GPR-2500 GB
% Oxygen Transmitter

Owner's Manual

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2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, e-mail: info@aii1.com, www.aii1.com

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1. Introduction

Your new oxygen transmitter incorporated an advanced electrochemical sensor specific to oxygen along with state-of-the-art digital electronics designed to give you years of reliable precise oxygen measurements in variety of industrial oxygen applications. To obtain maximum performance from your new oxygen transmitter, please read and follow the guidelines provided in this Owner's Manual.

Every effort has been made to select the most reliable state of the art materials and components, to design the transmitter for superior performance and minimal cost of ownership. This transmitter was tested thoroughly by the manufacturer prior to shipment 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 transmitter is your assurance that we stand behind every transmitter sold.

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

Serial Number: _____

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

Quality Control & Calibration Certification

Customer: _____ **Date:** _____

Order No.: _____

Model:	GPR-2500 Oxygen Transmitter	**S/N:**	
Configuration:	A-1161-IS-2 Rev C4 PCB Assembly, Main	**Batch:**	
	A-1182-2 Rev B PCB Assembly, Interconnection (18-28 VDC)	**Batch:**	
	Ranges: 0-1%, 0-5%, 0-10%, 0-25%	**Software Ver:**	
	Temperature compensation		
	A-2221 Flow Housing, 1/8" SS tubing, connections		
	Wall mount enclosure, painted aluminum 3"x4"x2"		
Sensor:	( ) GPR-11-32-4 Oxygen Sensor		
	( ) XLT-11-24-4 Oxygen Sensor	**S/N:**	
Accessories:	Owner's Manual		
	B-3170 Sample / Calibration Module		

		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% Oxygen		
	Noise level (±1% FS) on 1% range	± 0.01% Oxygen		
	Analog signal output 4-20 mA full scale			
	Overall inspection for physical defects			

Options: _____ NA

Other: _____ NA

3. Safety

General

This section summarizes the essential precautions applicable to the GPR-2500 GB percent Oxygen Transmitter. Additional precautions specific to individual transmitter are contained in the following sections of this manual. To operate the transmitter 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.

Warning: This symbol is used throughout the Owner's Manual to **Warn** and alert the user of the presence of electrostatic discharge.

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 transmitter 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 all warnings on the transmitter, accessories (if any) and in this Owner's Manual.
Follow Instructions: Observe all precautions and operating instructions. Failure to do so may result in personal injury or damage to the transmitter.

Pressure and Flow

GPR-2500 GB PPM Oxygen Transmitter is designed for measuring controlled atmosphere inside a glove box. Calibration requires a flowing span gas and using the Glove Box Housing Assembly (refer to photo section 4 Specification) which is equipped with 1/8" tube fitting connections and are intended to operate at positive pressure or for calibration with external span gas, inlet pressure but be regulated to 5-30 psig. The sample/span gas must be vented to atmospheric pressure.

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 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.

Mounting

The transmitter is approved for indoor use only. Mount the transmitter as recommended by the manufacturer.

Power supply

Supply power to the transmitter only as rated by the specification or markings on the transmitter enclosure. The wiring that connects the transmitter to the power source should be installed in accordance with recognized electrical standards. Never yank wiring to remove it from a terminal connection. Power consumption is less than 60 mA at 24 VDC.

Operating temperature

The maximum recommended operating temperature is 45ºC, (at temperatures above 25°C, the user is expected to accept a dramatic reduction in expected sensor life – refer to analyzer specification). On intermittent basis, the transmitter may be operated up to 50°C

Heat

Situate and store the transmitter away from sources of heat.

Liquid and object entry

The transmitter should not be immersed in any liquid. Care should be taken so that liquids are not spilled on and objects do not fall on the transmitter

Maintenance

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

Troubleshooting

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

Do not attempt to make repairs by yourself as this will void the warranty as per Section 10 and may result in electrical shock, injury or damage. All other servicing should be referred to qualified service personnel.

CLEANING: The transmitter 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. Do not touch the transmitter enclosure without first touching any solid conducting surface (to discharge any electrostatic charge on the body)

Non-use period

If the transmitter is equipped with a range switch advance the switch to the OFF position and disconnect the power when the transmitter is left unused for a long period of time. Store transmitter away from source of heat.

4 Features & Specifications

Technical Specifications *

Accuracy:	< 2% of FS range under constant conditions
Analysis:	0-1%, 0-5%, 0-10%, 0-25% FS ranges; auto-ranging or fixed single range
Application:	Monitoring the oxygen content of glove boxes and ambient atmospheres in confined spaces for oxygen depletion
Area Classification:	General purpose
Calibration:	Max interval—3 months. Air calibrate with clean source of certified span gas, compressed, or ambient (20.9% O2) air on 0-25% range.
Compensation:	Temperature
Connections:	1/8" compression tube fittings
Controls:	Water resistant keypad; menu driven range selection, calibration and system functions
Display:	Graphical LCD 2.75″ x 1.375″; resolution 0.001%; displays real time ambient temperature and pressure
Enclosure:	Painted aluminum, 3″x4″x2", 2 lbs.
Flow:	Ambient monitoring - not applicable; Not flow sensitive, 1-2 SCFH flow rate recommended
Linearity:	±1% of full scale
Pressure:	Ambient monitoring - ambient; Calibration and flowing gas systems: 5-30 psig
Power:	18-28 VDC two wire loop
Response Time:	90% of final reading in 13 seconds
Sample System:	None; optional glove box Sample Calibration Module
Sensitivity:	< 0.5% of FS range
Sensor Model:	GPR-11-32-4 for non-acid (CO_2) gas atmospheres XLT-11-24-4 for gases containing > 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 non-isolated
Operating Range:	5ºC to 45ºC (GPR sensor); -10º to 45ºC (XLT sensor)
Warranty:	12 months analyzer; 12 months sensor

Optional Equipment

Sample Calibration Module (B-3170)

Remote sensor (shown right)

* Subject to change without notice

GPR-2500 GB
Glove Box / Area Monitor
Oxygen Transmitter

2 Wire Loop Power
Advanced Galvanic Sensor Technology

(B-3170)

ISO 9001:2008 Certified
INTERTEK Certificate No. 485

2855 Metropolitan Place, Pomona, CA 91767 USA ♦ Tel: 909-392-6900, Fax: 909-392-3665, www.aii1.com, e-mail: info@aii1.com Rev 11/15

5. Operation

Principle of Operation

The GPR-2500 GB incorporates a variety of advanced galvanic fuel cell type oxygen sensors. These sensors are very specific to oxygen and generate an electrical signal proportional to the amount of oxygen present in a gas stream. The selection of a particular type of sensor depends on the composition of the sample gas stream. Consult the factory for recommendation.

