GPR-2600
% Oxygen Analyzer

Owner's Manual

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1. Introduction

Your new oxygen analyzer is a precision piece of equipment designed to give you years of use in a variety of industrial oxygen applications.

This analyzer is designed to measure oxygen concentration in inert gases, gaseous hydrocarbons, hydrogen, and a variety of gas mixtures. In order to derive maximum performance from your new oxygen analyzer, please read and follow the guidelines provided in this Owner's Manual.

The serial number of this analyzer may be found on the inside the analyzer. You should note the serial number in the space provided and retain this Owner's Manual as a permanent record of your purchase, for future reference and for warranty considerations.

Serial Number: _____

Every effort has been made to select the most reliable state of the art materials and components designed for superior performance and minimal cost of ownership. This analyzer was tested thoroughly by the manufacturer for best performance. However, modern electronic devices do require service from time to time. The warranty included herein plus a staff of trained professional technicians to quickly service your analyzer is your assurance that we stand behind every analyzer sold.

Advanced Instruments Inc. appreciates your business and pledge to make effort to maintain the highest possible quality standards with respect to product design, manufacturing and service.

2. Quality Control Certification

Quality Control & Calibration Certification

Customer:			**Date:**	
Order No.:				
Model No.:		GPR-2600 Oxygen Analyzer	**S/N:**	
Configuration:		A-1146-40 PCB Assembly, Main/Display	**Batch:**	
	( )	A-1147 PCB Assy, Interconnect, ( ) 1-5 V **OR** ( ) 4-20mA	**Batch:**	
	( )	A-1174 PCB Assy, Interconnect, ( ) 1-5 V + Contacts **OR** ( ) 4-20mA + Contacts	**Batch:**	
		Ranges: 0-1%, 0-5%, 0-10%, 0-25%	**Software Ver:**	
		Barometric pressure and temperature compensation Enclosure: Panel mount 10.75"W x 7.5"H x 12"D		
		SS sensor flow housing, flow meter with integral metering valve, 1/4" tube connections		
	( )	Temperature Controlled Sample System: ( ) 110 VAC **OR** ( ) 220 VAC		
	( )	"Oxygen Service" see P-1507 Rev 1, label analyzer, provide certificate		
	( )	Automated Sample/Span/Zero Inlet Valves		
	( )	A-2829 Bezel, 19" Rack		
	( )	Option 19" Rack mount with rear cover 19"W x 7"H x 12"D		
Sensor:	( )	GPR-11-32-4 Oxygen Sensor		
	( )	XLT-11-24-4 Oxygen Sensor	**S/N:**	
Accessories:		Owner's Manual		
		A-3491 Power Cord, Filtered (CABL-1008, FLTR-1014)		

		Expected Value	Observed Value	Pass
Test & Verify:	Default zero	.00 ± .05 low range		
	Default span in air @ 40 µA	19.0% to 23.0%		
	Span calibration upper limit in air @ 55 uA	20.5% to 21.3%		
	Span calibration lower limit in air @ 35 uA	20.5% to 21.3%		
	Reading after air (20.9%) calibration	20.5% to 21.3%		
	Baseline drift over 1 hour period (+5% FS) on 1% range	±0.05% of reading		
	Noise level (+1% FS) on 1% range	±0.01% of reading		
	Analog signal output 4-20 mA full scale			
	Analog Range ID output 4-20 mA full scale or relay contacts (above)			
		Alarm 1	**Alarm 2**	
	SETPOINT - Set alarm thresholds			
	MODE - Verify activation mode HIGH / LOW relative to setpoint			
	ENABLED - Verify alarms do not activate and OFF replaces SETPOINT			
	DELAY - Verify setpoint must be exceeded before activation			
	SILENCE/BYPASS - Verify main menu option de-activates alarm			
	Overall inspection for physical defects			
Options:				NA
Other:				NA

3. Safety Guidelines

This section summarizes the basic precautions applicable to all analyzers. Additional precautions specific to individual analyzer are contained in the following sections of this manual. To operate the analyzer safely and obtain maximum performance follow the basic guidelines outlined in this Owner's Manual.

Caution: This symbol is used throughout the Owner's Manual to **CAUTION** and alert the user to recommended safety and/or operating guidelines.

Danger: This symbol is used throughout the Owner's Manual to identify sources of immediate **DANGER** such as the presence of hazardous voltages.

Read Instructions: Before operating the analyzer read the instructions.

Retain Instructions: The safety precautions and operating instructions found in the Owner's Manual should be retained for future reference.

Heed Warnings Follow Instructions: Follow all warnings on the analyzer, accessories (if any) and in this Owner's Manual. Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the analyzer.
Heat: Situate and store the analyzer away from sources of heat.

Liquid and Object Entry: The analyzer should not be immersed in any liquid. Care should be taken so that liquids are not spilled into and objects do not fall into the inside of the analyzer.

Handling: Do not use force when using the switches and knobs. Before moving your analyzer be sure to disconnect the wiring/power cord and any cables connected to the output terminals located on the analyzer.

Maintenance

Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service.
Only trained personnel with the authorization of their supervisor should conduct maintenance.

Oxygen Sensor: DO NOT open the sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in this Owner's Manual. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

Troubleshooting: Consult the guidelines in section 8 for advice on the common operating errors before concluding that your analyzer is faulty. Do not attempt to service the analyzer beyond those means described in this Owner's Manual.

Do not attempt to make repairs by yourself as this will void the warranty, as detailed by section 9, and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

Cleaning: The analyzer should be cleaned only as recommended by the manufacturer. Wipe off dust and dirt from the outside of the unit with a soft damp cloth then dry immediately. Do not use solvents or chemicals.

Nonuse Periods: Disconnect the power when the analyzer is left unused for a long period of time.

Installation Consideration

Gas Sample Stream: Ensure the gas stream composition of the application is consistent with the specifications of the analyzer/sensor and review the application conditions before initiating the installation. Consult factory to ensure the sample is suitable for analysis.

Expected Sensor Life

With reference to the publish specification located in section 4 of this manual, the expected life of sensor is predicated on the basis of oxygen concentration at 21%,, temperature (77°F/25°C) and pressure (1 atmosphere). As a rule of thumb sensor life is inversely proportional to changes in these parameters.

Materials
Assemble the necessary zero, sample and span gases and optional components such as valves, coalescing or particulate filters, and pumps as dictated by the application; stainless steel tubing is essential for maintaining the integrity of the gas stream of low %O2 (<0.05%) measurements.

Operating Temperature
The sample must be sufficiently cooled before it enters the analyzer and any optional components. A coiled 10 foot length of ¼" stainless steel tubing is sufficient for cooling sample gases as high as 1,800ºF to ambient. The maximum recommended operating temperature is 45º C. On an intermittent basis, unless the user is willing to accept a reduction in expected sensor life – refer to analyzer specification, the analyzer may be operated at 50 degree ºC. At temperatures above 25ºC, the user can expect a reduction in sensor life of ~ 2.5% per degree increase in temperature. As an example, if the analyzer is continuously operated at 35ºC, the expected sensor life will be reduced by ~25%.

Pressure and Flow
All electrochemical oxygen sensors respond to partial pressure changes in oxygen in a gas stream.
A sample system and flowing gas samples are generally required for applications involving oxygen measurements in a gas mixture.

To analyze a gas stream, the gas must flow or be drawn through the sensor housing. The internal sample system of the analyzer may include a flow control (please check the QC sheet to ensure the included sample system), a flow indicator and al sensor housing with an o-ring seal.

Inlet Pressure
Analyzers designed for flowing samples under positive pressure requires sample pressure between 5-30 PSIG. This pressure range is recommended for ease in controlling the sample flow with the integral flow control valve. Sample pressure up to 100 PSIG is acceptable but will cause difficulty in setting the flow rate.

Outlet Pressure
In positive sample pressure applications, the sample must be vented to ambient air or in a vent with pressure less than 40 inches of water.

If the sample is vented to a line at pressure above ambient, a back pressure regulated set at no greater 1-2 PSIG must be installed on the downstream of the sensor to ensure a constant pressure on the sensor.

