APPLIED SENSING TECHNOLOGIES

Principle of Operation

Applied Sensing Technologies offers Galvanic type Micro-Fuel cell for sensing oxygen concentration in a gas mixture. These sensors are specific to oxygen and are excellent choice to measure oxygen in a variety of gas mixtures without any significant interference from other gases. These sensors are:

- specific to oxygen
- linear response to oxygen concentration
- relatively small size
- disposable at the end of their useful life
- exhibit absolute zero
- one point calibration
- low drift with long operating life
- no maintenance

The sensing element of the sensor, typically silver or gold plated perforated metal, covered by a gas limiting oxygen barrier, senses oxygen concentration in a gas mixture and provides a current signal proportional to the partial pressure of oxygen. To facilitate oxygen reduction reaction at the sensing element, easily oxidizable metal such as Pb serves as the anode (the electron source). The current flows between the anode and the sensing element via an external circuit. The flow of current is measured and expressed in understandable oxygen measuring units.
The reduction and oxidation reactions are given as

Reuction Reaction

$$O_2 + 2H_2O + 4e \longrightarrow 4OH^-$$

Oxidation Reaction

$$2Pb + 4OH^- \longrightarrow 2PbO + 2\,H_2O + 4e$$

Overall Reaction

$$2Pb + O_2 \longrightarrow 2PbO$$

Key Features of O_2 Sensors

Oxygen sensors are typically small in size and the operating life of the sensor strictly depends upon the rate at which the anode is consumed, which in turns depends upon the rate at which oxygen reaches at the sensing element. The design of the sensor is a compromise between the oxygen level being sensed and the amount of Pb needed to achieve sensor operating life to a reasonable time, typically 12-60 months.

Depending upon the gas limiting barrier used, oxygen sensors generate current signal from low to high uA per unit oxygen concentration. To measure oxygen in sub-PPM level, a higher current signal is needed for good signal to noise ratio. On the other hand, to measure oxygen in the percent level, a much lower current provides a good signal to noise ratio.

Color Coded Ring

Applied sensing Technologies sensors are color coded for easy identification of sensor application. The SRX series sensors are for O2 measurements in innert gasious hydrocabon and hydrogen; blue color for PPM O2 and green for % O2. In the SRZ series sensors, brown color is for O2 measurements in gases containing any level of CO2 and trace levels of H2S.

Sensor Calibration

Sensor signal is usually constant per unit oxygen concentration. However, ambient operationg conditions could affect the sensor signal, thus requiring perioding calibration. As stated, sensor signal is always proportional to the partial pressure of oxygen in a gas mixture, double the partial pressure - double the signal, no oxygen - no signal. This charecteristic of the sensor allows a single point calibration. Percent oxygen sensors could be calibrated in ambient air (20.9% oxygen at ambient pressure).

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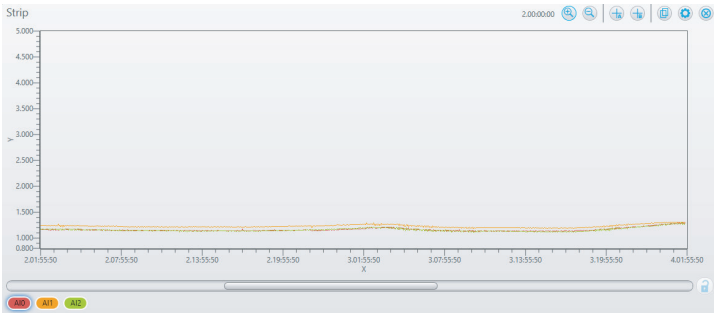
PPM oxygen sensors could be calibrated in ambient air but this option takes a significant amount of time for the sensor to recover to low PPM level (upwards of 60 minutes), therefore, a span gas containg 8-80 PPM oxygen is recommended for calibrtion. Typical calibration interval is 1-3 months.

Temperature Effect

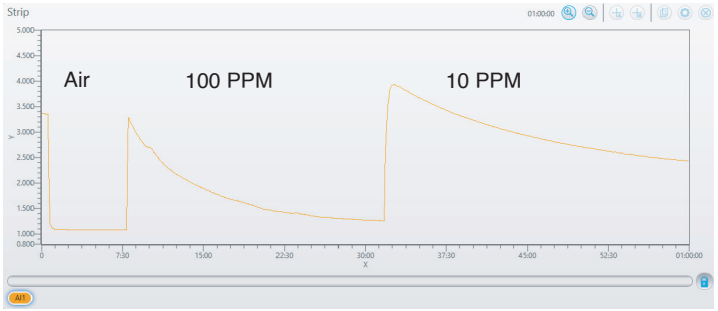
Sensor signal is also dependent on ambient temperature, sensor signal increases exponentially with increasing temperature, generally 2.0% to 2.4% per °C. While processing sensor signal, a resistor/thermistor network may be used to offset temperature effects.