Advanced Galvanic Sensor Technology

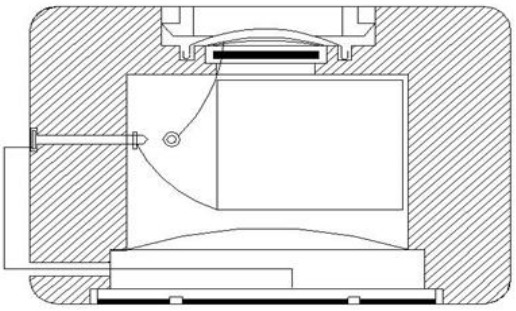
All galvanic type sensors function on the same principle and are specific to oxygen. They measure the partial pressure of oxygen from low PPM to 100% levels in inert gases, gaseous hydrocarbons, helium, hydrogen and mixed gases

Design Objectives

- Improve quality and reliability through a proprietary controlled manufacturing process . . .
- Comply with domestic and international quality standards
- Compact disposable dimensions
- No sensor maintenance
- Improve performance over replacement sensors - sensitivity, stability, response, recovery
- Longer operating and shelf life - translate into longer warranty period
- Low cost of ownership

% Oxygen Sensors

- Extend operating life to 10 years in air (20.9% O_2) . . .
  24 months in continuous 100% O_2
- Extended operating range to –40º C/F to 50º C
- Excellent stability at elevated pressure . . .
  Up to 10 atmospheres in hyperbaric chambers
- Superior compatibility with 0.5 - 100% CO_2 gas streams
  24 month operating life in traditional dimensions
- Develop special sensor for fast response and long life
  Large cathode with proprietary electrolytes and anodes



GPR/XLT 11 Series % Oxygen Sensor

Oxygen, the fuel for this electrochemical transducer, diffusing into the sensor, reacts electrochemically 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.

Proprietary advancements in design and chemistry add significant advantages to this extremely versatile oxygen sensing technology. Sensors for low % analysis recover from air to low % levels in seconds, exhibit longer life and reliable quality. The expected life of our new generation of percentage range sensors now range from 32 months to ten years with faster response times and greater stability. Another significant development involves expanding the operating temperature range for percentage range sensors from -20°C to 50°C. Contact factory for more specific information about your application.

Electronics

The signal generated by the sensor is processed by state of the art low power micro-processor based digital circuitry. The first stage amplifies the signal. The second stage eliminates the low frequency noise. The third stage employs a high frequency filter and compensates for signal output variations caused by ambient temperature changes. The result is a very stable signal. Sample oxygen is analyzed very accurately. Response time of 90% of full scale is less than 10 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 low range. Oxygen readings may be recorded by an external device via the 4-20 mA loop current or 1-5 VDC by using a 250 ohms resistor between the negative terminal of the transmitter and the ground of the loop power source.

NOTE: A 4-20mA signal output is provided on the two-wire 18-24VDC loop power source such as a PLC and represents a full scale range of measurement. When operated in conjunction witt manufacturer's recommended optional intrinsic safety barrier, the GPR-2500 GB meets the intrinsic safety standards required for use in Class 1, Division 1, Groups C, D hazardous areas.

The GPR-2500 GB is also available in a version, requiring optional intrinsic safety barriers, that has been certified to ATEX Directive 94/9/EC, Ex II 2 G Ex ia IIB T4 Gb Tamb -20ºC to + 50ºC

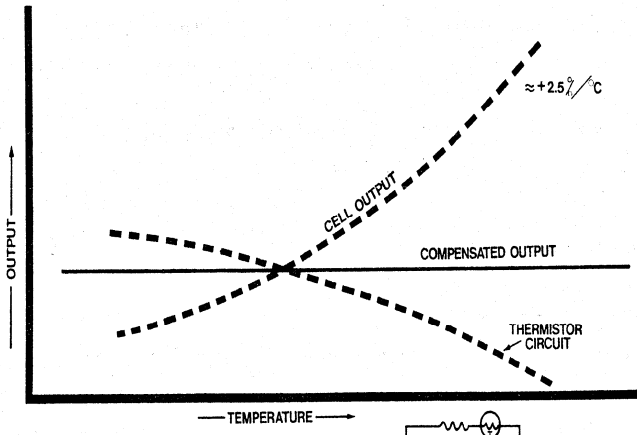
Sample System

The GPR-2500 GB is supplied with a unique Glove Box Housing Assembly that also includes a mounting bracket for sampling (see photo section 4 Specifications) and flow housing with valves for calibration.

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

Accuracy and Calibration

Single Point Calibration: As previously described the galvanic type 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 these 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 or percentage 'per unit volume'.

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' and all diffusion processes are temperature sensitive, the fact the sensor's electrical output will vary with temperature is normal. This variation is relatively constant (2.5% per ºC). A temperature compensation circuit employing a thermistor and a network of resisters offsets this effect with an accuracy of ±5% or better over a wide operating temperature range e.g., 5-45 °C can be obtained thus the signal output remains virtually independent of ambient temperature. There is extremely low error in measurement if the calibration and sampling are performed at similar temperatures (within +/- 5 ºC. Conversely, a temperature variation of 10 ºC may produce an error of >2% of full scale.

Accuracy: In light of the above parameters, the overall accuracy of an analyzer is affected by two types of errors: 1) 'percent of reading errors', illustrated by Graph A below and 2) 'percent of full scale errors', illustrated by Graph B, such as1-2% errors in readout and calibration devices. Other errors are 'spanned out' during calibration, especially when analyzer is calibrated close to the top end of the measuring range.

Transmitter Installation Considerations

Contents of sample stream

Ensure the gas stream or composition of the controlled atmosphere of the application is consistent with the specifications and review the application conditions before initiating the installation. Consult the factory if necessary to ensure the sample is suitable for analysis.

Sample pressure and flow

All electrochemical oxygen sensors respond to partial pressure changes in oxygen. The sensors are equally capable of analyzing the oxygen content of a flowing sample gas stream or monitoring the oxygen concentration in a controlled atmosphere.

Sample system for measuring oxygen in a flowing gas samples is generally required. The use of stainless steel tubing and fittings is critical for maintaining the integrity of the gas stream to be sampled

A flow indicator with an integral metering valve upstream of the sensor is recommended as a means of controlling the flow rate of the sample gas. A flow rate of 2 SCFH or 1 liter per minute is recommended for optimum performance.