Flow Rate
Flow rates of 1-5 SCFH cause no appreciable change in the oxygen reading. However, flow rates above 5 SCFH may generate a backpressure on the sensor and cause erroneous oxygen readings. A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

Recommendations to avoid erroneous oxygen readings and damaging the sensor

1. Do not place your finger over the vent (it pressurizes the sensor) to test the flow indicator when gas is flowing to the sensor. Removing your finger (the restriction) generates a vacuum on the sensor and may damage the sensor.
2. Assure there are no restrictions in the sample or vent lines.
3. Avoid excessive flow rate, flow rate above 5 SCFH may generate backpressure on the sensor.
4. Avoid sudden releases of backpressure that can severely damage the sensor.
5. Avoid the collection of liquids or particulates on the sensor, they block the diffusion of oxygen into the sensor - wipe away any liquid and particulate with a damped cloth only.

Moisture & Particulates
Installation of a suitable coalescing and/or particulate filter is required to remove liquid condensates, and/or particulates from the sample gas to prevent clogging of the sampling system. Moisture and/or particulates do not necessarily damage the sensor itself but collection of moisture/particulate on the sensing surface can block or inhibit

the diffusion of sample gas into the sensor thus resulting in a reduction of sensor signal output – and the appearance of a sensor failure. Consult factory for recommendations concerning the proper selection of coalescing/particulate filters.

Mounting

The standard analyzer is approved for indoor use only. Outdoor use requires optional enclosures, consult factory. Mount analyzer as recommended in this manual.

The analyzer is configured for panel mounting and requires a 7.5x10.8" cutout with 4 holes for the analyzer's front panel. Optional configurations include a panel mount with 7.75x7.75" cutout; 19" bezel for rack mounting, 12x12x8" wall mount enclosure (GPR-2600W).

Gas Connections

Sample Inlet and Sample Vent gas lines require 1/8" or ¼" stainless steel compression fittings connection; hard plastic tubing with a low gas permeability factor may be used for measurements of oxygen above 0.1%.

Power

Analyzer is rated to operate with 100-240 VAC, Supply power to the analyzer only as rated by the specification or markings on the analyzer enclosure. The wiring that connects the analyzer to the power source should be installed in accordance with recognized electrical standards. Ensure that the analyzer enclosure is properly grounded and meets the requirements of recommended local electrical standards.

Never yank wiring to remove it from a terminal connection.

Power Consumption

Analyzers consume a maximum of 30 watts, without the optional heaters. With optional 110 VAC or 220 VAC heaters installed, the maximum power consumption is 230 watts.

4. Features & Specifications

Advanced Instruments Inc.

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-1%, 0-5%, 0-10%, 0-25% FS ranges Auto-ranging or manual lock on a single range
Application:	Oxygen analysis in inert, helium, hydrogen, mixed and acid (CO_2) gas streams
Approvals:	CE
Area Classification:	General purpose
Alarms:	Two adjustable form C relay contacts non-latching; "weak sensor" indicator; power failure; system failure
Calibration:	3 month interval using air or certified span gas with O2 value approximating 80% of full scale range balance N2
Compensation:	Barometric pressure and temperature
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration, alarm and system functions
Data Acquisition:	Selectable data point intervals
Display:	Graphical LCD 5" x 2.75"; resolution .001%; displays real time ambient temperature and pressure
Enclosure:	Painted aluminum 7.5" x 10.8" x 12.25" panel mount
Flow:	Not flow sensitive; recommended flow rate 2 SCFH
Linearity:	> .995 over all ranges
Pressure:	Inlet - regulate to 5-30 psig to deliver 2 SCFH flow; vent - atmospheric
Power:	Universal; specify 100 or 200 VAC for heater system
Range ID:	Voltage, 4-20 mA or relay contacts
Response Time:	90% of final FS reading < 10 seconds
Sample System:	flow indicator
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-11-32-4 for non-acid (CO2) gas streams XLT-11-24-4 for gas mixture with > 0.5% CO_2
Sensor Life:	GPR-11-32-4 32 months in air at 25ºC and 1 atm XLT-11-24-4 24 months in air at 25ºC and 1 atm
Signal Output:	4-20mA isolated or 0-1V
Temp. Range:	-10ºC to 45ºC (GPR sensor), -20°C to 45° (XLT)
Warranty:	12 months analyzer; 12 months sensor

Optional Equipment

19" rack, wall mounting, auto zero/cal, remote communication-contact factory

* Specification subject to change without notice.

GPR-2600
Oxygen Analyzer

Advanced Full Featured Process O2 Analyzer

Advanced Sensor Technology

- Unmatched Performance in O2 Analysis
- Unmatched 32 Month Expected Life
- Sensitivity < 0.5% FS Range
- Extended –20°C (-4°F) Operating Range
- Excellent Compatibility with 0-100 CO2

2 Field Selectable Alarm Setpoints

Auto Ranging or Single Fixed

Options: Temperature Control
Auto-Zero and Auto-Cal
Remote Communication

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

INTERTEK ISO 9001:2008

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5. Operation

5. Operation

Principle of Operation

The GPR-2600 Oxygen Analyzers incorporates a variety of % range advanced galvanic fuel cell type sensors. The analyzer is configured for panel mounting and requires a 7.5"x10.8" cutout with 4 holes for the analyzer's front panel. Optional configuration; 19" bezel for rack mounting, 12"x12"x8" wall mount enclosure (GPR-2600W), 18.2"x16"x10" panel mount configuration (GPR-2600W-306) using the wall mount enclosure. Contact the factory for additional information on options. All configurations are tested and calibrated by the manufacturer prior to shipment.

The GPR-2600 series analyzers and sensors conform to CE standards and are manufactured under a Quality Assurance System, certified by an independent agency, in accordance with ISO 9001:2008 standards.

Advance Galvanic Sensor Technology

All galvanic sensors function on the same principle and are specific to oxygen. They measure the partial pressure of oxygen ranging from low PPM to 100% levels in inert gases, gaseous hydrocarbons, helium, hydrogen, mixed gases and acid gas streams. **Oxygen, the fuel for this electrochemical transducer, diffuses into the sensor and reacts chemically at the sensing electrode to produce an electrical current output proportional to the oxygen concentration in the gas phase.** The sensor's signal output is linear over all measuring ranges and remains virtually constant over its useful life. The sensor requires no maintenance and is easily and safely replaced at the end of its useful life.

Electronics

The signal generated by the sensor is processed by state of the art low powered micro-processor based digital circuitry. The first stage amplifies and converts the electrical current into voltage signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for the sensor's signal output variations caused by ambient temperature variations. The result is a very stable sensor signal.

Sensor's response time of 90% of a "step change" is less than 10-30 seconds (actual experience may vary due to the integrity of sample line connections, dead volume and flow rate selected) on all ranges under ambient monitoring conditions. Sensitivity is typically 0.5% of full scale of the lowest range of analysis.

Additional features of the micro-processor based electronics include manual or auto ranging, auto-zero and auto-cal, isolated 4-20mA signal for signal output, optional 4-20 mA as range ID, separate relay contacts rated 30 VDC max @ 1A or 110/220 VAC @ 5A are provided for the alarm feature. Optional range ID contacts are rated at 30 VDC @1A.

Whenever the analyzer is span calibrated, a unique algorithm predicts and displays a message indicating a 'weak sensor' (if the sensor output has fallen below a certain level), suggesting the sensor be replaced in the near future.

Sample System

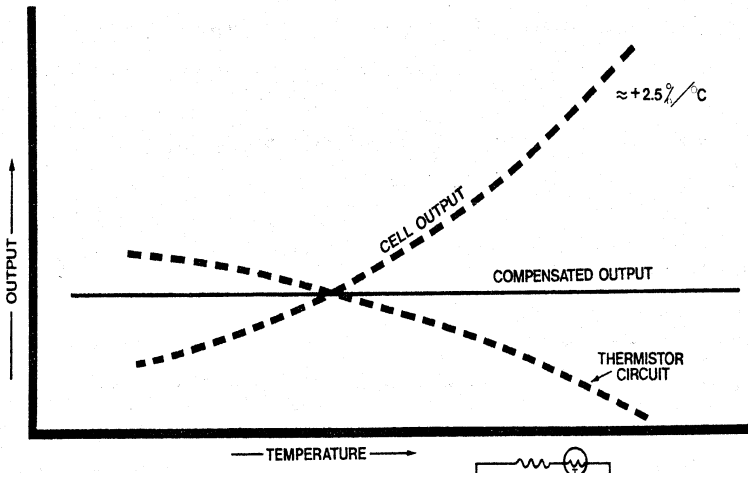
For accurate measurements, the sample gas must be properly presented to the sensor. In standard form, the GPR-2600 is equipped with a sample system that complements the performance capabilities of the advanced oxygen sensor. The sample system includes a flow meter and or flow meter with flow control valve

Advanced Instruments Inc. offers a full line of sample handling, conditioning and expertise to meet your application requirements. Contact us at 909-392-6900 or e-mail us at info@aii1.com for your specific requirements.

