 = Latching
12565	R/W	Bit (0-1)	Alarm 5 Type	0 = Low, 1 = High
12566	R/W	Bit (0-1)	Alarm 5 Latching	0 = NON-Latching, 1 = Latching
12567	R/W	Bit (0-1)	Alarm 6 Type	0 = Low, 1 = High
12568	R/W	Bit (0-1)	Alarm 6 Latching	0 = NON-Latching, 1 = Latching
12569	R/W	Bit (0-1)	Alarm 7 Type	0 = Low, 1 = High

12570	R/W	Bit (0-1)	Alarm 7 Latching	0 = NON-Latching, 1 = Latching
12571	R/W	Bit (0-1)	Alarm 8 Type	0 = Low, 1 = High
12572	R/W	Bit (0-1)	Alarm 8 Latching	0 = NON-Latching, 1 = Latching
12573	R/W	Bit (0-1)	Alarm 9 Type	0 = Low, 1 = High
12574	R/W	Bit (0-1)	Alarm 9 Latching	0 = NON-Latching, 1 = Latching
12575	R/W	Bit (0-1)	Relay 1 Fail-safe	0 = NON-Failsafe, 1 = Failsafe
12576	R/W	Bit (0-1)	Relay 2 Fail-safe	0 = NON-Failsafe, 1 = Failsafe
12577	R/W	Bit (0-1)	Relay 3 Fail-safe	0 = NON-Failsafe, 1 = Failsafe
12578	R/W	Bit (0-1)	Relay 4 Fail-safe	0 = NON-Failsafe, 1 = Failsafe
12582	R/W	Bit (0-1)	First DAC offset	0=0mA 1=4mA
12583	R/W	Bit (0-1)	Second DAC offset	0=0mA 1=4mA
12587	R/W	Bit (0-1)	Enable Sensor 1 for logging	0 = Not Enabled, 1 = Enabled to log
12588	R/W	Bit (0-1)	Enable Sensor 2 for logging	0 = Not Enabled, 1 = Enabled to log
12589	R/W	Bit (0-1)	Enable Sensor 3 for logging	0 = Not Enabled, 1 = Enabled to log
12590	R/W	Bit (0-1)	Enable Logger Time-stamp	0 = OFF, 1 = Enables time-stamp
12591	R/W	Bit (0-1)	Enable Security	0=OFF, 1=ON (ignore all)
12594	R/W	Bit (0-1)	Enable multi-drop (serial addressing)	0 = OFF, 1 = Addressing enabled
12801	R/W	Byte (0-255)	Select Sensor for Alarm 1	0=OFF, 1=Sensor1, 2=Sensor2, 3=Sensor3
12802	R/W	Byte (0-255)	Select Sensor for Alarm 2	
12803	R/W	Byte (0-255)	Select Sensor for Alarm 3	
12804	R/W	Byte (0-255)	Select Sensor for Alarm 4	
12805	R/W	Byte (0-255)	Select Sensor for Alarm 5	
12806	R/W	Byte (0-255)	Select Sensor for Alarm 6	
12807	R/W	Byte (0-255)	Select Sensor for Alarm 7	
12808	R/W	Byte (0-255)	Select Sensor for Alarm 8	
12809	R/W	Byte (0-255)	Select Sensor for Alarm 9	
12818	R/W	Byte (0-255)	Select Sensor for Output 1	0=OFF, 1=Sensor1, 2=Sensor2, 3=Sensor3
12819	R/W	Byte (0-255)	Select Sensor for Output 2	
12820	R/W	Byte (0-255)	Set Address from 1 to 32	
12821	R	Byte (0-255)	Sensors needing replacement bits	bit0=#1, bit1=#2, and bit2=#3
12822	R/W	Byte (0-255)	Enter Seconds for Logger interval	0 to 60
12823	R/W	Byte (0-255)	Set Year 20XX	0 to 99
12824	R/W	Byte (0-255)	Set Month	0 to 12
12825	R/W	Byte (0-255)	Set Date (Day of Month)	0 to 31

12831	R	Byte (0-255)	First 3 bits signify Sensors 1 to 3	
12832	R	Byte (0-255)	First 3 bits signify Sensors 1 to 3	
13086	R/W	Integer (0-65535)	Set to “1300” to access menu	
13087	R/W	Integer (0-65535)	Set Clock in minutes (24 hour time)	Hours*60+Minutes
13100	R/W	Integer (0-65535)	Set Baud Rate	See Manual
13101	R/W	Integer (0-65535)	Set or Read Logger Mode	0=Continuous 1=Start/Stop 2=Live
13102	R/W	Integer (0-65535)	Set or Read Logger State	0=Stop 1=Print 2=Run
13103	R/W	Integer (0-65535)	Set or Read default Main Screen	0 or 1
13106	R/W	Integer (0-65535)	Set desired Line Ending	0=CR/LF 1= 2= 3=
13844	R/W	float	Set Alarm 1 Trip point	
13845	R/W	float	Set Alarm 2 Trip point	
13846	R/W	float	Set Alarm 3 Trip point	
13847	R/W	float	Set Alarm 4 Trip point	
13848	R/W	float	Set Alarm 5 Trip point	
13849	R/W	float	Set Alarm 6 Trip point	
13850	R/W	float	Set Alarm 7 Trip point	
13851	R/W	float	Set Alarm 8 Trip point	
13852	R/W	float	Set Alarm 9 Trip point	
13853	R/W	float	Set Max DAC output 1	0 to 40
13854	R/W	float	Set Min DAC output 1	0 to 40
13855	R/W	float	Set Max DAC output 2	0 to 40
13856	R/W	float	Set Min DAC output 2	0 to 40
14081	R/W	string	Set Sensor 1 Name	
14082	R/W	string	Set Sensor 2 Name	
14083	R/W	string	Set Sensor 3 Name	
14098	R/W	string	Set Horn and Strobe 1 Name	
14099	R/W	string	Set Horn and Strobe 2 Name	
14100	R/W	string	Set Horn and Strobe 3 Name	
14101	R/W	string	Set Horn and Strobe 4 Name	
14102	R/W	string	Set Horn and Strobe 5 Name	
14103	R/W	string	Set Horn and Strobe 6 Name	
14104	R/W	string	Set Horn and Strobe 7 Name	
14105	R/W	string	Set Horn and Strobe 8 Name	