Application - Sample Pressure - Positive

A flow indicator with integral metering valve positioned upstream of the sensor is recommended for controlling the sample flow rate between 1-2 SCFH. To reduce the possibility of leakage for low ppm measurements, position a good quality needle valve upstream of the sensor to control the flow rate and position a flow indicator downstream of the sensor. If necessary, a pressure regulator (with a metallic diaphragm) is recommended upstream of the flow control valve to regulate the inlet pressure between 5-30 psig.

Application - Sample Pressure - Atmospheric or slightly negative

For sample at atmospheric pressure, (except when measuring oxygen in a glove box), an optional external sampling pump should be positioned downstream of the sensor to draw the sample from the process, by the sensor and out to atmosphere. Install a flow meter downstream of the sensor to control the flow through the sensor housing.
For sample at less than atmospheric pressure, push the sample through the sensor housing by positioning the pump and the needle valve upstream of the sensor. In either application, when pump is used, set the flow approximately at 1-2 SCFH.

NOTE: If pump loading is a consideration, a second throttle valve on the pump's inlet side may be necessary to provide a bypass path so the sample flow rate is within the above parameters.

Recommendations to avoid erroneous oxygen readings and damaging the sensor:

- Assure there are no restrictions in the sample or vent lines
- Avoid drawing a vacuum on the sensor that exceeds 14" of water column pressure
- Avoid excessive flow rates above 2 SCFH which generate backpressure on the sensor.
- Avoid sudden changes in the sample pressure.
- Avoid the collection of liquids or particulates on the sensor, they block the diffusion of oxygen into the sensor.

Removal of moisture & particulates from sample gas

Installation of a suitable coalescing and/or particulate filter is required to remove condensation, moisture and/or particulates from the sample gas to prevent erroneous analysis readings and damage to the sensor. Moisture and/or particulates do not necessarily damage the sensor, however, collection on the sensing surface can block or inhibit the diffusion of sample gas into the sensor resulting in a reduction of sensor signal output – and the appearance of a sensor failure when in fact the problem is easily remedied by blowing off the liquid condensed on the front of the sensor.

Power & Signal Connections

Power input connections

Transmitter is designed to operate with 18-24 VDC loop power. It provides 4-20 mA signal representing full scale of analysis on the power loop.

Locate the appropriate power source, for example, a PLC to meet the transmitter power requirements, Connect power to the power input terminal block mounted on the side of the main enclosure. Ensure that positive of the power source is connected to the + of the terminal block of the transmitter and the ground of the power is connected to the - terminal of the transmitter.

Signal output connections

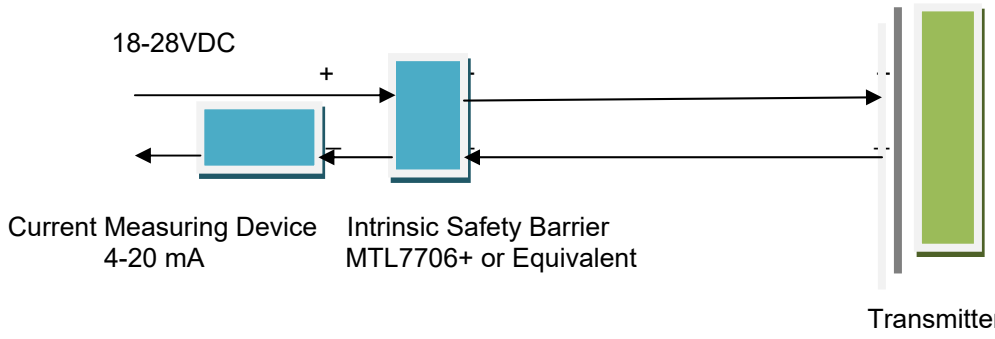
The 4-20mA current output is obtained by connecting the current measuring device between the negative terminal of power source and the negative terminal, marked (-), located in a small box mounted on the side of the main transmitter enclosure. The current flows from pin 1 (+ terminal) to pin 2 (negative terminal) and from pin 2 to ground of the power source.

To check the 4-20 mA signal output, connect an ammeter, as illustrated below, as the current measuring device and confirm the output is within 4 mA +/- 0.1mA with the transmitter LCD display reading 000.

Hazardous area operation

When used in conjunction with the optional intrinsic safety barriers, the design of the GPR-2500 GB meets recognized standards as intrinsically safe for operation in Class I, II, III; Division I, II; Groups C-G hazardous areas.

The GPR-2500 GB is also available in a version, requiring optional intrinsic safety barriers, that has been certified to ATEX Directive 94/9/EC, Ex II 2 G Ex ia IIB T4 Gb Tamb -20ºC to + 50ºC



Power input and signal output connections employing an intrinsic safety barrier

Locate the optional intrinsic safety barrier as close to the power source in the non-hazardous area as possible.

Mounting the Transmitter

The GPR-2500 GB electronics enclosure and the sensor housing assembly (sensor housing designed for mounting inside of Glove Box) can be mounted on any flat surface. Ideally, the transmitter electronics should be installed outside of the glove box.

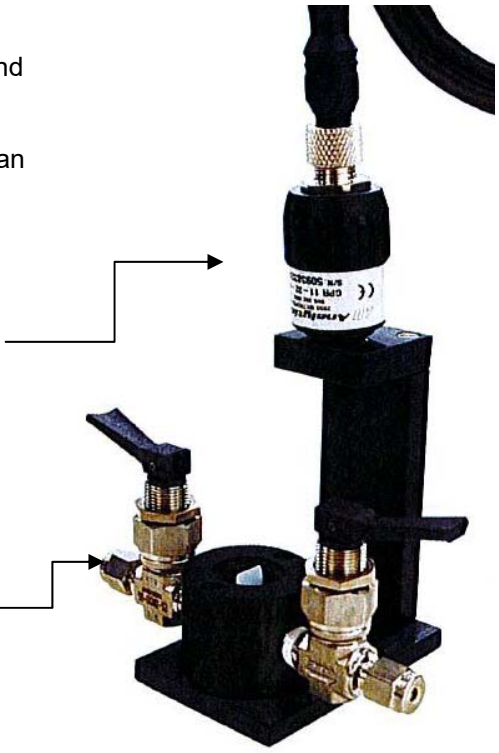
CAUTION: Minimize the length of cable from the sensor to the transmitter electronics (longer cable could pick up EMI/RFI interfering signal that may interfere with oxygen measurements. Furthermore, power to the transmitter should run through a separate conduit (bundling up power with other power cords may create interference with measurements).

