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# OXYGEN GAS SENSOR BT59i

## USER'S GUIDE



**CENTRE FOR MICROCOMPUTER APPLICATIONS**

<https://cma-science.nl>

## Short description

The Oxygen Gas sensor BT59i measures the gaseous oxygen concentration in the range of 0 to 100 %. It uses an electrochemical cell, which contains a lead anode. The anode and cathode are immersed in an electrolyte. When oxygen molecules enter the cell, they get electrochemically reduced at the cathode. This electrochemical reaction generates a current that is proportional to the partial pressure of oxygen in the gas mixture. The current is measured across a resistance to generate a small voltage output. The voltage output is amplified to the 0 .. 5V output range.

The Oxygen Gas sensor has a limited operating lifetime because the chemicals in the electrochemical cell are depleted over time. A lifetime of the sensor will depend on the way it is stored and exposed to open air (typical operating lifetime is 3-4 years).

The Oxygen Gas sensor can be directly connected to the analog BT inputs of the CMA interfaces.

## Sensor recognition

The Oxygen Gas sensor has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces.

If your Oxygen Sensor is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

## Calibration

The CMA Oxygen Gas Sensor BT59i is supplied calibrated. The output of the sensor is linear with respect to the % of oxygen concentration. The supplied calibration function is:

$$O_2 (\%) = 25.0 * V_{out} (V)$$

The Coach program allows selecting the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Coach Sensor Library.

As the sensor ages it shows some drift over its lifetime. For precise measurement a periodic calibration is recommended. Use for example the *Set to value* option to adjust a calibration point of oxygen level in air (in 0 % Relative Humidity this value is 20.9 %).

## Atmospheric Considerations

Because the % of oxygen varies with the amount of water vapor in the atmosphere, you may want to adjust your atmospheric oxygen calibration value to improve accuracy when using the Oxygen Gas Sensor. The accepted value of 20.9 % for atmospheric oxygen levels is calculated in dry air (0 % humidity). If you know the

relative humidity of the location at which you are calibrating, you can substitute one of the values below in place of 20.9 %.

Relative Humidity	0 %	25 %	50 %	75 %	100 %
Oxygen in % by volume	20.9	20.7	20.5	20.3	20.1

### How to store the sensor

The lifetime of the Oxygen Gas sensor depends on how it is stored and how much oxygen it is exposed to. To extend the sensor's life, you should store it in an airtight box or inserted into the plastic Nalgene bottle. Or even better store the sensor in a vacuum sealed bag. Storing the sensor correctly and reducing the exposure to oxygen will extend the sensor's life.

### Important

- Do **not** place the sensor into any liquid. The sensor is intended only for measuring *gaseous*, **not** aqueous, O<sub>2</sub> concentration.
- The electrolyte in the sensor element has similar dangers as batteries. The electrolyte shows weak acidity and contains heavy metals. **Never** dismantle the sensor. When skin is exposed to the electrolyte immediately rinse with water and seek medical attention.
- Even though the sensor responds rather quickly to changes in O<sub>2</sub> concentration, remember that gas must diffuse into the electrochemical cell located at the top of the sensor shaft before any changes in concentration can be detected. Since diffusion of gases is a slow process, there can be some delay in readings.

### Suggested experiments

The Oxygen Gas sensor can be used to monitor gaseous oxygen in a variety of biology and chemistry experiments such as:

- Monitoring human respiration.
- Monitoring changes in oxygen concentration during photosynthesis and respiration of plants.
- Monitoring respiration of animals, insects, or germinating seeds.
- Monitoring oxidation of metals such as iron.
- Monitoring consumption of oxygen by yeast during respiration of sugars.

## Technical Specifications

All characteristics are based on conditions at 25 °C, 50% RH and 1013 hPa.

<i>Sensor kind</i>	Analog, generates an output voltage between 0 .. 4 V
<i>Measurement range</i>	0 .. 100 %
<i>Resolution using 12 bit AD converter</i>	0.03 %
<i>Operating lifetime</i>	Depends on the way it is stored and exposed to air, typically 3-4 years
<i>Calibration function</i>	% O <sub>2</sub> = 25.0 V <sub>out</sub> (V)
<i>Drift</i>	< 1% volume O <sub>2</sub> / month in air
<i>Influence of humidity</i>	-0.03 % rel. O <sub>2</sub> reading per % RH
<i>Response Time t<sub>90</sub></i>	30 s
<i>Pressure Effect</i>	Directly proportional $V_{out} = V_{out(standard)} \times (P/1013)$
<i>Pressure range</i>	750 .. 1250 hPa
<i>Gas Sampling Mode</i>	Diffusion through solid membrane
<i>Storage Temperature</i>	-20 .. 60°C (Store sensor in airtight or sealed environment)
<i>Connection</i>	Attached cable with right-hand BT (British Telecom) connector

### Warranty:

The Gas Oxygen sensor BT59i is warranted to be free from defects in materials and workmanship for a period of 24 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

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**Note:** This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

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Rev. 30/03/2023