14123	R	string	Product	
14125	R	string	Serial Number of Sensors	13-XXXX, 13-XXXX, 13-XXXX
14127	R	string	Serial Number of PCB	
14129	R	string	Factory String	Not Available
14131	R	string	Factory Date	
14133	R	string	Factory Time	
14137	R/W	string	Enter User Code, Special Use Only	See section 4.8.11 System Information (“SYSTEM INFO”) on page 44
14139	R	string	Logger Start Time	
14140	R	string	Logger Max Time	
14141	R	string	Logger End Time	
14593	R/W	long int (32 bits)	Factory Alarm Flags	Currently Not Available
14594	R/W	long int (32 bits)		Currently Not Available
14595	R/W	long int (32 bits)		Currently Not Available
14596	R/W	long int (32 bits)		Currently Not Available
14597	R/W	long int (32 bits)		Currently Not Available
14598	R/W	long int (32 bits)		Currently Not Available
14599	R/W	long int (32 bits)		Currently Not Available
14600	R/W	long int (32 bits)		Currently Not Available
14601	R/W	long int (32 bits)		Currently Not Available
16641	R	Bit (0-1)	Alarm Status 1 thru 9	0 = NOT active 1 = ACTIVE
16642	R	Bit (0-1)		
16643	R	Bit (0-1)		
16644	R	Bit (0-1)		
16645	R	Bit (0-1)		
16646	R	Bit (0-1)		
16647	R	Bit (0-1)		
16648	R	Bit (0-1)		
16649	R	Bit (0-1)		
16669	R/W	Bit (0-1)	Print front screen on terminal	1=Print screen
16670	R/W	Bit (0-1)	0=No Echo 1=Echo characters typed at terminal	Does not work in Addressing Mode
17921	R	float	Oxygen Value for Sensor 1	
17922	R	float	Oxygen Value for Sensor 2	
17923	R	float	Oxygen Value for Sensor 3	
18179	R	string	System Message String	See Manual

Table 21 - Variable Registers

11.9 RS Data Logger

When activated the built in data logger will log an oxygen level range of 0 to 25% for all chosen sensors. The data logger interval can be set for any value between 1 and 60 seconds in 1 second increments. Estimated available logging time is shown in the table below.

Number of Sensors	Interval of 1 second	Interval of 60 seconds
1	18 hours	45 days
2	9 hours	22 days
3	6 hours	15 days

Table 22 - Logger Time / Interval Estimates

The data logger can run in 3 different modes. “Start/Stop”, “Continuous”, and “Live”.

1. **Start/Stop** mode will log the sensor readings until the memory is full.
2. **Continuous** mode will log the sensor readings while continuously over-writing the oldest data stored in memory.
3. **Live** mode outputs the sensor readings to the customers terminal at the set interval. The previous history can also be printed.

Setting up and accessing the data logger is done through the RS232 communications. Please reference the table below for commands.

Command	Name	Type	Options	Description
@12587=b	Tb_LOGGER_SENSOR1_ENABLED	bit	0,1 (NO, YES)	Log sensor 1
@12588=b	Tb_LOGGER_SENSOR2_ENABLED	bit	0,1 (OFF, ON)	Log sensor 2
@12589=b	Tb_LOGGER_SENSOR3_ENABLED	bit	0,1 (OFF, ON)	Log sensor 3
@13101=B	TE_LOGGER_STATE	Byte	Stop (0), Print (1), Run (2)	Print Logger, automatically stops if running
@13100=B	TE_LOGGER_MODE	Byte	Continuous (0), Start/Stop (1), Live (2)	Set to Continuous Mode
@12822=BB	TB_LOGGER_SECONDS_INTERVAL	Byte	0 to 60	Set Sample Interval in seconds
@12590=b	Tb_LOGGER_ENABLE_TIMESTAMP	bit		Turn Time stamp On/Off

Table 23 - Logger RS Commands

The data is output in a format that is compatible with “comma separated values” or “CSV” file format. To create a graph of the data, it highly recommended to use plot.ly (a website) that allows loading a CSV file and plotting the data “in the cloud”. The data is also easily imported to any program that supports CSV file formats. Examples include Microsoft Excel, LibreOffice Calc, Gnumeric, and DataPlot software programs. Note that the latter DataPlot program handles the data much faster than the spreadsheets due to the large amount of data that might be logged over a long period of time. Once imported the data can be opened and graphed according to the specific programs instructions.

Logged data will have a time stamp (if enabled in menu) and the oxygen values for all oxygen sensors selected.

12 APPENDIX A – Main Enclosure Template

NOTE! Please verify both dimensions before using as template as changes to the scale may occur during printing or copying.

Figure 30 - Main Enclosure Template

13 APPENDIX B – Remote Enclosure Template

NOTE! Please verify both dimensions before using as template as changes may occur during printing or copying.