Gas Connections:

The GPR-2500 GB is designed for measuring a controlled atmosphere and requires that the sensor be screwed into the upper section of the Glove Box Housing Assembly, as shown in the picture. However, the sensor housing with two toggle valves is provided to bring the span gas in for span calibration of the transmitter (during span calibration, the sensor must be mounted in the sensor housing).

Sensor mounted in the upper section of the sensor housing

Sensor housing with two toggle valves for span calibration with a span gas



Installation of Oxygen Sensor

The GPR-2500 GB Oxygen Transmitters are tested and calibrated prior to shipment and accompanied by a qualified oxygen sensor packaged in a separate shipping container. The sensor must be installed as instructed below.

Procedure

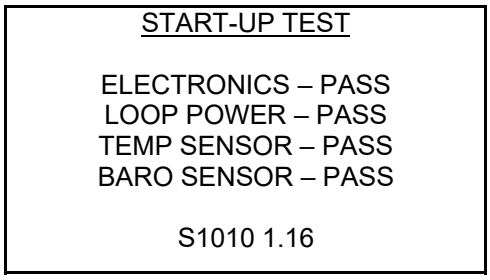
Caution: Do not change the factory settings until instructed to do in this manual.

1. Open the barrier bag containing the new sensor.
2. Remove the spring from inside of the round metal connector of the sensor (the spring keeps the positive and negative terminals of the sensor shorted to ensure that sensor is ready to use in a relatively short period of time after installation). **Note:** After removing the spring, the sensor must be connected to the sensor cable immediately. Failure to do so will prolong the time the sensor will require to stabilize.
3. Screw the oxygen sensor into the sensor housing. Finger tighten plus one eighth (1/8) turn to ensure a good seal between the sensor housing and the o-ring affixed to the sensor.
4. Assure the keyway registration of the female plug on the cable and male receptacle on the sensor match up.
5. Push the female plug (including the knurled lock nut) molded to the cable into the male receptacle attached to the new sensor.
6. Screw the knurled lock nut attached with the cable onto to the male connector of the sensor.
7. Proceed to calibration.

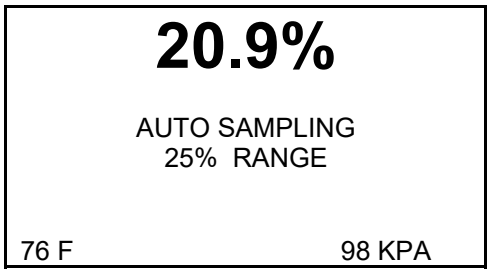
Establishing Power to the Electronics

Once the two wires of the shielded cable are properly connected to the terminals marked "POWER IN" in the small enclosure on the side of main transmitter enclosure, connect the other ends of the two wires to a suitable 18-24 VDC power supply such as a PLC, DCS, etc.

When power is applied, the transmitter performs several self-diagnostic system status checks termed “START-UP TEST” as illustrated below:



After self-diagnostic tests, transmitter display defaults automatically to the sampling mode and display the oxygen signal value seen by the sensor..

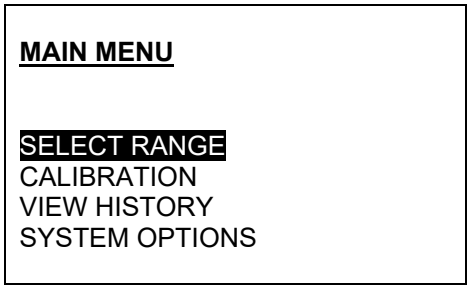


Menu Navigation

The four (4) pushbuttons located on the front of the transmitter operate the micro-processor:
Blue ENTER (select)
yellow UP ARROW
yellow DOWN ARROW
Green MENU (escape)

Main Menu

Access the MAIN MENU by pressing the MENU key:



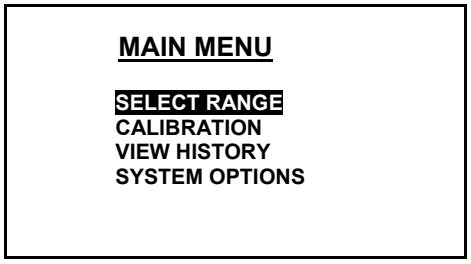
Range Selection

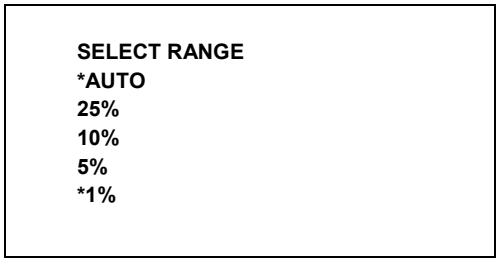
The GPR-2500 GB transmitter is equipped with four (4) standard measuring ranges (see specification) and provides users with a choice of sampling modes. By accessing the MAIN MENU, users may select either the AUTO SAMPLING (ranging) or MANUAL SAMPLING (to lock on a single range) mode.

Note: For calibration purposes, use of the AUTO SAMPLE mode is recommended.

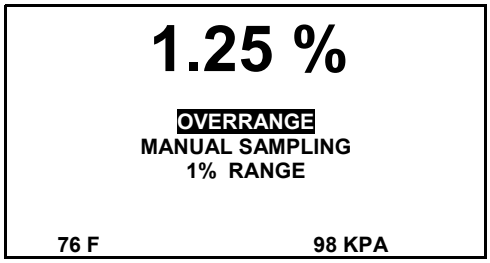
Auto/Manual Sampling

Access the MAIN MENU by pressing the MENU key.
Advance the reverse shade cursor using the ARROW keys to highlight SELECT RANGE and press ENTER
The display will show *AUTO and the actual range of analysis. Press the ENTER to select MANUAL RANGE and advance the cursor to the desired RANGE and press ENTER.
The following display appears:





In the AUTO range, the display will shift to the next higher range when the oxygen reading exceeds 99.9% of the upper limit of the current range. The display will shift to the next lower range when the oxygen reading drops to 85% of the upper limit of the next lower range. In MANUAL range, the analyzer will be locked on the selected range. If the oxygen value goes above 25% of the upper limit of the MANUAL selected range, an OVER RANGE warning will be displayed.



Once the OVER RANGE warning appears the user must advance to the next higher range.
NOTE: With oxygen reading above 25% of the selected range, the analog signal output will increase but will freeze at a maximum value of 1.2 V. After the oxygen reading falls below the full scale range, the voltage signal will become normal.