Accuracy Overview

Single Point Calibration: As previously described the galvanic oxygen sensor generates an electrical current proportional to the oxygen concentration in the sample gas. In the absence of oxygen the sensor exhibits an absolute zero, e.g. the sensor does not generate a current output in the absence of oxygen. Given the linearity and absolute zero properties, single point calibration is possible.

Pressure: Because sensors are sensitive to the partial pressure of oxygen in the sample gas, their output is a function of the number of molecules of oxygen 'per unit volume'. For best accuracy, the pressure of the sample gas and that of the calibration gas must be the same (in reality within 2-5 psi) so that when the SAMPLE/SPAN gases are switched, the gas flow rate would not drastically change.



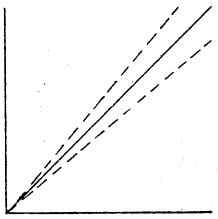
Temperature: The rate at which oxygen molecules diffuse into the sensor is controlled by a Teflon membrane otherwise known as an 'oxygen diffusion limiting barrier. The fact that all diffusion processes are temperature sensitive, the sensor's electrical output also varies with temperature. This variation is relatively constant (2.5% per ºC change in temperature). A temperature compensation circuit employing a thermistor offsets this effect with an accuracy of ±5% or better (over the operating temperature range of the analyzer) and generates an output signal that is virtually independent of small ambient temperature variation. To minimize error in oxygen measurement, the calibration of the analyzer should be carried out as close as possible to the temperature during sampling. A small temperature variation of ~10º F will produce < 2% error.

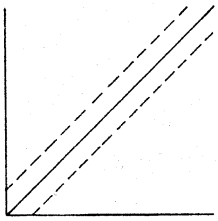
Accuracy: In light of the above parameters, the overall accuracy of an analyzer is affected by two factors:

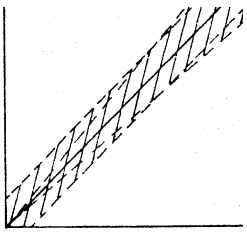
1) 'Percent of reading errors', illustrated by Graph A below, such as ±5% inherited error in the temperature compensation circuit due to the tolerances of the resistors and thermistor.

2) 'Percent of full scale errors', illustrated by Graph B, such as ±1-2% linearity errors generally associated with tolerances in the electronic components, which are really minimal due to today's technology and the fact that other errors are 'spanned out' during calibration.

Graph C illustrates these 'worse case' specifications that are typically used to develop an analyzer's overall accuracy statement of < 1% of full scale at constant temperature or < 5% over the operating temperature range. QC testing is typically < 1% prior to shipment.


A. PERCENT OF READING ERRORS


B. PERCENT OF FULL SCALE ERRORS

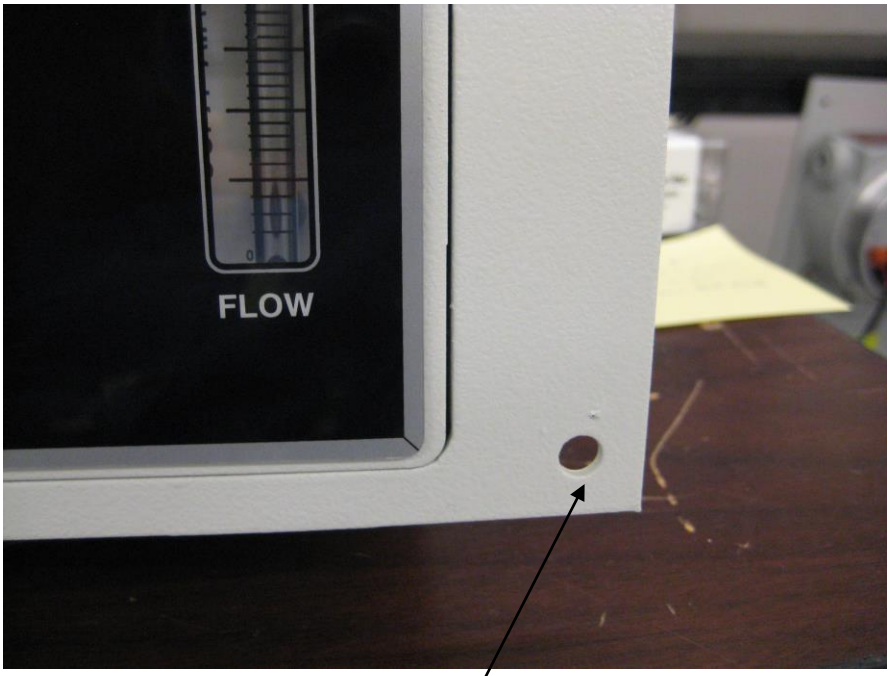

C. OVERALL ACCURACY

Example 1: As illustrated by Graph A any error during a span adjustment, e.g., at 20.9% (air) of full scale range would be multiplied by a factor of 4.78 (100/20.9) when used for measurements of 95-100% oxygen concentrations. Conversely, an error during span adjustment at 100% of full scale range will be reduced proportionately for measurements of lower oxygen concentrations. Refer to the Calibration section for additional details.

Mounting the Analyzer

The standard GPR-2600 is designed to be panel mounted and requires a cutout that accommodates the enclosure and 4 mounting bolts. The design also lends itself to 19" rack mounting with an optional bezel or wall mount enclosures as illustrated below.

1. The standard GPR-2600 is designed for panel mounting directly to any flat vertical surface, wall or bulkhead plate with the appropriate cut out and four ¼" diameter holes for insertion of the mounting studs through the front mounting bezel.
2. When mounting the analyzer, position it approximately 5 feet above the floor for better viewing purposes and easy access to various functions of the analyzer. Leave sufficient room for access to the terminal connections at the rear of the enclosure.
3. **Note:** The proximity of the analyzer to the sample point and use of optional sample conditioning components, such as a sample cooling coil, a coalescing filter and or a particulate filter may have an impact on sample lag time and hence the analyzer response time.



Four mounting holes on four corners to secure analyzer on a flat vertical surface

Gas Connections

The GPR-2600 with its standard flow through configuration is designed for positive sample pressure and requires ¼" compression type connections for incoming sample and outgoing vent lines.

The user is responsible for providing calibration gases and other optional components (if not purchased with the analyzer).

Flow Control Valve: A flow control valve is mounted upstream of the sensor and provides means of controlling the flow rate of the sample gas. Sample flow rate of 1-5 SCFH cause no appreciable change in the oxygen reading. However, for optimum performance, a flow rate of 1-2 SCFH is recommended.

