

## Oxygen sensor

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### General Questions:

#### What oxygen concentrations can be measured with the sensor?

Sensors with different measurement ranges can measure oxygen concentrations from 10 ppm to 96% oxygen.

#### Is it possible to operate the sensor outside the specified measurement range?

A longer operation of the sensor outside the specified measuring range can reduce the service life. The increased sensor currents lead to permanent damage of the electrode.

#### Is it also possible to measure dissolved oxygen in liquid mediums?

No, the oxygen sensor measures only the oxygen concentration in gaseous atmospheres.

#### How does the oxygen sensor work?

Basically there are two operational modes of the sensor. According to the environmental circumstances the sensor is operating with constant voltage or a constant resistor.

At relatively low ambient temperature deviations the sensor can be heated applying a constant voltage. The necessary heating voltage depends on the sensor's packages and is specified in the sensor's manual. At higher temperature deviations the sensor should be used in the constant resistor mode. In this case the sensor is regulated on a constant heating resistor and thus on a constant sensor temperature. In both modes you should consider that the sensor should be heated over a minimum time of 90 seconds to be ready for use. There are instructions in the sensor's manual.

Additionally to the heating of the sensor a second voltage for the sensor is necessary. This depends on the sensor type 0.7 – 1.6 volts.

#### What's the sensor's output signal?

As the oxygen sensor is operating through an amperometric measurement principle, results after applying the sensor's voltage electricity in a range between 0 – 420  $\mu$ A depending on the sensor's measurement range and the existing oxygen concentrations.

#### Is it necessary to calibrate the sensor?

Before using the sensor it is necessary to calibrate it once at known gases. Using this measurement you're able to define a constant with which all following measurements of measured oxygen concentrations out of the sensor electricity can be calculated.

In case of a sensor, with a measurement range exceeding 21% oxygen, concentration ambient air (20.9% oxygen concentration) can be used for calibration.

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### How accurate is the sensor?

As point of reference for the accuracy of measurement can generally be stated 1% as measurement range final value. The exact details due to the single sensor types can be found in the sensor's manual.

### Is it possible that the sensor signal drifts overtime?

If the sensor is used properly the sensor's drift is negligible.

### Does the sensor signal depend on temperature?

There's only a marginal connection between sensor signal and ambient temperature. This is explained in detail in the sensor's manual. This can be neglected for temperature deviations in the range of plus/minus 10°C. For higher temperature deviations a temperature regulator of the sensor heating (constant resistor method) should be used for compensating the temperature dependence.

### At which ambient temperature can the sensor be used?

The sensor can be used for temperatures between -20° to 350°. Higher working temperatures can be reached by choosing appropriate package material.

### Is there any interference with other gases?

On principle the sensor selects 100%. This means that you can only measure oxygen with the oxygen sensor. Admittedly if other gases exist, preliminary reactions may occur (conditional on high appearing temperatures and the existence of platinum) whereby additional oxygen may arise or oxygen may be consumed. The measured interferences are listed in the sensor's manual.

### Is it possible to use the sensor with flammable gases?

The sensor element's temperature is about 580°C. Hence the sensor may not be used with a mixture of gases that are flammable at this temperature.

### Which packages are available?

The transistor packages TO8 and TO39 are standard. Additionally SENSORE offers different transistor packages for direct installation on the gaseous atmospheres (sensors with screw thread, sensor with mounting flange etc.).

### What is the lifetime of an oxygen sensor?

The lifetime (MTTF) of an oxygen sensor is about 20.000 hours running time in clean ambient air (20.9% O<sub>2</sub>, 25°C, rH 20% - 60%). Other media lifetime may be evaluated in most cases.

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### **How can you assure that the sensor hole will not plug?**

The sensor's hole which has a diameter of 10 – 500  $\mu\text{m}$  depending on the type, is protected by a high temperature ceramic wool. This ceramic wool acts as particle filter. Additionally through the dynamic gas-exchange cycle at switching on and off, the sensor does a kind of self purification.

### **What happens if the sensor gets in touch with water?**

If water gets through the metal grid directly on the sensor's element it can be destroyed due to the resulting sudden temperature change (breakage in the electrode). Direct contact between the heated sensor and water must absolutely be avoided.

### **What happens to the sensor's electricity if the sensor is defective?**

If the sensor is defective the electricity can either fall or increase. The sensor's electricity falls if the sensor's pumpage gets less in consequence of its lifetime. If there is an error in contact it can even get down to zero. The electricity can also rise in consequence of a leaky sensor element.

### **Sensor unheated / storage of sensor**

#### **Are there any sensibilities of the sensor while it is not heated (cold) or are there any effects on the unheated (cold) sensor at storage in temperature?**

There are no effects on the sensor in non heated status up to the maximum usage temperature of 350°C.

#### **Are there any influences of humidity on the non heated (cold) sensor?**

Basically you need to distinguish between non condensed and condensed humidity. Non condensed humidity has got absolutely no effects on the non heated sensor. Condensed humidity within the package can lead to destruction (breakage of the sensor's electrode) of the sensor while heating up. In this case the sensor should be heated over 5 minutes before it is usable to avoid the aforesaid.

#### **Are there any effects on the sensor at humidity storage?**

See question above.

#### **What influences have a temperature changing on the non heated sensor?**

A temperature change have no influences on the sensor if the intermitted temperature are within the quoted borders of – 20°C and 350°C on the on hand and if the slew rate does not exceed 600°C/min.

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### Exhaust fumes and humidity

#### Which gases damage the oxygen sensor?

Gases which contain the halogens F, Cl, Br, as well as all existing compounds containing halogens in the gas phase like CFC cause even in slightest quantities a damage of the sensor.

Gases like SO<sub>x</sub> and H<sub>2</sub>S at an approximately concentration of 50ppm induce a loss of electrode activity and hence shorten its lifetime. The resulting lifetime depends on residence time and concentration and therefore can't be quoted.

Also damaging are volatile organic substances as for example vapours of silicone like sealing compounds or adhesives. These can influence the sensor's lifetime in a negative way.

#### Which influences have these gases on the heated (ready for use) sensor?

The above named gases can cause different damages on the sensor. It can lessen the catalytic effect of the platinum electrode. This can lead depending on the gas concentration to a reduction in response time or in the worst case to a breakdown of the sensor (sensor voltage decreases and the measured voltage does not match to the specified characteristic curve).

Due to the corrosive gases different chemical reaction can occur on the electrode, which can also falsify the measured value.

At minor concentrations or minor residence time the sensor damages are reversible. This means that the sensor regenerates if it is used under normal operating conditions (operation at ambient air 20.9% oxygen content).

#### Which influences have these gases on the unheated (cold) sensor?

All above named consequences occur increasingly to the unheated sensor, so that even a short interference of these gases can destroy the sensor.

#### Which influences has humidity on the heated (ready for use) sensor?

The heated sensor element is working at an operating temperature of more than 100° C. As a consequence the existing humidity cannot condense. As already stated above non condensed humidity has no influences on the sensor.