Analyzer Calibration

The electrochemical oxygen sensors generate an electrical current that is **linear** or proportional to the oxygen concentration in a sample gas. In the absence of oxygen the sensor exhibits an **absolute zero**, i.e., the sensor does not generate a current output in the absence of oxygen. Given the properties of linearity and an absolute zero, a single point calibration is possible.

The analyzer is equipped with “Zero Calibration” feature. However, as described below, zero calibration is recommended only when the application (or user) demands optimum accuracy of below 5% of the most sensitive or lowest range available on the analyzer. For example, if the user requires analysis of a sample gas below 0.05%, zero calibration may be required.

Span calibration, it is necessary to adjust the analyzer sensitivity for accurate measurements of oxygen by using a standardized (certified) oxygen or by using ambient air (20.9%).

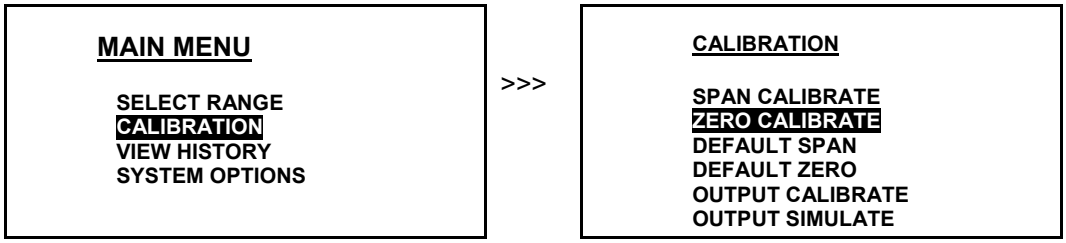
Zero Calibration

The maximum zero offset correction is limited to a maximum of 50% of the lowest (most sensitive) range for positive zero offset and 10% of the lowest range for negative zero offset.

Normally, zero calibration is performed when a new sensor is installed or changes are made in the sample system connections. Allow the ZERO gas to flow through the analyzer and wait until the signal has dropped to a low value and is stable.

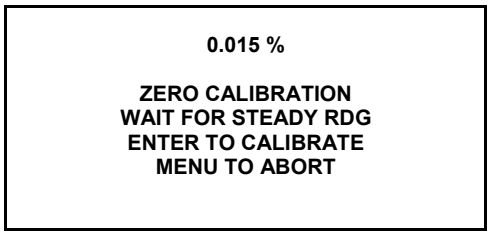
- Access the MAIN MENU by pressing the MENU key.
- Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
- Press the ENTER key to select the highlighted menu option.

The following displays appear:



- Advance the reverse shade cursor using the ARROW keys to highlight ZERO CALIBRATE.
- Press the ENTER key to select the highlighted menu option.

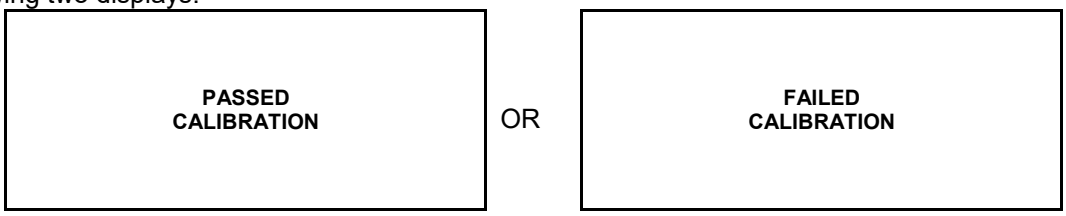
The following displays appear:



Wait until the analyzer reading stabilizes (depending on the history of the sensor and then press the ENTER key to calibrate (or MENU key to abort).

If the offset is less than 50% of the lowest range, by pressing ENTER will pass zero calibration and the transmitter will return to the Sample mode. On the other hand, if the offset is above 50%, pressing ENTER will fail calibration and the transmitter will return to Sample mode without completing the Zero calibration.

When in calibration mode, both Zero Calibration and Span Calibration, pressing the ENTER key results in one of the following two displays:

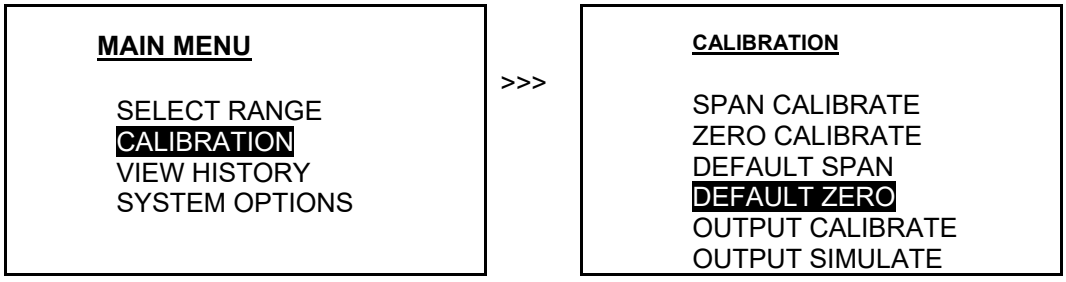


Factory Default Zero Calibration

This feature will eliminate any previous zero calibration adjustment and display the actual signal output of the sensor at a specified oxygen concentration. This feature allows the user to ensure that the accumulative zero offset never exceeds 50% of the lowest range limit. To perform Default Zero Calibration,

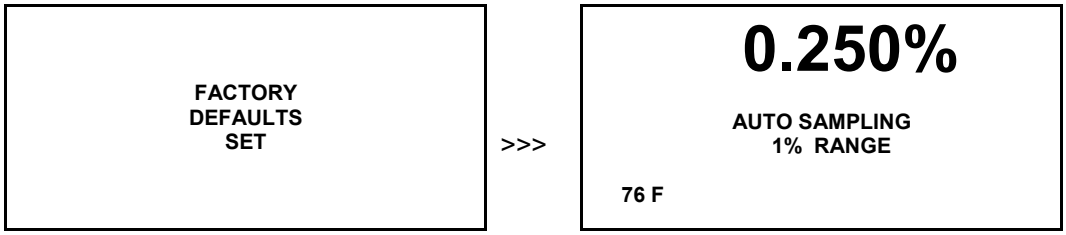
- Access the MAIN MENU by pressing the MENU key.
- Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
- Press the ENTER key to select the highlighted menu option.