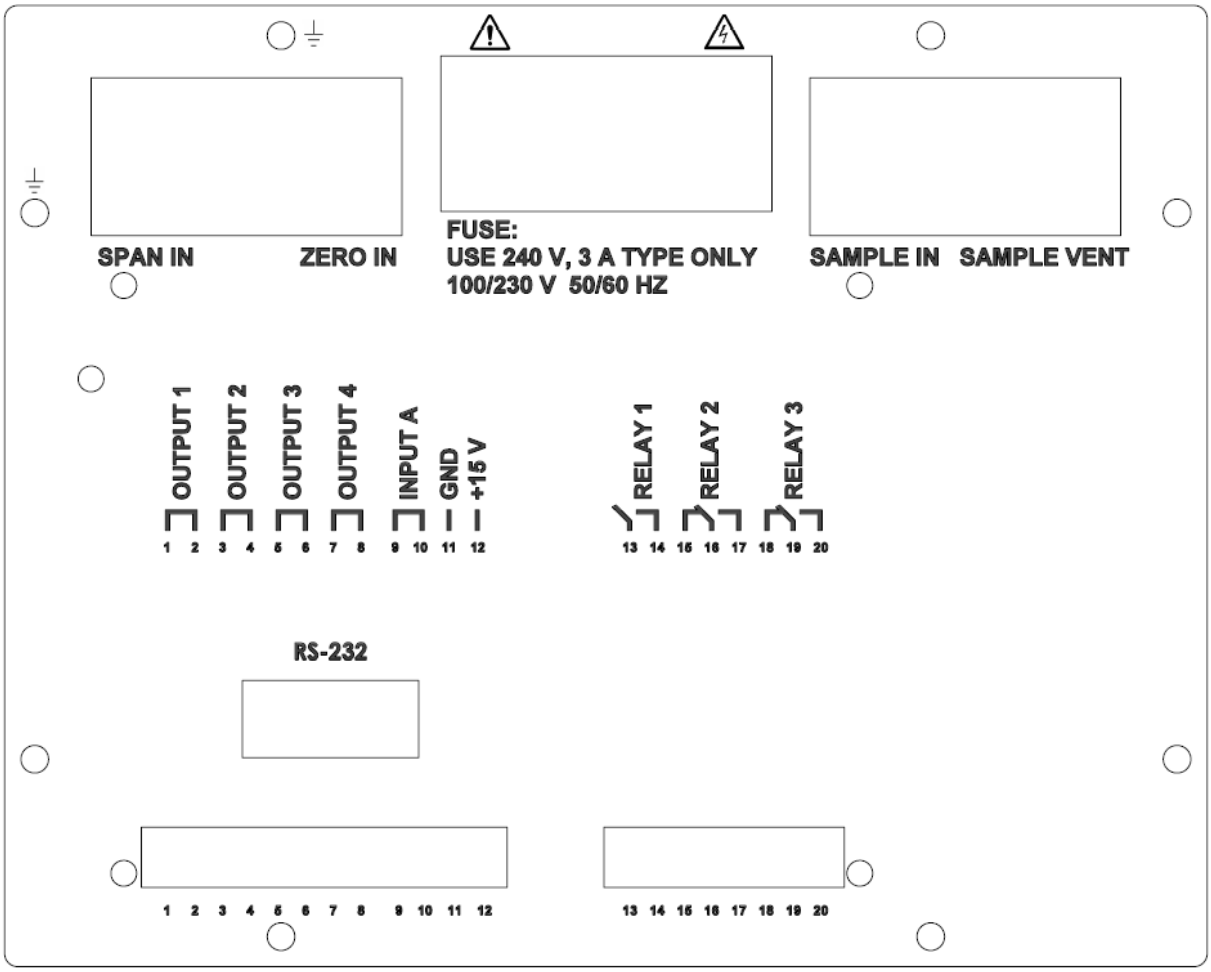
Analyzer with SS sensor housing, Flow control valve and Flow Meter

Electrical Connections

Incoming100-240VAC power is supplied through a universal power entry module. A standard computer type power cord (Part# PWRS-1008) is required for the universal power entry module. A well grounded insulated power cable is recommended to avoid noise resulting from unwanted interference.

Power consumption is approximately 30 watts without optional heater and 150-200 watts with the heater system.

Caution: Integral 4-20mA converters are internally powered and do not require external power. DO NOT supply any voltage to any of the terminals of the 4-20 mA signal output or the 4-20 mA range ID. If a power is supplied, the 4-20 mA chip can be permanently damaged.



Procedure for making connections

1. As illustrated above the alarm relays and signal output connections are hard wired to push-open type terminal blocks located at the rear of the analyzer.
2. Use a small bladed screwdriver to push the lever down and insert the stripped end of the wire into the slot. **NOTE:** Strip insulation of the wires no more than 3/16 inch in length.
3. Insert the stripped end of the cables into the appropriate terminal slots assuring no bare wire remains exposed that could come in contact with the back panel of the analyzer enclosure.
4. Release the lever to secure the wires in the receptacle.
5. To connect to an active relay or "fail safe", connect the live cable to the common terminal C and the secondary cable to the normally open NO terminal.
6. To break the connection upon relay activation, connect the secondary cable to the normally closed NC terminal.

Danger: While connecting the cables to the relay terminals, ensure there is no voltage on the cables to prevent electric shock and possible damage to the analyzer.

Caution: Assure the stripped wire ends of the cable are fully inserted into the terminal slots and do not touch each other or the back panel of the analyzer enclosure.

Oxygen Level Alarms

The analyzer is configured with two user adjustable threshold type alarm relays that can be configured in the field from the ALARM option on the MAIN MENU as follows:

1. Establish independent alarm set points
2. Either Hi or Lo oxygen condition
3. Either On or Off (enabled or disabled)

Both alarms may be temporarily defeated using a user entered 'timeout' period (normally in minutes)

The alarm set point represents an oxygen value. When the oxygen reading exceeds (high alarm) or falls below (low alarm) the alarm set point, the relay is activated and the LCD displays the alarm condition.

When activated, the alarm function triggers the corresponding SPDT Form C non-latching relay rated @ 5A, 30VDC or 240VAC resistive. To prevent chattering of the relays, a 2% hysteresis is added to the alarm set point. This means that the alarm will remain active until the oxygen reading has fallen 2% below the alarm set point (high alarm) or risen 2% above the alarm set point (low alarm) after the alarm was activated. The timeout feature is useful while replacing the oxygen sensor or during calibration when the oxygen reading might well rise above the alarm set point and trigger a false alarm.

Note: When making connections the user must decide whether to configure/connect Alarm 1 and Alarm 2 in failsafe mode (Normally Open – NO – where the alarm relay de-energizes and closes in an alarm condition) or non-failsafe mode (Normally Closed – NC – where alarm relay energizes and opens in an alarm condition).

Power/System Failure Alarm

A dry contact (Relay 1) rated at 30VDC @ 1A is provided as a power/system failure alarm that activates when power supplied to the analyzer's circuits is interrupted. The contact is normally closed but opens when the power to the analyzer is switched off or interrupted. The power fail alarm cannot be disabled.

0-1 VDC, 0-5 VDC and 4-20 mA Signal Output

The analyzer provides 0-1 VDC (Output 4), 0-5 VDC (Output 3) and 4-20mA (Output 2) full scale signal. The integral IC on the main PCB provides 4-20mA fully isolated signals for output and optional 4-20 mA range ID. This IC does not require any external power.

Range ID

The standard range ID (Output 1) is designated with a voltage output corresponding to a specific range. For example, 5V corresponds to the least sensitive range (25% on the GPR-2600 analyzer) and drops 1V for each additional range. Optional 4-20 mA signal as range ID is also available. With 4-20 mA range ID option, 20mA represents the least sensitive range and it drops by 4mA (16mA, 12mA, 8mA, 4mA) for each additional range. Please check the QC sheet to confirm the range ID option ordered.

Relay contacts associated with each range may also be provided as range ID. With relay contacts as range ID, the common pin of all relays is connected to the terminal marked COMM and five (5) normally open relay contacts that close when the related range is active. The dry contacts are rated at 30VDC @ 1A.

Caution: The integral 4-20mA converters are internally powered and do not require external power. Applying any external voltage will permanently damage the 4-20mA converter.

Temperature Controlled Heater System with Thermal Runaway Protection

The standard GPR-2600 Series analyzer is generally not equipped with the heater system. However, in anticipation of very low % (less than 0.01 %) oxygen analysis, the user may elect to add the optional heater system. This unit is a PID controller which operates between 0-99°F. At the factory the controller is programmed to maintain the temperature at 85°F.

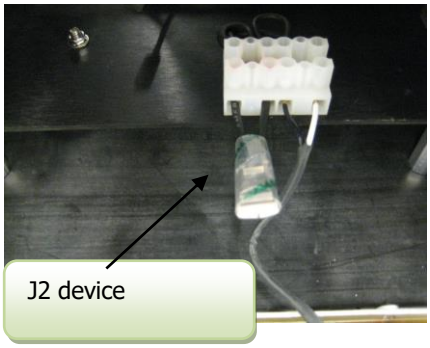
Caution: Do not change this setting. A higher temperature setting may drastically reduce sensor life and possibly cause damage to the electronic circuitry of both the controller and the analyzer.