Measurement Accuracy and Stability

The most sought out charateristic of a galvanic type oxygen sensor is the measurement accuracy and long term stability. Applied Sensing Technolgies incorporated a number of innovations in the sensor design. PPM sensor anode is coiled allowing the anode to completely immerse in the electrolyte thus preventing any dry spots in the anode, typically encountered when using sintered granular lead anode, thus eliminating unwanted signal spikes. Electroetched sensing element provides extremely smooth sensing surface results, low signal noise and high measurement stability. The sensor design provides fast response and speedy recovery from an upset condition, excellent linearity, repeatability and stability even in varying ambient conditions.



48 hours chart data showing stability of three SRX series PPM oxygen sensors , 0-10 PPM full scale range, sample gas nitrogen containing 0.8 PPM oxygen, sample flow rate 0.5 SCFH. Ambient temperature varience +/-10-15 °F during 48 hours day and night cycles



Reovery of SRZ series PPM oxygen sensors from 2 minutes exposure in air to below 10 PPM on pure nitrogen
From air to 100 PPM 7.5 minutes
From air to 10 PPM 32 minutes
From air to 5 PPM 55 minutes

Sensor Compatibility with Acid Gases

The SRZ series sensors use a special electrolyte formulation that enables sensor tolerance to any level of CO2 in a measuring gas and trace levels of H2S. Propriatory electrolyte formulation enhances sensor stability at temperature near freezing.

Flow, Position and Motion Sensitivity

Since the sensor signal is limited by the rate of diffusion of oxygen thru barrier membrane, sensor is insensitive to changes in sample flow, provided no significant back pressure is created. A sample flow of 0.5-5 SCFH is recommended for optimum performance. Sensor is not position sensitive and can be mounted in any position but preferred mounting position is with sensing facing down. Minor mechanical vibration will have no impact but sudden movement of sensor must be avoided.

Recommended Storage

Sensors are sealed in metalized bags under nitrogen. Sealed sensor may be kept on shelf for as long as needed but ideal recommended shelf life for SRX series sensor is six months and for SRZ series sensor is three months. Recommended storage temperature is under 35 °C but preferred storage temperature is under 25 °C. Electrolyte used in SRZ series sensors is volitile and hence are recommended to be stored under 10 °C, preferably in a refrigerator.

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Cross Reference to Oxygen Sensors

Industrial PPM Oxygen Sensors

AST Part No.	OEM	OEM Part No.
SRX-MT22	Teledyne AII AMI GE Panametrics	B2/B2C PSR-12-223 T2 OX1
SRX-MT22-XL	Teledyne	B2C-XL
SRX-MA333	AII	GPR-12-333
SRX-MA333-M	AII	GPR-12-333-M
SRX-MA100-M	AII	GPR-12-100-M
SRX-MA100-4	AII	GPR-12-100-4
SRX-MGP-41	IT Gambert	P-41
SRZ-MT12	Teledyne AII GE Panametrics AMI	A2/A2C XLT-12-123 OX2 T4
SRZ-MA333	AII	XLT-12-333
SRZ-MA333-M	AII	XLT-12-333-M
SRZ-MA100-M	AII	XLT-12-100-M
SRZ-MA100-4	AII	XLT-12-100-4
SRZ-MGP-41A	IT Gambert	P-41A

Galvanic type electrochemical oxygen sensors, also known as micro-fuel cells, are extremely versatile, very specific to oxygen, easy to use and require no maintenance except a periodic calibration. At the end of their useful life, they can be disposed off just like a battery.

These sensors are extensively used in a variety of applications, specifically monitoring sub-PPM levels of oxygen in inert gases, hydrogen and gaseous hydrocarbon streams.
Cross reference shown is for reference of the most commonly used PPM Oxygen sensors only.
Contact us for any specific sensor design and application.