The following displays appear:



- Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT ZERO.
- Press the ENTER key to select the highlighted menu option.

The following display appears and after 3 seconds the system returns to the SAMPLING mode:

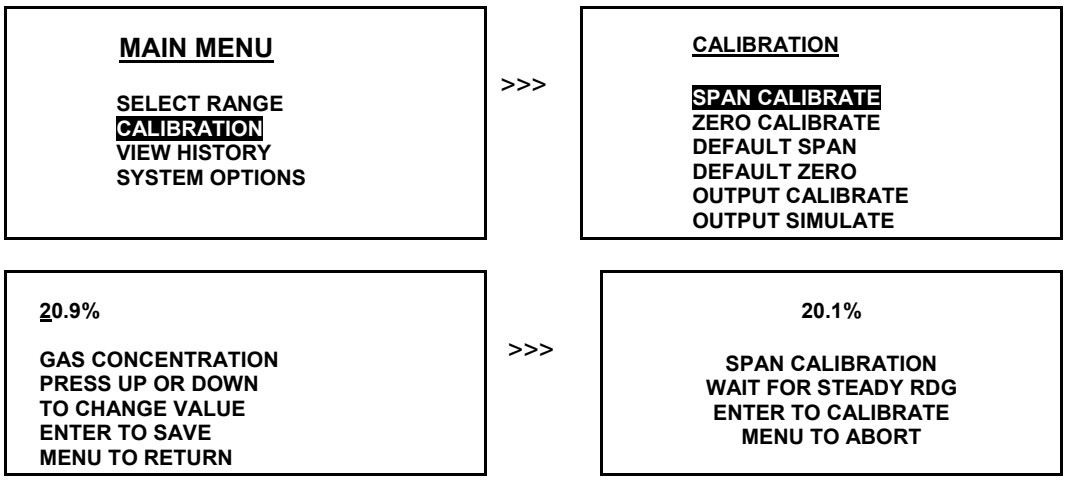


Span Calibration Procedure
Air Calibration

This procedure requires only a source of clean ambient air and removal of the sensor from its flow housing or by pushing ambient air through the sensor housing. To perform air calibration.

- Remove the sensor from the screw-in sensor housing or push the air through the sensor housing thus exposing the sensor to ambient air or alternatively, flow a certified span gas through the sensor housing.
- Advance the cursor on the MAIN MENU to CALIBRATE and press ENTER.
- Advance the cursor to SPAN CALIBRATION and press ENTER

The following displays appear:



- By using the UP or DOWN arrow keys, enter the appropriate digit where the cursor is blinking
- Press the ENTER key to advance the underline cursor right or press the MENU key to advance the underline cursor left to reach to the desired digit of the gas value.
- Repeat until the complete span value has been entered.

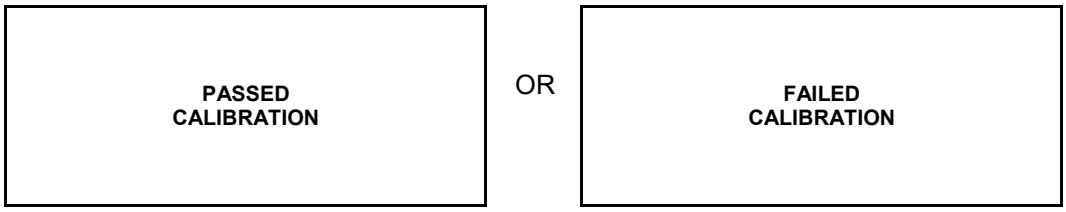
In the example above, a span value of 20.9% has been entered.
After the span value has been entered, the transmitter will prompt to press ENTER key to accept SPAN CALIBRATION or MENU to ABORT.

Caution: Allow the transmitter reading to stabilized before accepting calibration.

After successful calibration, the transmitter will display a message “Passed Calibration” and return to the Sample mode.

NOTE: The transmitter is allowed to accept calibration when O2 reading is within the acceptable window. If the O2 reading is outside of this limit, by pressing ENTER to accept calibration will result in “Failed Calibration” and return to Sample mode without completing Span calibration.

After pressing ENTER either of the following two messages will be displayed and the transmitter will return to SAMPLE mode.

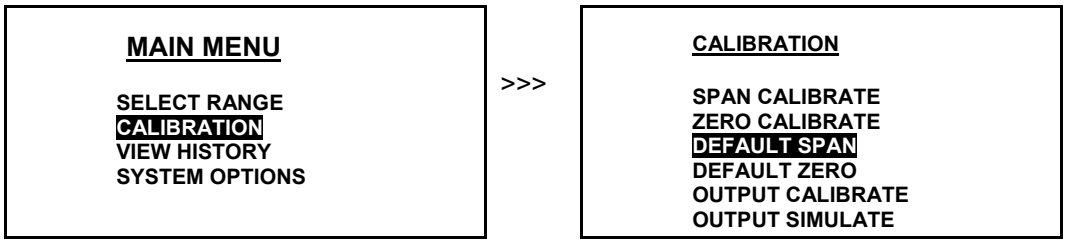


Default Span Calibration

Default Span Calibration will set the oxygen reading based on the actual signal output of oxygen sensor and erase any previous span calibration data. For example, with factory default settings, when a span gas is introduced, the transmitter will display oxygen reading within -30 +50% of the span gas value, indicating that the sensor signal output is within the specified limits. This feature allows the user to check the sensor's signal output to ensure sensor is in good working condition without removing it from the sensor housing. To perform default span calibration.

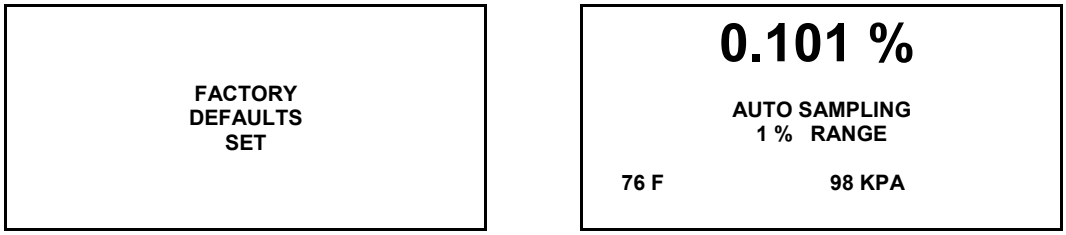
- Access the MAIN MENU by pressing the MENU key.
- Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
- Press the ENTER key to select the highlighted menu option.