Warning: Keep the front door securely fastened and closed when the temperature controller is ON.

When power is applied to the temperature controller, the controller tunes itself to eliminate and/or minimize the over/under shoot of temperature from the set point. It is recommended that at initial start-up, when replacing the oxygen sensor or when trouble shooting, turn off the power to the heater (by setting the temperature set point at 60°F to prevent overheating the analyzer). When operating the analyzer under normal conditions, set the temperature controller at 85ºF.

Changing the display value from °F to °C:

1. Push the UP ARROW and ENTER buttons down for 5 seconds to access the SECURE MENU
2. Press INDEX to advance to the F-C MENU
3. Select °C or °F by pressing the UP ARROW key
4. Press the ENTER key when F-C starts flashing on the display
5. Press INDEX to exit the SECURE MENU



Heater Runaway Protection

Part of the optional temperature controlled heater system is a heater runaway protection circuit that protects the electronics in the event the temperature controller should fail and thereby allowing the heater to runaway damaging the components inside the analyzer.

The runaway protection is provided by a J2 type device positioned between the temperature controller and the heater. This device cuts-off power to the heater if the temperature inside the analyzer exceeds 70°C. Should the J2 device cut power to the heater, correct the problem and reset the runaway protector device (J2 will conduct under normal conditions) by exposing it to 0°C for a few minutes (a refrigerator freezer will do).

NOTE, should the J2 fail to reset itself, replace it.

To access the J2, remove the back cover of the analyzer. The j2 is mounted on a white terminal block as shown in the figure above.

Installing a new Oxygen Sensor

The analyzer is equipped with an internal oxygen sensor that has been tested and calibrated by the manufacturer prior to shipment and is fully operational from the shipping containers. The sensor has been installed at the factory. However, it may be necessary to install the sensor in the field.

Caution: DO NOT open/dissect the sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in the Owner's Manual appendix. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in manner similar to that of a common battery in accordance with local regulations.

Oxygen screws in to a SS or Delrin flow through sensor housing. Screw sensor only finger tight.

Establishing Power to the Electronics

Power to the analyzers is supplied by an integral universal 100-240VAC power supply. The appropriate AC line voltage is supplied by using a standard power cord connected to the universal power entry module. **Ensure that EMI/RFI filter on the power cord remains intact and close to the power entry module.**

ENSURE THAT POWER LINE INCULDES "SURGE PROTECTER" AND RFI/EMI FILTER TO PREVENT INTERFERENCE FROM EXCESSIVE LINE VOLTAGE VARIATIONS

Check power rating of the analyzer printed at the back of the analyzer and make sure that a proper AC voltage supply is available. Incorrect AC power may cause safety hazard and damage to the analyzer.

Once the power cord is inserted into to the power entry module at the rear of the enclosure, as illustrated above, connect the plug end of the power cord to an appropriate AC outlet. When power is supplied to the analyzer, the analyzer performs self-diagnostic checks and the 5" x 2.75" graphical back-lit LCD displays the following message

he main screen contains information pertinent to the analyzer. This information consist of

- Temperature and pressure at the upper left corner.
- The current MODE of the analyzer is indicated at the middle center of the LCD. A user customizable name appears across the top center line of the LCD.
- Date and time at the upper right corner.
- Left hand side of the LCD shows if Alarm 1 & 2 are currently active (Example shows Alarm 1 active and Alarm 2 inactive) and the speaker symbol is if the audible alarm is active or not.
- At the center of the LCD displays the current reading of the sensor and below that displays the range the analyzer.
- Right hand side of the LCD displays:
    - SC: Signal Conditioning option selected.
    - Out Hold: Holds output until user has finished servicing analyzer.
    - Def Rnge: Default Range enabled.
- Bottom right hand side of LCD displays if the analyzer is locked with a passcode.

What if Power to the Analyzer is interrupted?

In the event power to the analyzer is interrupted, all pneumatic valves will close. When power is restored, the analyzer will return to operation in the STANDBY mode. The analyzer requires user intervention to bring analyzer back to the same conditions that existed prior to power interruption.

Menu Navigation

Sample Screen:

- Press **Menu/Esc** to show Main Menu (if the menu is locked, a passcode prompt will appear)
- Press **Enter** to show graph screen
- Press **Up** to bypass an active alarm or accept a span or zero calibration in progress
- Press **Down** to abort a span or zero calibration in progress
- Hold **Menu/Esc** and **Enter** for ½ second to restart analyzer
- Hold **Menu/Esc** for ½ second to clear non-critical error messages

Main Menu:

- Press **Up/Down** to move selection pointer
- Press **Enter** to select a menu item
- Press **Menu/Esc** to return to previous menu

Graph Screen:

- Press **Enter** to cycle graph (O2, Temperature, Pressure)
- Press **Menu/Esc** to return to sample screen or Data Logging menu
- Press **Up/Down** to go to Next/Previous graph page (page number is displayed in upper-right corner, page 1 is most recent data)
- Hold **Up/Down** for ½ second to zoom graph to next higher/lower range

Numeric/Alpha-numeric entry:

- Press or hold **Up/Down** to increase/decrease digit value
- Press **Enter** to edit next digit to the right or accept entry (right-most digit)
- Press **Menu/Esc** to edit the next digit to the left or abort entry (left-most digit)

There are several sub-menus within each main menu. The details of selecting certain features within a menu or sub-menu are given below

Auto Range Sampling

In the Auto Range mode, the analyzer will automatically select the appropriate full scale range depending on the concentration of oxygen in a sample gas. The display will shift to the next higher range when the oxygen reading exceeds 99.9% of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the next lower range.

For example, if the analyzer is reading 1% on the 0-10 % range and an upset occurs, the display will shift to the 0-25% range when the oxygen reading exceeds 10%. Conversely, once the upset condition is corrected, the display will shift back to the 0-10% range when the oxygen reading drops to 8.5%.

Manual Range Sampling

In MANUAL RANGING, output will not shift automatically. Instead, when oxygen reading exceeds 125% of the upper limit of the current range, output will freeze at 125% value of the selected range but analyzer display will shift to the next higher range and show actual oxygen concentration.

To select MANUAL RANGING, select SAMPLE and press ENTER, then select MANUAL RANGING and then advance cursor to the appropriate range and press ENTER again.

Note: In MANUAL RANGING, signal output will max out at about 125% of the selected range (even though oxygen reading on the LCD will shift to the next higher range).
In MANUAL RANGING, following information will appear on the LCD display.

Optional Internal Sampling Pump

When operating the sample pump **ENSURE** the flow valve is completely open. This prevents drawing a vacuum across the sensor. Extended vacuum draw across the sensor with damage the sensor.
The optional internal sampling pump can operated with two actions:

1. Press and Hold for 3 seconds the enter button on the overlay while on the sampling screen.

   Or

2. Selecting the PUMP option on the main menu.

Analyzer Transportation

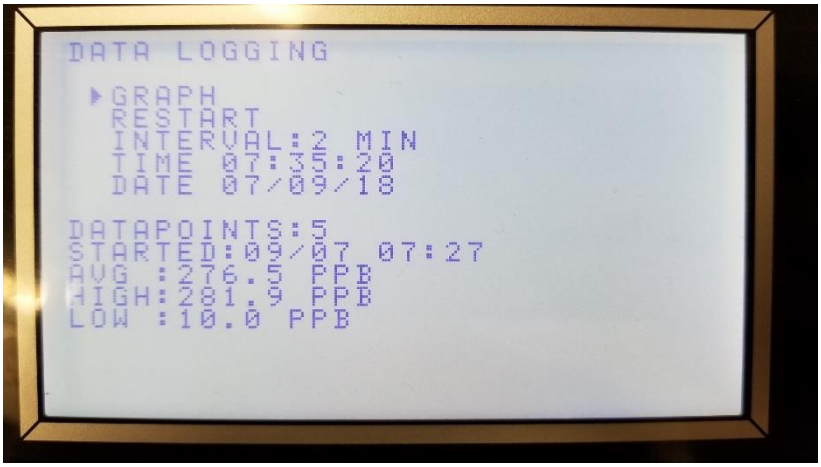
For moveable cart applications - Before transporting the analyzer from one place to another, make sure the second installation site is ready to install the analyzer. Follow the steps below

3. Place analyzer in Bypass mode.
4. Disconnect analyzer power
5. Disconnect sample, span gas lines and instrument air from analyzer.
6. Transport analyzer to new site as soon as possible
7. Establish sample connections at the new installation site. **CAUTION:** Purge sample and span gas lines before connecting to analyzer ports, failure to do so will increase the trending down time.
8. Establish power to analyzer
9. Select BYPASS mode, set sample flow between 1-2 SCFH and purge for 5 minutes
10. Select Sample mode and let sample purge for 5 minutes
11. The analyzer will begin trending down
12. It is not necessary to re-calibrate the analyzer

Data Logging

In the Data Logging Menu the user can select the following options.