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APPLIED SENSING TECHNOLOGIES

Cross Reference to Oxygen Sensors

Medical Oxygen Sensors - Ventilators

AST Part No.	OEM	OEM Part No.
SRX-CT-1	Teledyne	R-22MED
	CITY	MOX-1
	All	PSR-11-917-M
	Maxtec	MAX-12
SRX-CT-2	Teledyne	R-17MED
	All	PSR-11-917-J
	CITY	MOX-2
	Maxtec	MAX-13
SRX-CT-3	CITY	MOX-3
	Maxtec	MAX-3
SRX-CT-4	Teledyne	T-7
	CITY	MOX-4
	Maxtec	MAX-17
SRX-CT-12	Envitec	OOM202
	CITY	MOX-9
	Maxtec	MAX-12
SRX-CT-KE4	All	11-77-KE4
	Maxtec	MAX-250K
SRX-CT-60	All	All-11-60
	Maxtec	MAX-48
SRX-25F3	Figaro	KE-25F3
	Maxtec	MAX-25

Industrial & Personal Safety Oxygen Sensors

SRZ-CF25	Figaro	KE-25
SRZ-CF25F1	Figaro	KE-25F1
SRZ-CF25F3	Figaro	KE-25F3
SRZ-CF25F4	Figaro	KE-25F4

SRX-CT Series sensors are specifically designed for breathing air equipments such as ventilators. User must check compatibility of sensors with the intended equipments.
NOTE: For optimal accuracy, sensors for ventilators must be calibrated before each use and 24 hours after continuous use in oxygen above 90%

SRX-CF series sensors are specificaally design for applications where CO_2 is present in measuring gas, for example, measuring oxygen in food storage facility. Contact us for any specific sensor design and application.

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APPLIED SENSING TECHNOLOGIES

Cross Reference to Oxygen Sensors

Diving Oxygen Sensors

AST Part No.	OEM	OEM Part No.
AST-17D	Teledyne	R-17
	All	PSR-11-39-JD
AST-22D	All	PSR-11-39-MD
	Teledyne	R-22S
	Maxtec	MAX_12
	City	MOX-1
AST-22D-2	All	PSR-11-39-rEvo
AST-22D-5	All	PSR-11-39-MD5
SRX-CTR30	IT Gambert	D-18
SRX-CTR31	Teledyne	R-33-S, R-33D
	IT Gambert	D-03
	Analox	9212-0
	UBS	O2 Stick
SRX-CTR32	All	PSR-11-37-D2-1
	IT Gambert	D-09
	Analox	9121-0
	Teledyne	R-33S1, R-33D1
SRX-CTR34	Teledyne	R-22AEX
	IT Gambert	D-13
AST-14D	AP Diving	APD14
	All	PSR-11-39-SMB
AST-14D1	Titan Rebreather	SF2
	All	PSR-11-39-XD
AST-14D2	JJ Rbreather	JJ-CCR
	All	PSR-11-39-J
AST-40D	Analox	9100-9920-9B
AST-60D	All	All-11-60
AST-75D	All	All-11-75D
AST-75D-PO2	All	All-11-75-PO2D

SRX-CT and AST series sensors are specifically designed for breathing air analyssis and scuba diving application. User must check their compatibility with intended equipment/rebreather before. Sensor must be calibrated before use and shouldn't be used after the expiry date. Sensors for rebreather equipment shows linear response upto 1.6 atm of O_2 (sensors with mV ouput in air upto 16 mV only).

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APPLIED SENSING TECHNOLOGIES

Cross Reference to Oxygen Sensors

Industrial % Oxygen Sensors

AST Part No	OEM	Part No
SRX-CT21	Teledyne All AMI	B1/B1C PSR-11-21 P1
SRX-CT23	Teledyne All GE Panametrics	B3/B3C PSR-11-23 OX3
SRX-CT33	Teledyne All AMI	C3 PSR-11-330 P4
SRX-CTE2	Teledyne All	E2 PSR-11-52
SRX-CA32	All	GPR-11-32
SRX-CA32-RTS	All	GPR-11-32-RTS
SRX-CA60	All	GRP-11-60
SRX-CA60-RTS	All	GPR-11-60-RTS
SRX-CA120	All	GPR-11-120
SRX-CA120-RTS	All	GPR-11-120-RTS
SRX-CA120-4	All	GPR-11-120-4
SRX-CA32-4	All	GPR-11-32-4
SRX-CA60-4	All	GPR-11-60-4
SRX-CGP-21	IT Gambert	P-21
SRZ-CT15	Teledyne All GE Panametrics AMI	A3/A5 XLT-11-15 OX4 P3
SRZ-CA24	All	XLT-11-24
SRZ-CA24-4	All	XLT-11-24-4
SRZ-CGP-21A	IT Gambert	P-21A

Galvanic type electrochemical oxygen sensors, also known as micro-fuel cells, are extremely versatile, very specific to oxygen, easy to use and require no maintenance except a periodic calibration. At the end of their useful life, they can be disposed off just like a battery.

These sensors are extensively used in a variety of applications, specifically monitoring oxygen in air separation, food processing and packaging, area monitor for personal safety, inert gas welding and glove box purge to name just a few.
Cross reference shown is for reference of the most commonly used % O2 sensors only. Contact us for any specific sensor design, signal output, electrical contacts and application.

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