The following display appears:



- Advance the reverse shade cursor using the ARROW keys to highlight DEFAULT SPAN.
- Press the ENTER key to select the highlighted menu option.

The following displays appear and after 3 seconds the system returns to the SAMPLING mode:



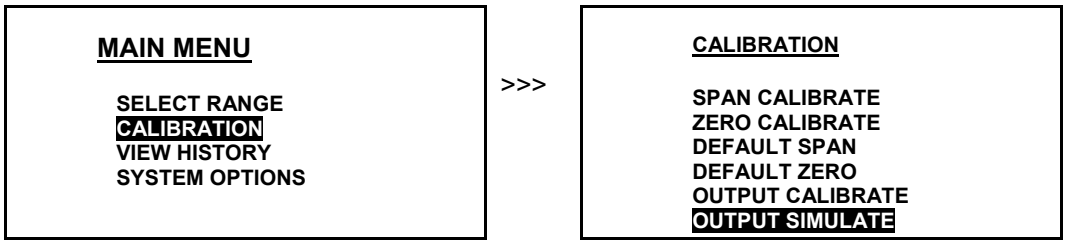
Analog Output Check- Output Simulate

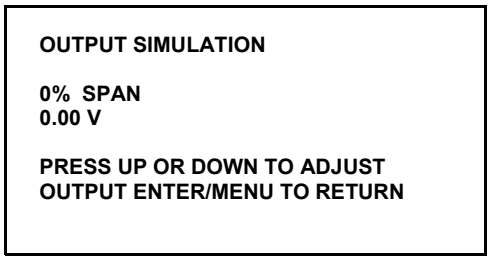
This feature allows the user to simulate the electronics and the signal output. A known current is added to the transmitter electronics internally to generate equivalent 4-20 mA signal output. This feature allows the user to check all interconnections from the transmitter to the signal output recording device before installation of sensor thus preventing the user to open the sensor bag before the transmitter installation is complete and satisfactory. To simulate signal output

- Access the MAIN MENU by pressing the MENU key.

- Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION and then select OUTPUT SIMULATE.
- Press the ENTER key to select the highlighted menu option.

The following displays appear:





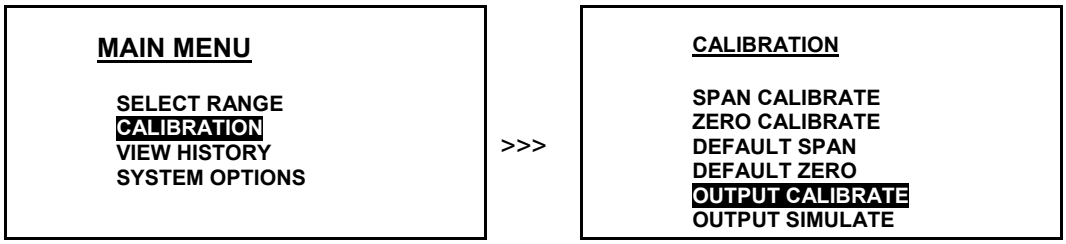
Pressing UP or DOWN key will increase or decrease the output by 5% of the full scale signal each time. Check the output on an external recording device or a voltmeter/ammeter. The output on the external recording would be the % of the full scale signal selected, for example, 0% will represent 4 mA, 25% value will represent 8 mA V and 50% span value will represent 12 mA V of the 4-20 mA full scale. After SIMULATION is complete, press ENTER/MENU key to return to SAMPLE mode.

Note: To perform "Calibrate-Output Simulation", an external recording device must be connected between the negative terminal of the power source and negative terminal of the transmitter.

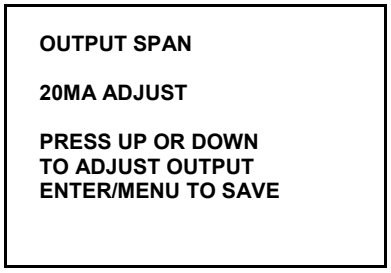
Analog Output Adjustment-Output Calibrate

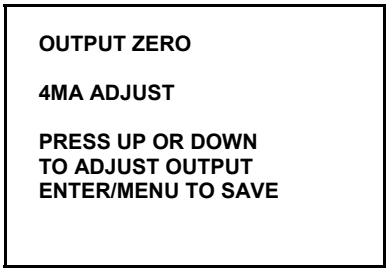
In rare instances the 4-20 mA signal output may not agree with the reading displayed on the LCD. This feature enables the user to adjust the 4-20 mA signal output.

- Access the MAIN MENU by pressing the MENU key.
- Advance the reverse shade cursor using the ARROW keys to highlight CALIBRATION.
- Press the ENTER and then advance the cursor to OUTPUT SPAN and press ENTER. The following displays appear:



- Press the ENTER key to select the highlighted menu option and the following display appears:





- By pressing UP or DOWN arrow, the signal output will change. Keep pressing the Up or DOWN key until the output is matches either 20Ma or 4mA. Note: To perform "Output Calibrate", an external recording device must be connected to the signal output port of the transmitter.
- Press ENTER to SAVE the changes.

Sampling a Gas

GPR-2500 GB Oxygen Transmitter may be used to monitor oxygen in a confined atmosphere such as a glove box or in a sample gas at a positive pressure. As stated above, to monitor oxygen in a glove box, mount the sensor in the upper section of the sensor housing assembly and allow the front end of the sensor exposed to glove box atmosphere. Ensure that the pressure inside of the glove box is relatively stable (minor changes in the pressure inside of glove box may cause the output to change in proportion to the changes in the pressure.

Procedure

Following calibration, the transmitter is ready for sampling a gas. To begin sample gas analysis

- Select the desired sampling mode - auto or manual – as described above.
- Use a suitable tubing to transport the sample gas to the transmitter (unless it is installed inside of a glove box
- For sample gases under positive pressure, the user must provide means of controlling the inlet pressure between 5-30 psig.
- For sample gases under atmospheric or slightly negative pressure, an optional external pump is necessary to push the sample through the sensor housing at recommended sample flow rate.
- Assure the sample is adequately vented for optimum accuracy, response and recovery – and safety.

View History

This feature allows the user to view the maximum, minimum and average O2 concentration, maximum ambient temperature, the number of days the sensor has been in service (at the time of installation and first calibration, the user must enter YES to confirm "new sensor") and the number of days since the last calibration was done.

Electronics System Options

This features allows the user to

- Set security; password protected operation
- Define ranges; choose a range between two ranges, for example, 2% full scale instead of 5% full scale.
- Display signal below 0.00; negative signal, yes or no.