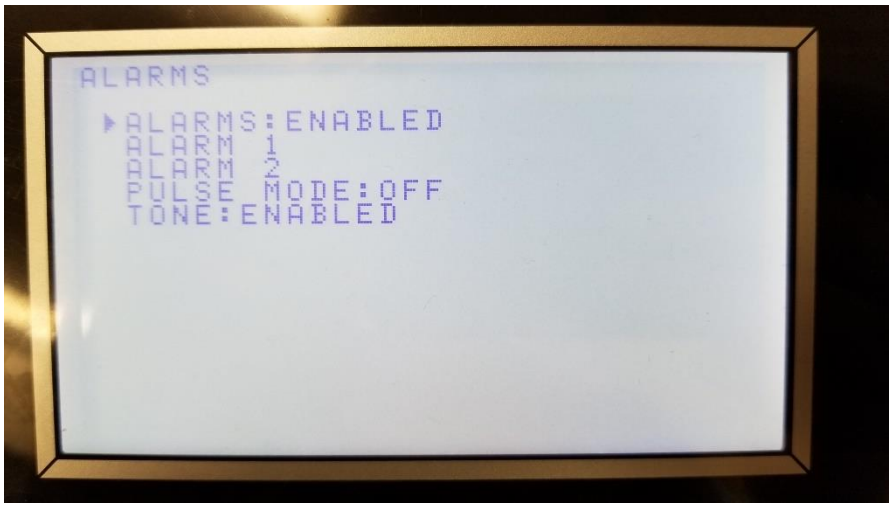
- **Graph Screen:**



  - Press **Enter** to cycle graph (O2, Temperature, Pressure)
  - Press **Menu/Esc** to return to sample screen or Data Logging menu
  - Press **Up/Down** to go to Next/Previous graph page (page number is displayed in upper-right corner, page 1 is most recent data)
  - Hold **Up/Down** for ½ second to zoom graph to next higher/lower range
- **Restart**: Clears any information on the graphs and starts from zero.
- **Interval**: Sets the logging interval in minutes.
- **Time**: The user can change to time to match the location the analyzer is located.
- **Date**: The user can change the date to match the location the analyzer is located.
- **Datapoints**: How many datapoints have been taken since the data logging has begun.
- **Started**: The date and time data logging began.
- **Avg:** Average O2 reading of the sensor.
- **High**: Highest O2 reading since beginning of data logging.
- **Low:** Lowest O2 reading since beginning of data logging.

Alarms

In the Alarms Menu the user has the following options.



- Alarms: Enable or Disable both alarms.
- Alarm 1:
    - Enable or Disable Function
    - Setpoint: Set the value that the user wishes for the alarm to trigger.
    - Mode: Low or High. If set Low the alarm will trigger when the reading travels below the setpoint. If set High the alarm will trigger when the reading travels above the setpoint.
    - Delay: Sets a timer delay for the alarm. When the O2 reading reaches the setpoint, the alarm will trigger once the delay timer has expired. Setting delay to 00 will trigger the alarms immediately when the O2 reading reaches the setpoint.
    - Latching: If YES, active alarm must be manually bypassed.
    - Failsafe: If YES, alarm relay is energized while inactive, de-energized while active.
- Alarm 2: Same as Alarm 1.
- Pulse Mode: Disables Alarm 2. Relay 1 energizes for 3 seconds on activate, relay 2 energizes for 3 seconds on de-activate.
- Tone: Enables/Disables the beeper when alarms are triggered.

System Menu

Security

- Lock Now: Will go to sample screen and require a user passcode to enter menus. (Default passcode: 2855).
- Set Passcode: Will allow the user to set a passcode.
- Auto Lock: Locks the menu if no keys are pressure for the set time. Setting to 0 disables Auto Lock.

Analog Output

- Output Hold:
    - Display: Analog output follows the displayed O2.
    - Freeze: Analog output stops updating and holds the last output reading.
    - Zero: Analog outputs 0V or 4mA.
    - Full-scale: Analog outputs 1V, 5V, or 20mA.
- Calibrate 0-1V: Allows the user to calibrate the 0-1V output.
- Calibrate 0-5V: Allows the user to calibrate the 0-5V output.
- Calibrate 4-20mA: Allows the user to calibrate the 4-20mA output.
- Test: Using Up/Down keys allows the user to test the analog outputs in increments of 20%.

Signal Conditioning

- None: No signal conditioning applied to the O2 signal.
- Average: Rolling average over the number of samples (N) provided by the user. A new sample is taken every second.
- Fast:
    - A: Attenuation. Change of reading divided by the attenuation equals final change in reading.
    - T: Threshold. Set % of full scale of the signal that would be attenuated. The threshold compares the current sample reading to the previous sample. i.e. T =2% of 500ppb range, 2% is 10ppb. Any reading change of less than 10ppb will divide the change of reading by the attenuation factor. So, if A = 100 and change of reading is 5ppb then the reading will only change by 0.05%.

Auto Bypass

When the O2 reading travels to 20% of the 3rd range the analyzer will automatically switch to bypass valves to ensure the sensor does not get exposed to high amounts of oxygen. Exposure to high amounts of oxygen will damage the sensor and auto bypass will help protect the sensor.

Show Negative

The analyzer provides the user with the option to choose whether they wish to display negative readings. This feature is useful if the user prematurely zeroes the analyzer either inadvertently or knowingly during a quick start situation.

Unit ID

User customizable identification of the analyzer. The name given to the analyzer displays on the top center of the sample screen.

Temperature

User selectable temperature units, to display the temperature in either Fahrenheit or Celsius.

Pressure

User selectable pressure units, to display the pressure in either PSI or KPA.

Date Format

User selectable data format:

- YY/MM/DD
- DD/MM/YY
- MM/DD/YY

Info

The information screen displays the analyzer characteristics such as model number, serial number, firmware version, and more.

Standby and Storage

Short term shutdown

This procedure is for momentarily shutting down and moving the analyzer from one site to another or for a temporary shutdown.

1. After short term shutdown, to restart,
   1.1. Establish power to analyzer
   1.2. Set sample flow rate to 1-2 SCFH
   1.3. Allow sample line to purge for 5 minutes
   1.4. Move crossover valve to Sample and begin sampling

If the **analyzer is not to be used** for analyzing a sample gas, it is recommended that you keep the analyzer running and have pure nitrogen (at least 99.999) flow through analyzer (to preserve gas, a flow rate as low as 0.1 SCFH should be sufficient). This will always keep analyzer in "ready state" for analyzing sample gases.

Long term Shutdown

If analyzer is to be stored for a long period of time (greater than 30 days), it is recommended to remove sensor from analyzer and store analyzer in a clean environment. This is to prevent the likelihood of electrolyte leaking out of sensor and damaging the sensor housing. WHEN STARTING ANALYZER AGAIN, YOU MUST INSTALL A NEW SENSOR

Installation & Start-up is now complete . . . Proceed to calibrate the Analyzer

The electrochemical oxygen sensors manufactured by Analytical Industries Inc. (dba Advanced Instruments) generate an electrical current that is **linear** or proportional to the oxygen concentration in the sample gas. In the absence of oxygen the sensor exhibits an **absolute zero**, e.g. the sensor does not generate a current output in the absence of oxygen. Given the properties of linearity and an absolute zero, single point calibration is possible.

As described below, zero calibration is recommended only when the application (or user) demands optimum accuracy for analysis below 5% of the most sensitive or lowest range available on the analyzer. Span calibration in one of the forms described below is sufficient for all other measurements.