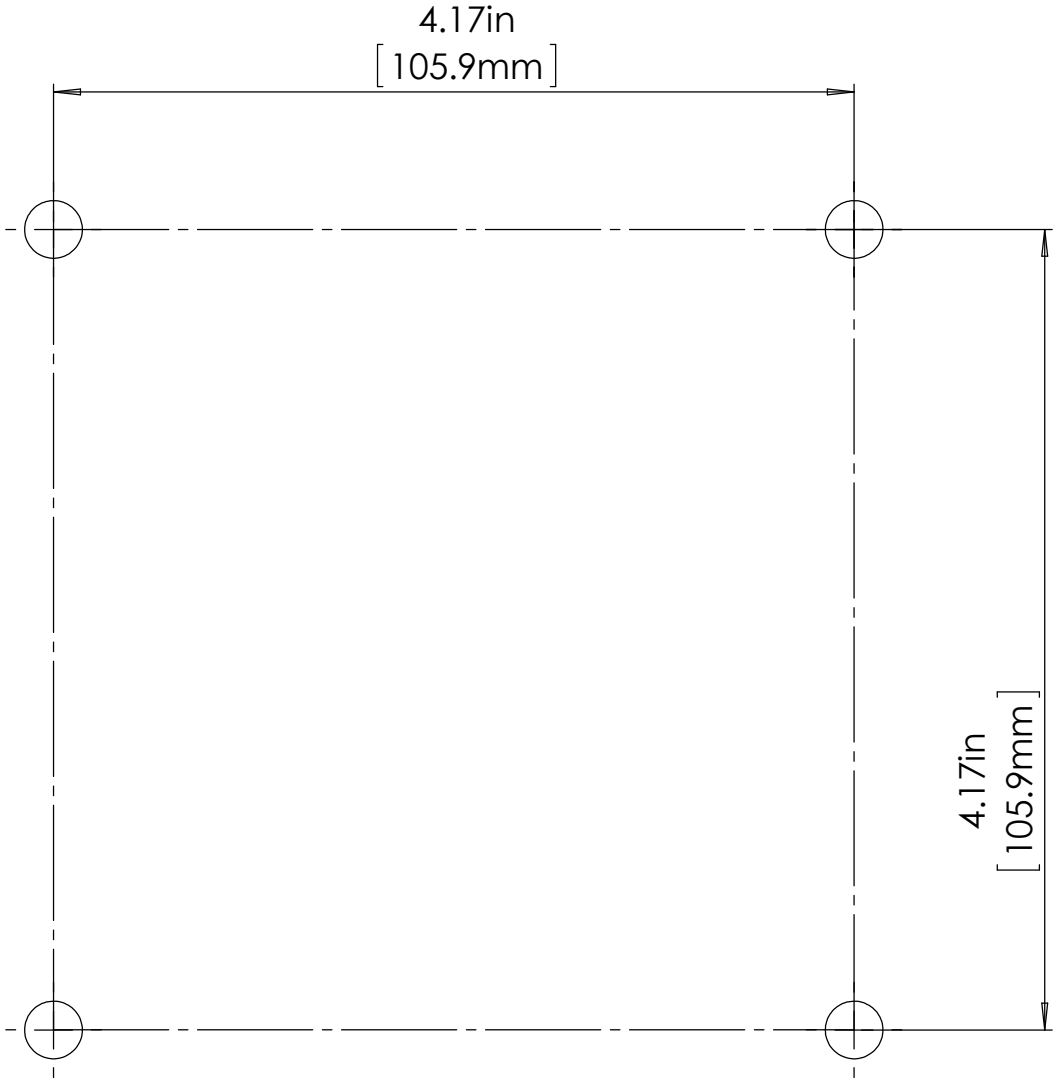


Figure 31 - Remote Enclosure Template

14 APPENDIX C – Terminal Block Reference

The first three (3) connectors inside on the left are designated as the power input connectors. See below for assignments for AC or DC connections.

NOTE: Power must be specified at the time of order.

14.1 Standard AC Connections

The Series 1300 can be powered from an AC signal of 90 to 265VAC 50/60Hz. Connect to the AC power terminal block as follows.

Terminal Block TB1	Connection
L	AC Line
G	AC Chassis Ground
N	AC Neutral

Optional DC Connections:

The Series 1300 can be optionally powered from a nominal 24V (18-36V) DC signal. Connect to the DC power terminal block as follows.

Terminal Block TB1	Connection
+	DC Positive
G	Chassis Ground
-	DC Return

14.2 Remote Sensor And Horn And Strobe Connections

Terminal Block TB1	Signal	Connects to:
1	Cable Shield	Shield of Remote cable
2	Remote Sensor 1 Positive	Remote Electronics Terminal VIN
3	Remote Sensor 1 Return	Remote Electronics Terminal VOUT
4	Cable Shield	Shield of Remote cable
5	Remote Sensor 2 Positive	Remote Electronics Terminal VIN
6	Remote Sensor 2 Return	Remote Electronics Terminal VOUT
7	Cable Shield	NC
8	Cable Shield	Shield of horn and strobe cable
9	horn and strobe Positive	horn and strobe Terminal V+
10	horn and strobe Data	horn and strobe Terminal DAT
11	horn and strobe Return	horn and strobe Terminal GND

14.3 PCB Connectors

TB2, TB3, and TB4 are used for process outputs and relay contacts.

Terminal Block	Pin	Signal	Description
TB2	1	Analog Output 1	Return
	2		Positive
	3		Shield
	4	Analog Output 2	Return
	5		Positive
	6		Shield

Terminal Block	Pin	Signal	Description
TB3	1	Relay 1	Normally Closed Contact
	2		Common Contact
	3		Normally Open Contact
	4	Relay 2	Normally Closed Contact
	5		Common Contact
	6		Normally Open Contact
TB4	1	Relay 3	Normally Closed Contact
	2		Common Contact
	3		Normally Open Contact
	4	Relay 4	Normally Closed Contact
	5		Common Contact
	6		Normally Open Contact

15 APPENDIX D – Horn and Strobe(s)

15.1 Externally Powered Horn And Strobe(s)

For powering horn and strobe(s) from an external DC power source please follow these instructions:

1. If wiring more than four (4) horn and strobes then choose which horn and strobes will be powered externally. Four (4) can be powered directly from the main electronics using the standard power supply.
2. Wire the external power supply positive (+) to J5, pin 1 labeled “EXT PWR +”.
3. Wire the external power supply negative (-) to J5, pin 2 labeled “EXT PWR -”.

