Data sheet: Oxygen sensor
Type: SP-xx-yyy (ampero-potentiometric type)

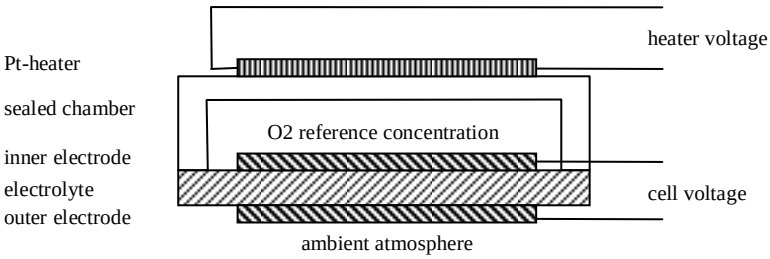
Main Features:

- Oxygen sensor for rough conditions (in particular condensing humidity)
- Potentiometric oxygen measurement based on an electrochemical ZrO_2 cell
- amperometric recalibration procedure in absence of a reference atmosphere
- Oxygen range: 1mbar -250mbar (0,1%~25% O2 at standard atmosphere)
- Operating temperatures up to 350°C (ambient)

Principle of Operation:

The sensor is based on a solid-state electrochemical cell (Nernst cell) which is heated to temperatures around 525°C. The inner electrode of the cell is in contact with a sealed reference chamber, while the outer electrode is in contact with the ambient gas, which has to be analyzed. The voltage between the electrodes corresponds to the quotient of the O_2-partial pressures (Nernst law).

For absolute O_2-partial pressure measurement it is therefore necessary to calibrate the partial pressure of the reference chamber. This can be done by comparison with a known O_2-partial pressure in the surrounding gas. It is also possible to establish a defined O_2-partial pressure by an amperometric pumping process in absence of a reference atmosphere.



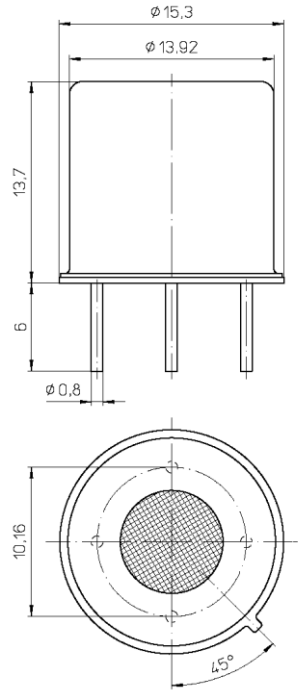
Schematic drawing of a sensor element

Characteristic Data:

Standard Package

TO-8 Housing:

Pin 1	heater H+
Pin 2	heater H-
Pin 3	outer electrode S+
Pin 4	inner electrode S-



TO8-package

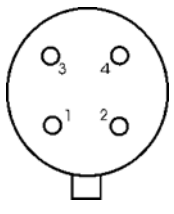
Measuring parameter and medium

O2-partial pressure of the ambient gas atmosphere

Measuring range

1mbar-250mbar O2
(0.1 ~ 25.0% O2 at standard atmospheric pressure)

Extended measuring ranges might be possible, if evaluated in detail (upon request)



Pin out (bottom view)

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Output characteristic:

$$U_n = \frac{RT_{cell}}{4F}\ln\left(\frac{p_{O2meas}}{p_{O2Ref}}\right) \qquad p_{O2meas} = p_{O2ref}\, e^{\frac{4FU_n}{RT_{cell}}}$$

Cell voltage	U_n [V]
Gas constant	R = 8,314 J mol^{-1} K^{-1}
Faraday constant	F = 96485 C mol^{-1}
Cell temperature	T_{cell} [K]
Measuring gas	p_{O2meas} [mbar]
Reference gas	p_{O2Ref} [mbar]

Heater voltage/Cell temperature

Applied heater power:

3.5 – 4.0 Volts (1.3 to 1.8 Watts, depends on application and thermal links)
The cell temperature can be calculated from the resistance change of the Pt-heater (4-wire measurement)
Typical target cell temperature: 525°C

$$T_{cell} = \frac{(R_{op} - R_{25°C})}{R_{25°C}\alpha_{Pt}} + 25K + 273{,}15K - T_{offset}$$

Cell temperature	T_{cell} [K]
Heater resistance @ 25°C	$R_{25°C}$ = 3,25Ω ±0,20Ω
Heater resistance during operation	R_{op} (depending on the voltage supply and thermal links)
Temperature coefficient platinum	α_{Pt}=3245 ppm/K
Temp offset heater-cell	T_{offset}=50K (typical)

Calibration principle

Internal recalibration procedure:

No reference atmosphere necessary

Typical duration time of recalibration procedure:	2 min
Typical pumping current:	10-20uA
Recalibration period:	up to 48h

Detailed information upon request

External recalibration procedure

Reference gas necessary (usually standard O2-concentration of air is sufficient)

Typical output-signal

-100mV to 20mV (depending on the reference concentration)

Accuracy

Typ. 2% of measuring range (5mbar)

Response time (t90)

<30 sec.

Warm up time

Approx. 2 min.

Maximum temperatures

Housing during operation: approx. 70 °C (at 25°C ambient temperature)
Max. ambient temperature: 350 °C

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