Zero Calibration

Despite the absolute zero inherent in electrochemical oxygen sensors, the reality is that analyzers can display an oxygen reading when sampling a zero gas due to:

- Contamination or quality of the zero gas
- Minor leakage in the sample line connections
- Residual oxygen dissolved in the sensor's electrolyte
- Tolerances of the electronic components

The zero capability of every analyzer is qualified prior to shipment. However, because the factory sample system conditions differ from that of the user, no ZERO OFFSET adjustment is made to the analyzer by the factory

NOTE: zero calibration is recommended only when the application (or user) demands optimum accuracy for analysis below 5% of Full Scale of the most sensitive or lowest range available on the analyzer

Zero Calibration Procedure

GPR-2600 analyzer has no integral oxygen scrubber to produce zero gas from sample gas. An external source of zero gas is required to perform zero calibration. To perform Zero calibration, follow the steps below.

In order to perform a ZERO calibration,

- From the MAIN MENU screen, select Calibration.
- From CALIBRATION menu, select Zero Calibrate.
- On the bottom left of the LCD Zero Cal will appear with Up = Accept, Down = Abort. A timer of 30 minutes will appear underneath the valve mode selected. After the 30-minute timer is up then the analyzer will attempt to perform the zero calibration. The user may Accept or Abort the calibration at any time. Ensure reading is stable before prematurely Accepting the zero calibration.

After ZERO calibration, analyzer will automatically return to the previous valve mode selected.
CAUTION: If zero calibration is performed pre-maturely (analyzer still trending down), analyzer may show a negative reading in the SAMPLE mode.

Span Calibration

Involves periodically checking and/or adjusting the electronics to the sensor's signal output at a given oxygen standard or a span gas. To minimize error due to ambient temperature variations, span calibration of the analyzer must be done as close as possible to the sampling temperature conditions. The frequency of calibration varies with the application conditions; the degree of accuracy of the measurement required. However, the interval between span calibrations should not exceed one (1) months.

Note: Regardless of the oxygen concentration of the standard used, the span calibration process takes approximately 10-15 minutes

Span Calibration Procedure

Analyzer may be calibrated by using a certified span gas with oxygen content 50-80% of the sampling range or one range above, balance nitrogen.
To enter a span gas value:

- Go to the Calibration Menu.
- Select Span Gas: 20.90 %
- Using the Up/Down and Enter keys select the span gas value listed on the gas tank.
- Once the span gas value has been selected, select Span Background Gas: Nitrogen.
- Select span background gas and press Enter.

To initiate a span calibration

- Select Span Calibrate on the Calibration Menu.
- The valves will actuate to Span Bypass for 30 seconds to ensure the line is purged down before continuing to Span Calibration.
- On the bottom left of the LCD Span Cal will appear with Up = Accept, Down = Abort. A timer of 30 minutes will appear underneath the valve mode selected. After the 30-minute timer is up then the analyzer will attempt to perform the span calibration. The user may Accept or Abort the calibration at any time. Ensure reading is stable before prematurely Accepting the span calibration.

Normal Sampling

After installation and calibration is complete, select the Sample from the main Menu. Choose the Auto or Manual range option. The analyzer will immediately begin to analyze the gas sample and display the real time oxygen concentration on the screen.

When switching sample gas streams, a sudden spike in the analyzer signal might appear. Allow sufficient time to the analyzer to stabilize before starting to collect the real time analysis data. The analyzer data may be stored in the internal analyzer memory or recorded on a recording device by using the 0-1V or 4-20 mA analog signal. When connecting the analog output to an external recording device, limit the length of cable to less than 6 feet. If possible, use a shielded cable with the shield connected to the ground of the recording device.

6. Maintenance

There are no moving parts in the analyzer given the modular nature of the electronics and sensor. Cleaning the electrical contacts when replacing the sensor is the extent of the maintenance required.
Serviceability: Except for replacing the oxygen sensor, there are no parts inside the analyzer for the operator to service. Only trained personnel with the authorization of their supervisor should conduct maintenance.

Sensor Replacement
Periodically, the oxygen sensor will require replacement. The operating life is determined by a number of factors that are influenced by the user and therefore difficult to predict. The sections dealing with Specification and Installation Considerations define the normal operating conditions and expected life of the standard sensor utilized by the GPR-2600 analyzer. As a general guideline, expected sensor life is inversely proportional to changes in oxygen concentration, pressure and temperature.

The signal output of a PPM sensor (GPR-11-32-4 OR XLT-12-24-) in air ranges from 40 uA to 55 uA. You may check the sensor output of a sensor by using an ammeter (set ammeter in the micro-amp mode and connect the com of the meter to the inner gold contact and the mA/uA of the meter to the outer gold contact at the back of the sensor). If the output of the sensor in air is not within the expected range, do not install the sensor. Install a new sensor and send the defective sensor to factory for warranty evaluation.

Caution: DO NOT open the oxygen sensor. The sensor contains a corrosive liquid electrolyte that could be harmful if touched or ingested, refer to the Material Safety Data Sheet contained in the Owner's Manual appendix. Avoid contact with any liquid or crystal type powder in or around the sensor or sensor housing, as either could be a form of electrolyte. Leaking sensors should be disposed of in accordance with local regulations.

7. Spare Parts

Recommended spare parts for the GPR-2600 Oxygen Analyzer include:

Item No.	Description
GPR-11-32-4	% Oxygen Sensor
XLT-11-24-4	% Oxygen Sensor for Sample containing CO2
GPR-11-32	% oxygen sensor with optional sensor with SS housing
XLT-11-24	% oxygen sensor with optional sensor with SS housing for sample with CO2

Other spare parts:

A-3051	Flow Through SS Housing
*CTRL-1004	Controller Temperature PID
*HTR-1006	Disc Heater
MTR-1008	Meter Digital Panel LCD Backlight
A-1146-40-rG	PCB Assembly Main / Display
A-1147-40-rG3	PCB Assembly Power Supply
*SNSR-1006	RTD Temperature Sensor
*SNSR-1002	Thermal Runaway Protector J-2 Sensor

*Required only if the analyzer equipped with integral heater system

8. Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery	1. At installation, sensor was exposed to air for too long. 2. Defective sensor 3. excessive, dead volume in sample line 4. contaminated sample gas due to leakage in sample line connections 5. Sensor damaged in service due to prolonged exposure to air or electrolyte leakage 6. Sensor nearing end of life	1. Replace sensor 2. If recovery unacceptable or O_2 reading fails to reach 50% of lowest range after 48-72 hours of installation of sensor, check gas connections and gas integrity before replacing sensor again 3. Leak test the entire sample system: 4. Vary the flow rate (1-5 SCFH); O_2 reading that changes inversely to the changes in flow rate indicates a leakage in the sample system bringing gas to the analyzer 5. Correct source of leak 6. Replace sensor
90 % Response time slow	1. Increased dead legs or distance of sample line 2. low flow rate	1. Reduce dead volume by reducing sample tube length 2. Increase flow rate
O2 reading doesn't agree with expected O2 values	1. Pressure and temperature of the sample is varying 2. Abnormality in sample gas 3. Liquid covering sensing area of sensor 4. Presence of interference gases 5. Unauthorized maintenance done 6. Sensor nearing end of life	1. Calibrate the analyzer at the sample temperature, pressure and flow. 2. Confirm O2 contents of sample gas Consult factory 3. Clean sensor's sensing surface 4. Replace sensor, contact factory for sample conditioning 5. Contact factory 6. Replace sensor
Erratic, negative or no O2 reading possibly accompanied by electrolyte leakage	1. Pressurizing the sensor by flowing gas to the sensor with the vent restricted and suddenly removing the restriction draws a vacuum on the sensor, causing electrolyte leakage 2. Contaminated sample or exhausted O2 sensor	Replace sensor Replace sensor, condition sample gas

O2 reading drifts slowly upward	1. Sensor is nearing end of its useful life	1. Replace sensor
span requires large gain adjustment	1. Low sensor output signal possibly due to moisture condensation on sensor from liquid in sample gas or electrolyte leakage from sensor	1. Ensure there is no condensable moisture in the sample gas. Flow sample gas for 2-3 hours to flush moisture from sample system
	2. Presence of interference gases, e.g., ,Cl_2, HCl, H2S	2. Consult factory
O2 reading swings too much with minor variation in ambient temperature	Software bug	Contact factory
The O2 reading freezes even though O2 in sample is changing.	Software bug	Contact factory
No O2 reading with known O2 sample gas.	Defective O2 sensor	Replace O2 sensor
"SENSOR" message appears after Span calibration	Sensor output below the recommended range	Replace sensor

9. Warranty

The design and manufacture of GPR Series oxygen analyzers, monitors and oxygen sensors are performed under a certified Quality Assurance System that conforms to established standards and incorporates state of the art materials and components for superior performance and minimal cost of ownership. Prior to shipment every analyzer is thoroughly tested by the manufacturer and documented in the form of a Quality Control Certification that is included in the Owner's Manual accompanying every analyzer. When operated and maintained in accordance with the Owner's Manual, the units will provide many years of reliable service.