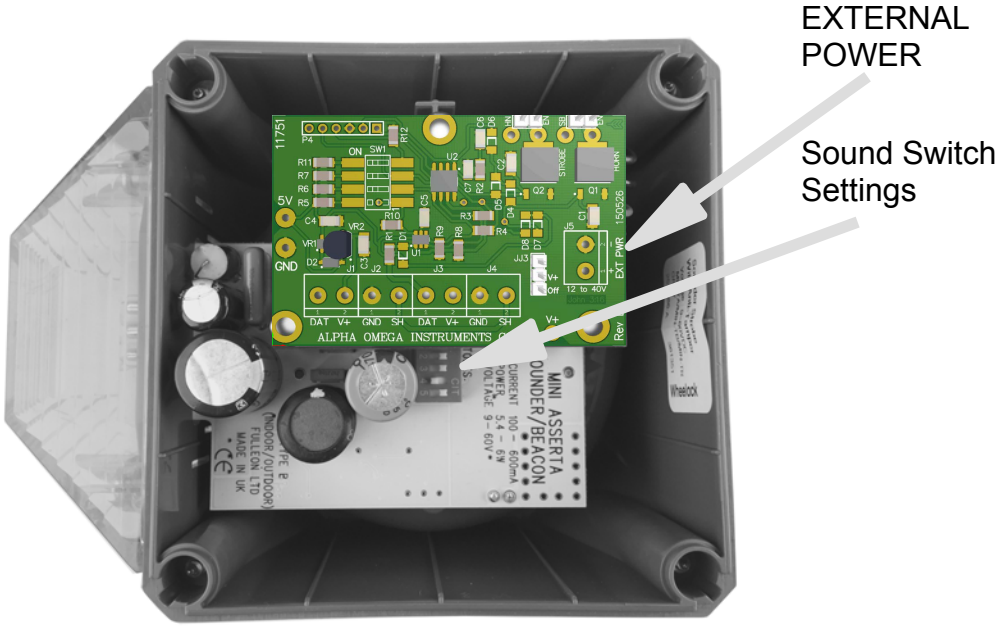
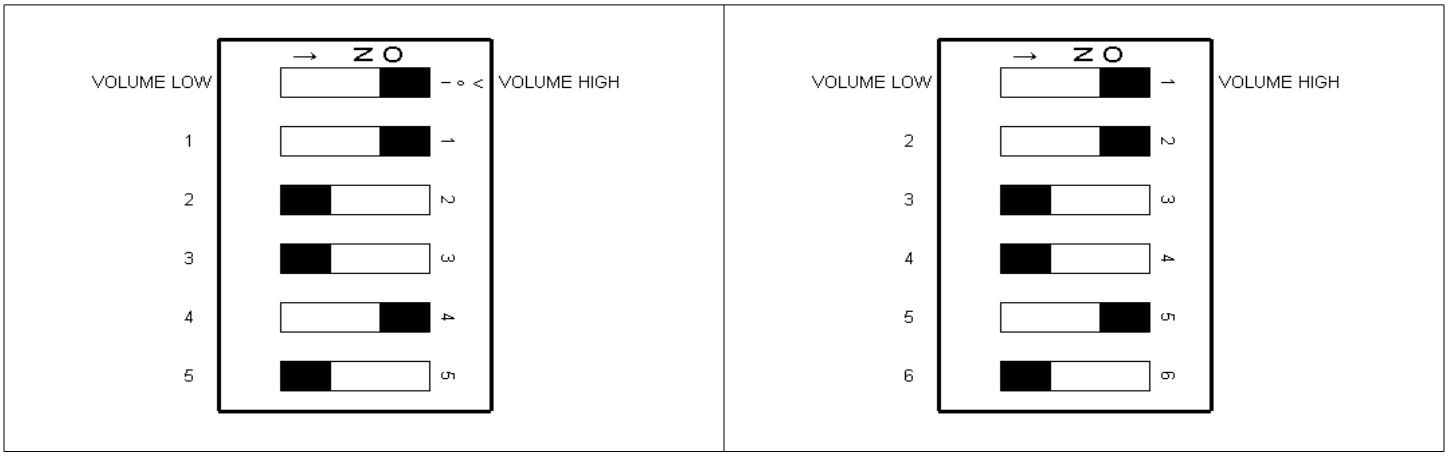


Figure 32 - Horn And Strobe PCB Wiring Diagram

15.2 Horn And Strobe Sound Switch Settings

The “Sound Switch Settings” switch bank is located beneath the Horn and Strobe PCB as shown in Figure 32 - Horn and Strobe PCB Wiring Diagram above. There are two variations as shown below:



Please note that the first switch is the HORN VOLUME and defaults to HIGH. The other five (5) switches control the tones as listed in Table 24 - Horn and Strobe Sound Switch Settings.

15.3 Horn And Strobe Tone Settings

Shown below are the switch selectable tones on the horn and strobe “Sound Switch Settings” switch bank shown in Figure 32 - Horn and Strobe PCB Wiring Diagram.

