OXYGEN SENSOR

JSO-100 & 200 Series

Oxygen Sensor

This sensor is a galvanic cell type oxygen sensor that measures oxygen gas (O_2) in air. It has a lead anode, a gold cathode, an acid electrolyte, and a flourine resin membrane. The current flow between the electrodes is proportional to the oxygen concentration being measured. An internal bridge resistor is used to provide an mV output linearly proportional to O_2. Unlike polargraphic oxygen sensors, galvanic do not require a power supply.

The mV ouptut responds to the partial pressure of oxygen in air. The standard units for partial pressure are kPa. However, gas sensors that respond to partial pressure are typically calibrated to read out in mole fraction of the gas in air, or units of moles of oxygen per mole of air. These units can be directly converted to % O_2 in air, or ppm O_2 in air. The concentration of oxygen in our atmosphere is 20.95%. This precise percentage has not changed for decades. It is also constant across changing temperatures or pressures. This allows for precise calibration of the instrument.

Being a galvanic cell type sensor, a small amount of oxygen is consumed in the reaction in order to prodcue the current flow and subsequent mV output. The oxygen consumption was measured to be 2.2 umol O2 per day when the O2 concentration was 20.95% (3240 mmol) at 23 C.

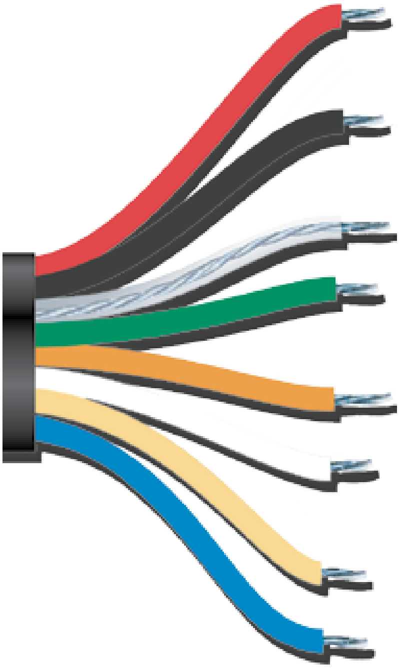
Application

Our oxygen sensors are galvanic cell sensors that have a lead anode, a gold cathode, an acide electrolyte, and a Teflon membrane. The current flow between the electrodes is proportional to the oxygen concentration being measured. An internal bridge resistor is used to provide an mV output.

Cleaning

Debris on the oxygen sensor is a common cause of low readings. Salt deposits can accumulate on a sensor from evaporation of sprinkler irrigation water and dust, which can accumulate during periods of low rainfall. Salt deposits should be dissolved and removed with vinegar and a soft cloth or q-tip. Dust and other organic deposits are best removed with water, rubbing alcohol, or window cleaner. ***Never use an abrasive cleaner on the lens.***

Connection Instructions



Red High side of differential channel (positive lead for sensor)

Black Low side of differential channel (negative lead for sensor)

Clear Analog ground (shield wire)

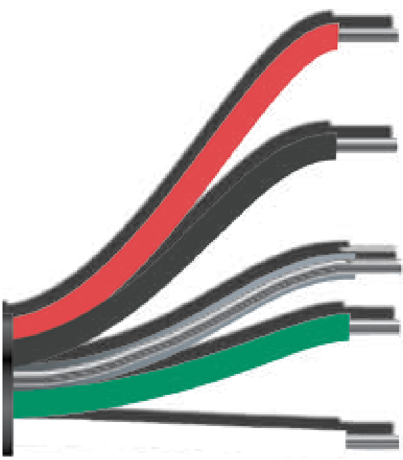
Green Single-ended channel (positive lead for thermistor)

Orange Analog ground (negative lead for thermistor)

White Excitation channel (excitation for thermistor)

Yellow 12V port (positive lead for heater)

Blue Ground (negative lead for heater)



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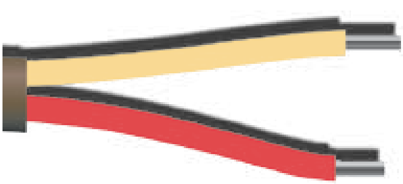


Yellow High side of differential channel (positive lead for thermocouple)

Red Low side of differential channel (negative lead for thermocouple)

Using the Sensor

For the most stable reading, the sensor should be used with the sensor opening facing down. This facilitates the best contact of the electrollyte and the electronics.

1. Connect the O_2 lead wires to a volt meter or a datalogger.

2. To calibrate, measure the mV output of the sensor in a well-ventilated area. Do not breathe on the sensor as exhaled breath has a lower O_2 concentration compared to ambivalent air (20.95%). The output is approximately 50 mV for the soil sensor and 12 mV for the fast response sensor in ambient air. To derive the multiplier, divide 20.95 by the mV output minus the zero offset. The zero offset can be measured in pure N_2 gas or approximated as 2.5 mV for the soil sensor and 0.25 mV for the fast response sensor.

    Example: 20.95% / (50 - 2.5 mV) = 0.441% O_2 per mV

    To derive the intercept, multiply the measured voltage offset by the calibration factor.

    Example: 2.5 mV * 0.441% O_2 per mV = 1.103% O_2

    The calibration factor and intercept are correct for the current elevation, pressure, temperature, and humidity.

3. Calibration establishes the multiplier and offset necessary to convert the mV reading to % O_2. Install the multiplier and offset values in your datalogger program.