To enter password, from SYSTEM OPTIONS menu, select SECURITY, then enter four digit PASS CODE, numeral numbers only and press ENTER. Then select AUTO LOCK option and enter the number of minutes after which access to MENU options will be locked (access allowed only after entering the PASS CODE).

In the event PASS CODE is lost, enter the factory default PASS CODE 2855 to access the MENU and then re-enter the new PASS CODE.

Choosing the option to display negative number will allow the user to see the display below 0.00 but the output will be locked at 4 mA.

Standby

The transmitter has no special storage requirements.
The sensor should remain connected during storage periods.
Store the transmitter with the power OFF at a safe location and away from a direct heating source.
If storing for an extended period of time protect the transmitter from dust, heat and moisture.

6. Maintenance

Generally, cleaning the electrical contacts or replacing filter elements is the extent of the maintenance requirements of this transmitter.

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 normal operating conditions and expected life of the standard sensor are defined in section 4 Specifications.

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

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. 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-2500 GB Series Oxygen Transmitter:

Item No.	Description
GPR-11-32-4	Oxygen Sensor, for measuring O2 in inert gases
XLT-11-24-4	Oxygen Sensor, for measuring O2 in gases containing CO2

Other spare parts:

Item No.	Description
FITN-1018	Connector SS 1/8" MNPT to 1/8" Tube
B-3170	Glove Box Housing Assembly
A-3051	Housing Flow Adaptor
A-1161-IS-1 Rev C4	PCB Assembly Main
A-1182-1 Rev B	PCB Assembly Interconnection
VALV-1026	Valve, Toggle 1/8" NPT 1/8" Tube

8. Troubleshooting

Symptom	Possible Cause	Recommended Action
Slow recovery	At installation, defective sensor	Replace sensor if recovery unacceptable or O_2 reading fails to reach 10% of lowest range
	Air leak in sample system connection(s)	Leak test the entire sample system: Vary the flow rate, if the O_2 reading changes inversely with the change in flow rate indicates an air leak - correct source of leak
	Abnormality in zero gas	Qualify zero gas (using portable transmitter)
	Damaged in service - prolonged exposure to air, electrolyte leak	Replace sensor
	Sensor nearing end of life	Replace sensor
High O_2 reading after installing or replacing sensor	Transmitter calibrated before sensor stabilized caused by:	Allow O_2 reading to stabilize before making the span/calibration adjustment
	1) Prolonged exposure to ambient air, worse if sensor was unshorted	Continue purge with zero gas
	2) Air leak in sample system connection(s)	Leak test the entire sample system (above)
	3) Abnormality in zero gas	Qualify zero gas (using portable transmitter)
High O_2 reading Sampling	Flow rate exceeds limits	Correct pressure and flow rate
	Pressurized sensor	Remove restriction on vent line or open SHUT OFF valve completely
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO_2 or acid gases are present
	Abnormality in gas	Qualify the gas (use a portable transmitter)
Response time slow	Air leak, dead legs, distance of sample line, low flow rate, volume of optional filters and scrubbers	Leak test (above), reduce dead volume or increase flow rate
O_2 reading doesn't agree to expected O_2 values	Pressure and temperature of the sample is different than span gas	Calibrate the transmitter (calibrate at pressure and temperature of sample)
	Abnormality in gas	Qualify the gas (use a portable transmitter)

Symptom	Possible Cause	Recommended Action
Erratic O_2 reading or No O_2 reading	Test sensor independent from transmitter	Remove sensor from housing. Using a volt-meter set to uA output; apply the (+) lead to the outer ring of the sensor PCB and the (-) lead to the center circle to obtain the sensor's output in air. Contact factory with result. Sensors without PCB use mV setting.
	Change in sample pressure	Calibrate the transmitter (calibrate at pressure and temperature of sample)
	Dirty electrical contacts in upper section of sensor housing	Clean contacts with alcohol (minimize exposure time of MS sensor to ambient air to extent possible)
	Corroded solder joints on sensor PCB from corrosive sample or electrolyte leakage from sensor	Replace sensor and return sensor to the factory for warranty determination
	Corroded spring loaded contact in upper section of sensor housing from liquid in sample or electrolyte leakage from sensor	Upper section of sensor housing: Clean contacts with alcohol, flow sample or zero gas for 2-3 hours to flush sample system and sensor housing Sensor: Replace if leaking and return it to the factory for warranty determination
	Liquid covering sensing area	Wipe with alcohol and lint free towel or flow sample or zero gas for 2-3 hours to flush
	Improper sensor selection	Replace GPR/PSR sensor with XLT sensor when CO_2 or acid gases are present
	Presence of interference gases	Consult factory
	Presence of sulfur gases	Replace sensor and install scrubber
	Unauthorized maintenance	Replace sensor, obtain authorized service
	Sensor nearing end of life	Replace sensor
Erratic O_2 reading or Negative O_2 reading or No O_2 reading possibly accompanied by electrolyte leakage	Pressurizing the sensor by flowing gas to the sensor with the vent restricted or SHUT OFF valve which places a vacuum on the sensor in excess 4" of water column, something which is strongly discouraged. The front sensing membrane is .000625 thick, heat sealed to the sensor body and subject to tearing when vacuum is suddenly applied.	Zero the transmitter. If not successful replace the sensor Avoid drawing a vacuum on the sensor
	A premature adjustment of the ZERO OFFSET potentiometer is a common problem	From MAIN MENU select DEFAULT ZERO

9. Warranty

The design and manufacture of the GPR-2500 GB PPM Oxygen Transmitter is performed under a certified Quality Assurance System that conforms to ISO 9001:2008 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 recommendations in 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. Analytical Industries Inc. reserves the right in its sole discretion to invalidate this warranty if the serial number does not appear on the analyzer.

If your transmitter or any component 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 Analytical Industries 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

Analytical Industries Inc. will not pay for: loss of time; inconvenience; loss of use of your Analytical Industries Inc. analyzer or property damage caused by your Analytical Industries 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, so the above exclusions may not apply to you.

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 909-392-6900 (or e-mail sales-medical@aii1.com) between 8:00am and 5:30pm 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:

Analytical Industries Inc.
dba 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 Analytical Industries 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	KOH = Colorless, odorless aqueous solution or Acetic Acid = Colorless, vinegar-like odor aqueous solution

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).
Waste Disposal Method	In accordance with federal, state and local regulations applicable to the disposal of household batteries.

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 Protective Equipment	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