(1)	(2)				
1	14	11111	800 & 970Hz	2Hz (250ms~250ms)	BS Fire Tone
2	14	11110	800 & 970Hz	7Hz (7/s)	BS Fire Tone
3	14	11101	800 & 970Hz	1Hz (1/s)	BS Fire Tone
4	14	11100	2850Hz	Steady	
5	4	11011	2400 ~ 2850Hz	7Hz	
6	4	11010	2400 ~ 2850Hz	1Hz	
7	14	11001	300 ~ 1200Hz	3s Sweep, 0.5s silence, then repeat	Dutch Fire Tone
8	14	11000	1200 ~ 500Hz	1Hz	DIN Tone
9	4	10111	2400 & 2850Hz	2Hz (250ms~250ms)	
10	14	10110	970Hz	0.5Hz (1s On / 1s Off)	
11	14	10101	800 & 970Hz	1Hz (500ms~500ms)	BS Fire Tone
12	4	10100	2850Hz	0.5Hz (1s On / 1s Off)	
13	14	10011	970Hz	0.8Hz (250ms On / 1s Off)	
14	14	10010	970Hz	Steady	BS Fire Tone
15	14	10001	554 & 440Hz	100ms ~ 400ms	French Fire Tone
16	16	10000	660Hz	3.3Hz (150ms On / 150ms Off)	Swedish Fire Tone
17	17	01111	660Hz	0.28Hz (1.8s On / 1.8s Off)	Swedish Fire Tone
18	18	01110	660Hz	0.05Hz (13s Off / 6.5Hz On)	Swedish Fire Tone
19	19	01101	660Hz	Steady	Swedish Fire Tone
20	20	01100	554 & 440Hz	0.5Hz (1s On / 1s Off)	Swedish Fire Tone
21	21	01011	660Hz	1Hz (500ms ~ 500ms)	Swedish Fire Tone
22	14	01010	2850Hz	4Hz (150ms On / 100ms Off)	Pelican Crossing
23	14	01001	800 ~ 970Hz	50Hz	BS Fire Tone
24	4	01000	2400 ~ 2850Hz	50Hz	
25	25	00111	970Hz	3 x 500ms pulses followed by 1.5s silence then repeat	ISO 8201
26	26	00110	970 & 800Hz	3 x 500ms pulsed sweep followed by 1.5s silence	ISO 8201
27	27	00101	4000Hz	3 x 500ms pulsed two tone followed by 1.5s silence	
28	10	00100	800 & 970Hz	2Hz (250ms ~ 250ms)	BS Fire Tone
29	988Hz	00011	990 & 650Hz	2Hz (250ms ~ 250ms) (Symphoni Tones)	BS Fire Tone
30	510Hz	00010	510 & 610Hz	2Hz (250ms ~ 250ms) (Squashni Micro Tones)	BS Fire Tone
31	31	00001	300 ~ 1200Hz	1Hz	
32	32	00000	510 & 610Hz	1Hz (500ms ~ 500ms)	

Table 24 - Horn And Strobe Sound Switch Settings

15.4 Horn And Strobe Mechanical Details

Shown below are the mechanical details of the horn and strobe enclosure.