Characteristics

Zero Offset

The mV output in ultra-pure nitrogen gas (0.000% O2) is typically 5% of the ambient (20.95%) output for the soil sensor and 2% of the ambient output for the fast response sensor. Precise measurements of hypoxic and anaerobic conditions can be made by making a periodic zero calibration of the sensor with ultra-pure nitrogen gas.

Life Expectancy

The life expectancy of the sensor is expressed in %-hours as follows:

[Oxygen Concentration (%) * Exposure Time (hours)]

Accordingly, the life of the Apogee oxygen meter is 900,000 hours or approximately 5 years of continuous use at 20.95% oxygen at 20° C.

Storage Temperature

The life of the sensor can be extended by storage at a lower temperature. For example, a sensor stored at 0° C will have a life expectancy approximately twice that of a sensor stored at 20° C. The absolute minimum storage temperature is -20° C. Below -20° C, the electrolyte will freeze. This does not damage the sensor, but to resume measurement the electrolyte must be thawed. Maximum storage temperature is 60° C.

Shock and Vibration

The sensor is resistant to 2.7 g of shock. However, vibration may influence the sensitivity of the sensor and should be minimized.

Effects on Output

Influence from Various Gases

The sensor is unaffected by CO, CO_2, NO, NO_2, H_2S, H_2, and CH_4. There is a small effect (approximately 1%) from NH_3, HCl, and C_6H_6 (benzene). The sensor is sensitive to SO_2 and can be damaged by O_3.

Temperature Sensitivity

A change in temperature changes the amount of O_2 available to the sensor and therefore changes the mV output that correlates to the atmospheric constant of 20.95%. Additionally, the sensor electronics have a small temperature dependence. To eliminate temperature effects, simply recalibrate or use the correction equations found on our website.

Pressure Sensitivity

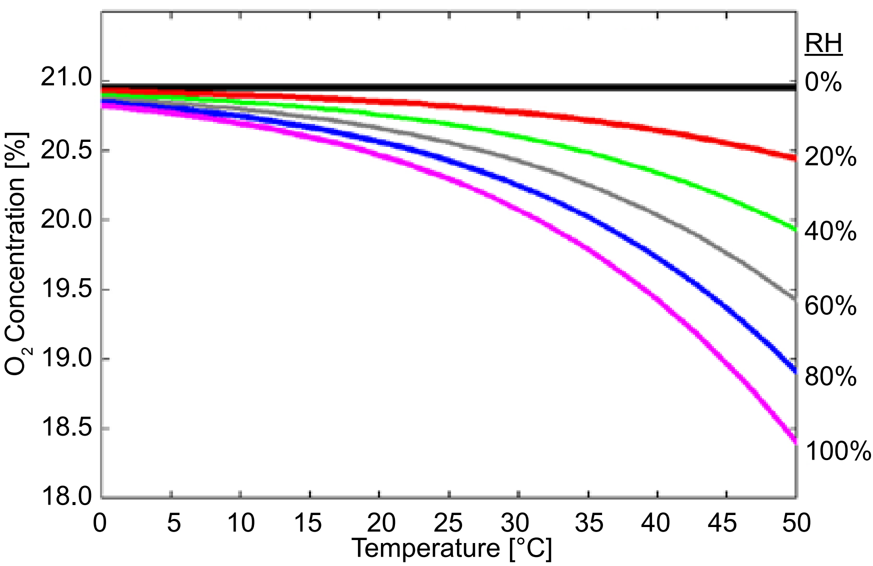
A change in barometric pressure changes the amount of O_2 available to the sensor and therefore changes the mV output that correlates to the atmospheric constant of 20.95%. To eliminate pressure effects, simply recalbirate or use the correction equations found on our website. This requires a pressure measurement, which can be done with the Apogee barometric pressure sensor (model SB-100).

Model SB-100

Humidity Changes

The graph below shows an example of humidity dependency. The sensor chemistry is not influenced by humidity, but its output decreases because O2 is displaced by water vapor molecules in the air. The effect of humidity is larger at warmer temperatures because there is more water vapor in the air.

Humidity Effects on Relative O_2 Concentration (at 101.324 kPa)



For use in high humidity, such as in soil, remove the head and take the calibration measurement over water in a sealed container as shown at right. To acocunt for humidity effects, simply recalibrate or use the correction equations found on our website.

Specifications

Sensor Dimensions
- 3.15 diameter by 6.85 cm long
- ½" by 20 threaded end

Mass
- 175 g

Diffusion Head
- 3.5 cm long by 3.5 cm diameter
- 125 mesh screen

Flow-Through Head
- 3.2 cm long by 3.2 cm diameter
- ⅛" barbed adapters for hose connections

Range
- 0 to 100% O_2

Accuracy
- < 0.02% O_2 drift per day

Response Time
- JSO-100 Series: 60 seconds
- JSO-200 Series: 12 seconds

Repeatability
- ± 0.001% O_2 (10 ppm)

Output
- JSO-100 Series: 50 mV
- JSO-200 Series: 12 m

Input Power
- 12 V power for heater
  - * Current drain: 74 mW typical at 12 VDC
- 2.5 V excitation for thermistor

Operating Environment
- -20 to 60° C
- 0 to 100% relative humidity
- 60 to 140 kPa

Cable
- 5 meters foil-shielded cable
- Santoprene jacket
- Ending in pigtail leads
- Additional cable is available in multiples of 5 meters

Warranty
- 1 year against defects in materials and workmanship