Coverage

Under normal operating conditions, the monitor, analyzers and sensor are warranted to be free of defects in materials and workmanship for the period specified in accordance with the most recent published specifications, said period begins with the date of shipment by the manufacturer. The manufacturer information and serial number of this analyzer are located on the rear of the analyzer. Advanced Instruments Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your Advanced Instruments Inc. monitor, analyzer and/or oxygen sensor is determined to be defective with respect to material and/or workmanship, we will repair it or, at our option, replace it at no charge to you. If we choose to repair your purchase, we may use new or reconditioned replacement parts. If we choose to replace your Advanced Instruments Inc. analyzer, we may replace it with a new or reconditioned one of the same or upgraded design. This warranty applies to all monitors, analyzers and sensors purchased worldwide. It is the only one we will give and it sets forth all our responsibilities. There are no other express warranties. This warranty is limited to the first customer who submits a claim for a given serial number and/or the above warranty period. Under no circumstances will the warranty extend to more than one customer or beyond the warranty period.

Limitations

Advanced Instruments Inc. will not pay for: loss of time; inconvenience; loss of use of your Advanced Instruments Inc. analyzer or property damage caused by your Advanced Instruments Inc. analyzer or its failure to work; any special, incidental or consequential damages; or any damage resulting from alterations, misuse or abuse; lack of proper maintenance; unauthorized repair or modification of the analyzer; affixing of any attachment not provided with the analyzer or other failure to follow the Owner's Manual. Some states and provinces do not allow limitations on how an implied warranty lasts or the exclusion of incidental or consequential damages, these exclusions may not apply.

Exclusions

This warranty does not cover installation; defects resulting from accidents; damage while in transit to our service location; damage resulting from alterations, misuse or abuse; lack of proper maintenance; unauthorized repair or modification of the analyzer; affixing of any label or attachment not provided with the analyzer; fire, flood, or acts of God; or other failure to follow the Owner's Manual.

Service

Call Advanced Instruments Inc. at 909-392-6900 (or e-mail info@aii1.com) between 7:30 AM and 5:00 PM Pacific Time Monday thru Thursday or before 12:00 pm on Friday. Trained technicians will assist you in diagnosing the problem and arrange to supply you with the required parts. You may obtain warranty service by returning you analyzer, postage prepaid to:

Advanced Instruments Inc.
2855 Metropolitan Place
Pomona, Ca 91767 USA

Be sure to pack the analyzer securely. Include your name, address, telephone number, and a description of the operating problem. After repairing or, at our option, replacing your Advanced Instruments Inc. analyzer, we will ship it to you at no cost for parts and labor.

10. MSDS Material Safety Data Sheet

Product Identification

Product Name	Oxygen Sensor Series - PSR, GPR, AII, XLT
Synonyms	Electrochemical Sensor, Galvanic Fuel Cell
Manufacturer	Analytical Industries Inc., 2855 Metropolitan Place, Pomona, CA 91767 USA
Emergency Phone Number	909-392-6900
Preparation / Revision Date	January 1, 1995
Notes	Oxygen sensors are sealed, contain protective coverings and in normal conditions do not present a health hazard. Information applies to electrolyte unless otherwise noted.

Specific Generic Ingredients

Carcinogens at levels > 0.1%	None
Others at levels > 1.0%	Potassium Hydroxide or Acetic Acid, Lead
CAS Number	Potassium Hydroxide = KOH 1310-58-3 or Acetic Acid = 64-19-7, Lead = Pb 7439-92-1
Chemical (Synonym) and Family	Potassium Hydroxide (KOH) – Base or Acetic Acid (CH_3CO_2H) – Acid, Lead (Pb) – Metal

General Requirements

Use	Potassium Hydroxide or Acetic Acid - electrolyte, Lead - anode
Handling	Rubber or latex gloves, safety glasses
Storage	Indefinitely

Physical Properties

Boiling Point Range	KOH = 100 to 115° C or Acetic Acid = 100 to 117° C
Melting Point Range	KOH -10 to 0° C or Acetic Acid – NA, Lead 327° C
Freezing Point	KOH = -40 to -10° C or Acetic Acid = -40 to -10° C
Molecular Weight	KOH = 56 or Acetic Acid – NA, Lead = 207
Specific Gravity	KOH = 1.09 @ 20° C, Acetic Acid = 1.05 @ 20° C
Vapor Pressure	KOH = NA or Acetic Acid = 11.4 @ 20° C
Vapor Density	KOH – NA or Acetic Acid = 2.07
pH	KOH > 14 or Acetic Acid = 2-3
Solubility in H_2O	Complete
% Volatiles by Volume	None
Evaporation Rate	Similar to water
Appearance and Odor	Aqueous solutions: KOH = Colorless, odorless or Acetic Acid = Colorless, vinegar-like odor

Fire and Explosion Data

Flash and Fire Points	Not applicable
Flammable Limits	Not flammable
Extinguishing Method	Not applicable
Special Fire Fighting Procedures	Not applicable
Unusual Fire and Explosion Hazards	Not applicable

Reactivity Data

Stability	Stable
Conditions Contributing to Instability	None
Incompatibility	KOH = Avoid contact with strong acids or Acetic Acid = Avoid contact with strong bases
Hazardous Decomposition Products	KOH = None or Acetic Acid = Emits toxic fumes when heated
Conditions to Avoid	KOH = None or Acetic Acid = Heat

Spill or Leak

Steps if material is released	Sensor is packaged in a sealed plastic bag, check the sensor inside for electrolyte leakage. If the sensor leaks inside the plastic bag or inside an analyzer sensor housing do not remove it without rubber or latex gloves and safety glasses and a source of water. Flush or wipe all surfaces repeatedly with water or wet paper towel (fresh each time).

Disposal

In accordance with federal, state and local regulations.

Health Hazard Information

Primary Route(s) of Entry	Ingestion, eye and skin contact
Exposure Limits	Potassium Hydroxide - ACGIH TLV 2 mg/cubic meter or Acetic Acid - ACGIH TLV / OSHA PEL 10 ppm (TWA), Lead - OSHA PEL .05 mg/cubic meter
Ingestion	Electrolyte could be harmful or fatal if swallowed. KOH = Oral LD50 (RAT) = 2433 mg/kg or Acetic Acid = Oral LD50 (RAT) = 6620 mg/kg
Eye	Electrolyte is corrosive and eye contact could result in permanent loss of vision.
Skin	Electrolyte is corrosive and skin contact could result in a chemical burn.
Inhalation	Liquid inhalation is unlikely.
Symptoms	Eye contact - burning sensation. Skin contact - soapy slick feeling.
Medical Conditions Aggravated	None
Carcinogenic Reference Data	KOH and Acetic Acid = NTP Annual Report on Carcinogens - not listed; LARC Monographs - not listed; OSHA - not listed
Other	Lead is listed as a chemical known to the State of California to cause birth defects or other reproductive harm.

Special Protection Information

Ventilation Requirements	None
Eye	Safety glasses
Hand	Rubber or latex gloves
Respirator Type	Not applicable
Other Special Protection	None

Special Precautions

Precautions	Do not remove the sensor's protective Teflon and PCB coverings. Do not probe the sensor with sharp objects. Wash hands thoroughly after handling. Avoid contact with eyes, skin and clothing. Empty sensor body may contain hazardous residue.
Transportation	Not applicable