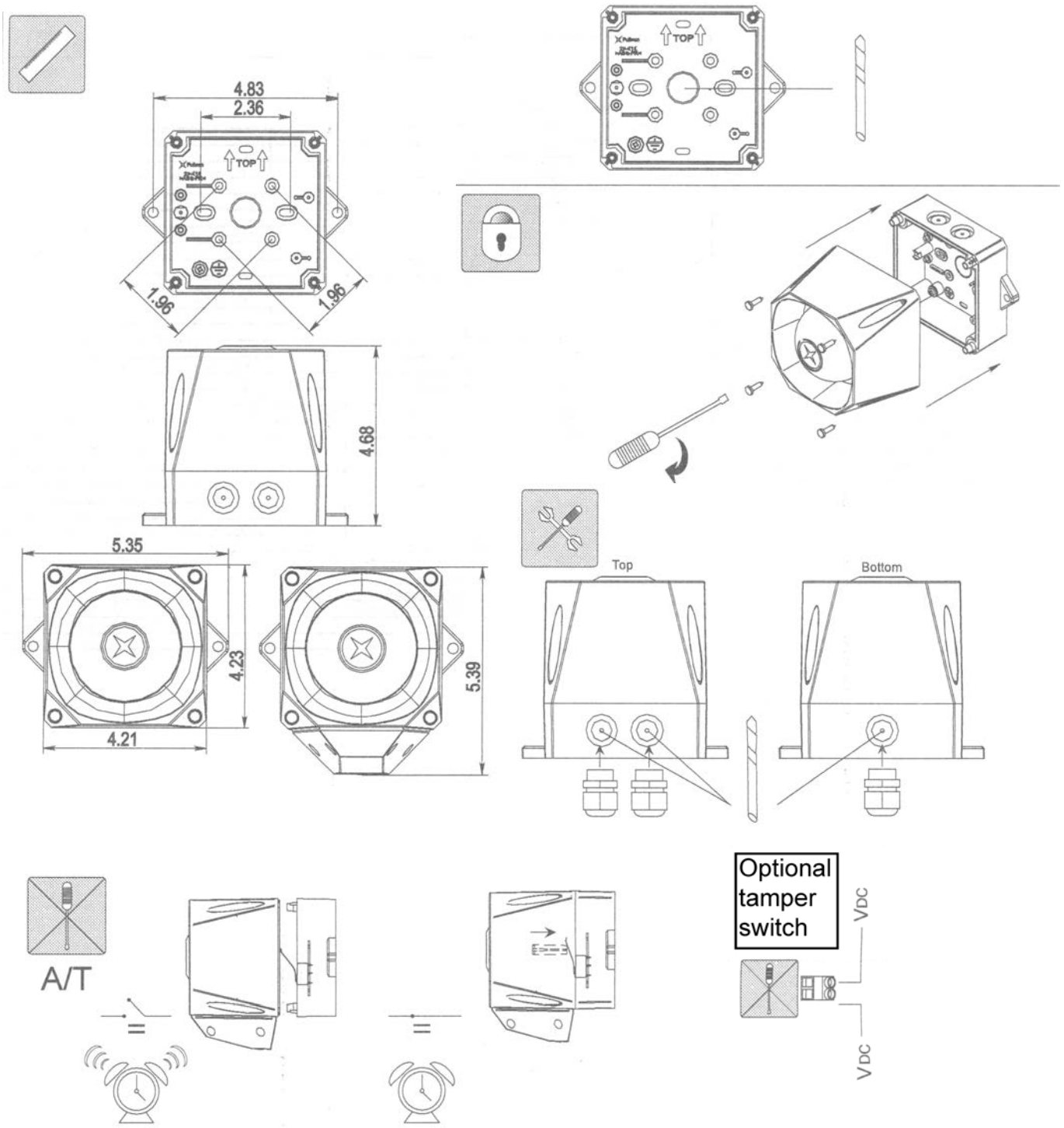


Figure 33 - Horn And Strobe Mechanical Details

15.5 Horn And Strobe PCB Detail

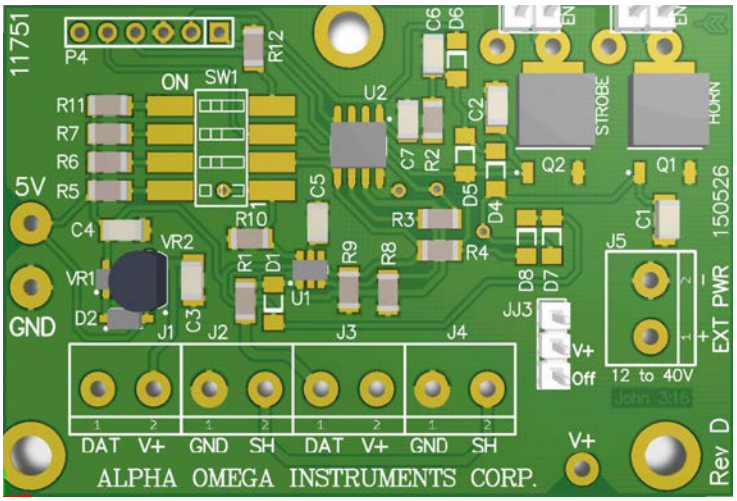


Figure 34 - Horn And Strobe PCB Detail

16 APPENDIX E – Remote with Calibration Fixture

Calibration Fixture shown attached to remote sensor enclosure.

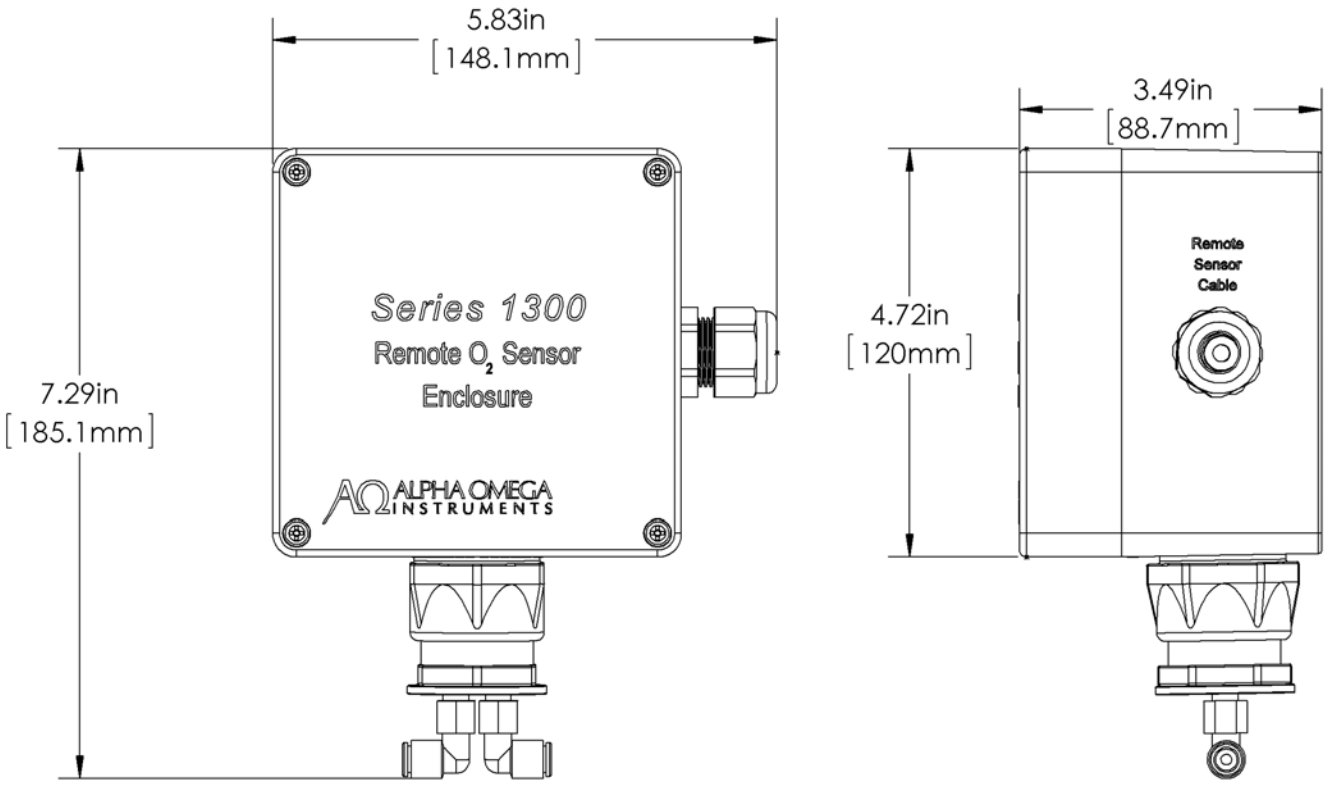


Figure 35 - Remote Oxygen Sensor Enclosure & Optional Calibration Fixture

17 APPENDIX F – Oxygen Sensor Material Safety Data Sheet

SECTION I - PRODUCT IDENTIFICATION	
Manufacturer's Name:	Alpha Omega Instruments Corp
Address	40 Albion Rd. Suite 100.
Telephone	401-333-8580
Date Prepared	September 3, 1998
Date Revised	April 12, 2001
Trade Name	1SEN
Description	Weak acidic solution encapsulated in plastic housing.

SECTION II - HAZARDOUS INGREDIENTS OF SOLUTION	
Lead Acetate, Trihydrate	CAS # 6080-56-4
	OSHA/PEL 0.05 mg/m3
	ACGIH/TLV 0.15 mg/m3
TLV and PEL are for lead, inorganic dusts and fumes, as Pb	
Note: Lead has been reported as causing cancer in laboratory animals, exercise due care.	
Acetic Acid, Glacial	CAS # 64-19-7
	OSHA/PEL 10 PPM
	ACGIH/TLV 10 PPM
NOTE: TLV and PEL are for concentrated (90% - 100%) Acidic Acid, actual solution is less than 50%.	
Lead	CAS # 7439-92-1
	OSHA/PEL 0.03mg/m3

SECTION III - PHYSICAL & CHEMICAL CHARACTERISTICS	
Boiling Point: Not Available	Specific Gravity: Not Available
Vapor Pressure: Not Available	Vapor Density: Not Available
Evaporation Rate: Not Available	Physical State: Liquid
Melting Point: Not Available	PH: 3.5 – 7.0 Flash Point: > 100 degrees C
Appearance & Odor:	Colorless Liquid: Vinegar like odor
Extinguisher Media:	Use water spray, alcohol foam, dry chemical or carbon dioxide
Special Fire Fighting Procedures:	Respiratory protection should be used to avoid breathing fumes.
Unusual Fire & Explosion Hazards:	Lead acetate decomposes at boiling point and toxic gases are produced. Acetic acid vapors may flow along surfaces to distant ignition sources and flash back. Closed containers exposed to heat may explode.

SECTION IV - REACTIVITY DATA OF SOLUTION	
Stability:	Stable
Hazardous Polymerization:	Will not occur
Conditions to Avoid:	Heat, flame, other sources of ignition
Incompatibles:	Strong acids, strong bases, strong oxidizing agents.
Decomposition Products:	Lead fumes, carbon monoxide, carbon dioxide.

SECTION V - HEALTH HAZARD DATA OF SOLUTION	
Lead Acetate Component	Data is for lead, inorganic dusts and fumes as Pb
(TLV/TWA):	0.15 mg/m3
STEL:	Not Established
PEL:	0.05 mg/m3
Toxicity:	Intraperitioneal Rate LD50 for Lead Acetate Trihydrate is 200 mg/Kg
Carcinogenicity:	This substance is listed as a NTP anticipated human carcinogen and an IARC animal carcinogen.
Reproductive Effects:	None identified
Effects of Overexposure:	
INHALATION:	Tightness and pain in chest, coughing, difficult breathing.
SKIN CONTACT:	Irritation.
EYE CONTACT:	Irritation.
SKIN ABSORPTION:	May be harmful.
INGESTION:	Is harmful and may be fatal, headache, nausea, vomiting, dizziness, gastrointestinal irritation.
CHRONIC EFFECTS:	Anemia, kidney damage, blurred vision, lead build-up in the central nervous system.
Target Organs:	GI tract, central nervous system, kidneys, blood, gingival tissue.
Medical Conditions Generally Aggravated by Exposure:	None identified.
Primary Routes of Entry:	Ingestion, inhalation, eye contact, skin contact, absorption.
Emergency and First Aid Procedures:	
INGESTION:	CALL A PHYSICIAN. Give large amounts of water.
INHALATION:	If inhaled, remove to fresh air.
SKIN CONTACT:	In case of contact, flush with water for at least 15 minutes.
EYE CONTACT:	In case of contact, flush with water for at least 15 minutes.
Acetic Acid	Data is for concentrated acid.
Threshold Limit value (TLV/TWA)	25 mg/m3
Short term exposure limit (STEL)	37 mg/m3
Permissible exposure limit (PEL)	25 mg/m3

SECTION V - HEALTH HAZARD DATA OF SOLUTION	**(continued)**
Toxicity:	
Oral rate LD50 for acetic acid:	3310 mg/kg
Intravenous mouse LD50 for acetic acid:	525 mg/kg
Skin rabbit LD50 for acetic acid:	1060 mg/kg
Inhalation mouse LD50 for acetic acid:	5620 mg/kg
Carcinogenicity NTP:	No
IARC	No
Z List:	No
OSHA Reg:	No
Carcinogenicity:	None identified
Reproductive Effects:	None identified
Effects of Overexposure:	
INHALATION:	Severe irritation or burns of respiratory system
SKIN CONTACT:	Severe burns, may cause dermatitis
EYE CONTACT:	Severe burns, permanent eye damage.
SKIN ABSORPTION:	None identified
INGESTION:	Burns to mouth and throat, nausea, vomiting, gastrointestinal irritation, diarrhea, shock, may be fatal
CHRONIC EFFECTS:	Lung damage, teeth damage
Target Organs:	Respiratory system, eyes, skin, teeth, lungs.
Medical Conditions Generally	Respiratory system disease, skin disorders.
Aggravated by Exposure:	
Primary Routes of Entry:	Inhalation, ingestion, skin contact, eye contact.
Emergency and First Aid Procedures:	
INGESTION:	CALL A PHYSICIAN. Give large amounts of water.
INHALATION:	If inhaled, remove to fresh air.
SKIN CONTACT:	Immediately flush skin with plenty of water for at least 15 minutes.
EYE CONTACT:	Immediately flush with plenty of water for at least 15 minutes.

SECTION VI - SPILL AND DISPOSAL PROCEDURES	
NOTE: The sensors are sealed, and under normal circumstances, the contents of the sensors do not present a health hazard. The following information is given as a guide in the event that a cell leaks.	
Steps to be taken in the event of a spill or discharge:	Wear respiratory protection and full protective clothing Neutralize spill with soda ash or lime Carefully place material into clean, dry container and cover. Flush spill area with water.
Disposal Procedure:	Dispose in accordance with all applicable federal, state and local environmental regulations, with regards to lead or lead acetate.
EPA Hazardous Waste Numbers:	
Lead	D008
Lead Acetate	U144 (Toxic Waste)
Acetic Acid, Glacial	D001, D002 (Ignitable, Waste)

SECTION VII - ENGINEERING AND WORK PRACTICES CONTROLS	
VENTILATION:	Use general or local exhaust ventilation to meet TLV requirements.
RESPIRATORY PROTECTION:	Respiratory protection required if airborne concentration exceeds TLV.
EYE/SKIN PROTECTION:	Safety goggles, uniform, apron, neoprene gloves are recommended.
Protective measures during cell replacement:	
Before opening the packaging containing the sensor cell, check the sensor cell for leakage. If the sensor cell leaks, do not open the container. If there is liquid around the cell while in the instrument, use the protection listed above in this section.	

SECTION VIII - STORAGE AND HANDLING PRECAUTIONS	
Storage Requirements:	Store in a cool, well-ventilated area.

18 APPENDIX G – Battery Backup

The Series 1300 Oxygen Deficiency Monitor when equipped with the battery backup option, will be shipped with the battery pack installed but **disconnected**. Therefore the battery must **FIRST** be connected **BEFORE** operating the instrument, otherwise the battery backup will not work. Please read section 18.2Battery installation/Replacement below for information on how to access the battery and how to connect the battery connector. Please be aware that the instrument will NOT turn on immediately after the battery is reconnected.

18.1 Battery Backup details

The battery backup is designed to operate the instrument for approximately 30 minutes after a main power loss under it's full rated load. This includes all relays energized and (4) instrument powered horn and strobes[9]. The backup time is determined by the total charge time, the ambient temperature, and the number of alarms/relays being powered during backup. The instrument will automatically turn off when the battery reaches it's minimum recommended voltage.

18.1.1 Battery Temperature

It is recommended to keep the ambient temperature below 35 degrees C to maximize the performance of the battery and maintain maximum backup times. Higher ambient temperatures will adversely affect the battery and result in less backup time and premature failure over time.

When main power is restored, the instrument will recharge the battery pack back to it's full capacity. This will take approximately 16 hours if fully discharged.

18.1.2 Battery Testing

The battery pack is of the NiMH (Nickel Metal Hydride) type. It is recommended that the battery backup be tested on a regular basis to verify operation. In the absence of any protocol, it is recommended that the battery be inspected and a discharge test be performed every 3 to 6 months. If the battery is not holding a charge or the battery and/or it's connections look damaged or corroded, the battery must be replaced.

18.2 Battery Installation/Replacement

It is recommended that a fully qualified trained electrician perform any wiring.

WARNING: Remove all power to the instrument before opening the cover to the instrument.

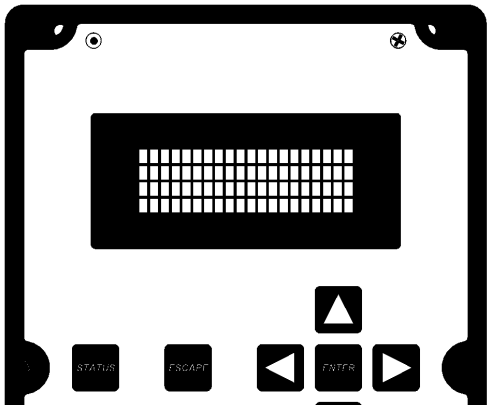
Follow these steps to replace the battery:

1. Remove the front cover by locating and removing the six (6) Phillips head screws located on the edges of the front cover of the instrument. The cover will lift off.
2. While holding the hinged front panel display, locate and remove the two (2) flat head Phillips head screws at the top of the hinged display panel. Put these screws aside for later. Pull panel fully open and away from the enclosure.

WARNING: Use only the screws provided. Use of alternate type screws may result in damage. Contact Alpha Omega Instruments for proper replacement screws if necessary.

[9] More than four horn and strobes require an external power source.

Two screws at top



3. Disconnect the battery connector located on the battery charger board on the right side of the enclosure. The battery connector is a large white connector on the left side of the battery charger board and is labeled “P1”. This connector is used to connect to the battery pack that is located underneath the battery charger board. Pull up to disconnect. Take note of the polarity (RED toward the left) to avoid misplacement and possible damage to the connector when replacing later. **NOTE**: if this is a newly factory installed battery, the battery connector will already be connected but shifted over by one or two pins for shipping only. Simply reconnect it with all three (3) pins lining up and skip to step 6.
4. Access the battery pack; While holding the battery charger board, remove the (3) three pan head Phillips screws at the top, right and left sides of the battery charger board. Put these screws aside for later.

   DO NOT remove the two (2) bottom screws on the battery charger board.

   The hinged board will now open and the battery pack can then be removed.

   NOTE: There is a small, thin foam backing behind the battery pack attached to the enclosure, make sure that this foam backing remains in place.

5. Replace the battery pack with ONLY the same type battery pack from Alpha Omega Instruments Corp. (PN 13-BAT). While holding the new battery pack in place, lift the battery charger board up into place and align the three (3) holes in the printed circuit board with the stand-offs. Replace the three pan head (3) Phillips screws into the battery charger board and hand tighten to secure it back into place.
6. Re-attach the battery pack connector to the battery charger board at “P1” making sure the RED lead is closest to the edge of the board.

   NOTE: Accidentally swapping the polarity of the battery connector could result in damage to the connector on the battery charger board. Avoid excessive force while pushing the connector onto the P1 connection and verify that the tines on the battery pack connector are facing up.

7. Close the hinged display panel and install the two (2) flat head Phillips screws that were originally installed at the top.
8. Replace the outer cover and install the six (6) Phillips head screws to secure.

The instrument is ready for the main power to be applied.