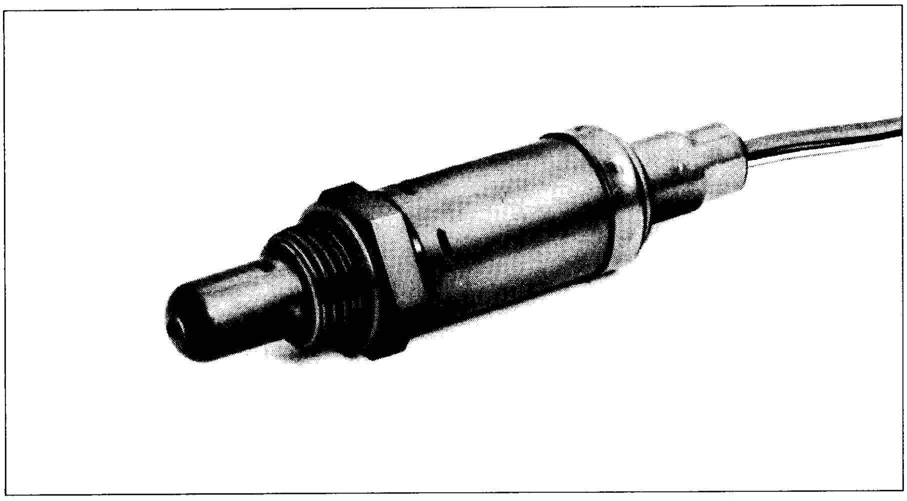
BOSCH

Oxygen "Lambda" sensor

Measurement of oxygen content

- Principle of galvanic oxygen concentration cell with solid electrolyte permits measurement of oxygen concentration for example in exhaust-gases
- Sensor with output signal which is both stable and insensitive to disturbance for extreme operating conditions



Accessories

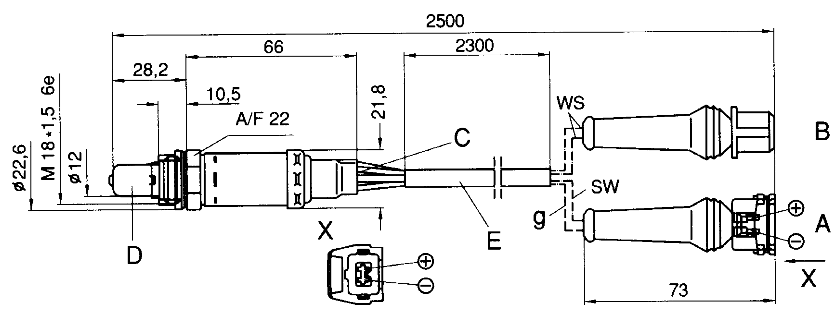
Connector for heating element:	
Plug housing	**1 284 485 110**
Receptacles [1]	**1 284 477 121**
Protective cap	**1 250 703 001**
Connector for sensor:	
Coupling plug	**1 224 485 018**
Blade terminal [1]	**1 234 477 014**
Protective cap	**1 250 703 001**
Special grease for thread:	
Can, 120 g	**5 964 080 112**

[1] 5 per pack; 2 are required in each case.

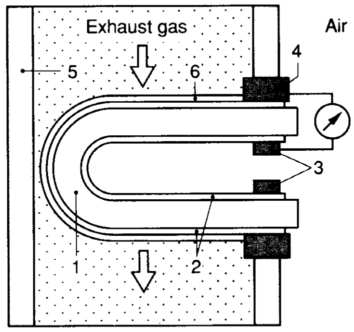
Technical data / Range

Part No.		**0 258 104 002**
Usage conditions		
Passive temperature range (storage-temperature range)		– 40...+ 100 °C
Perm. sustained exhaust-gas temperature with heater switched on		+ 600 °C
Max. perm. exhaust-gas temperature with heater switched on (200 h cumulative)		+ 800 °C
Operating temperature at hexagon of sensor housing		≤ + 500 °C
at cable bushing		≤ + 200 °C
at connecting cable		≤ + 150 °C
at connector		≤ + 120°C
Temperature gradient in front of sensor ceramic		≤ + 100 K/s
Temperature gradient at hexagon of sensor housing		≤ + 150 K/s
Permissible vibration at hexagon		
Stochastic vibration – max. acceleration		≤ 800 m•s^{-2}
Sinusoidal vibration – amplitude		≤ 0.3 mm
Sinusoidal vibration – acceleration		≤ 300 m•s^{-2}
Max. load current		± 1 µA
Heating element		
Rated supply voltage		12 V
Operating voltage		
sustained		12 ... 14 V
brief periods (75 seconds)		24 V
Heating power for ϑ_{Gas} = 350°C and exhaust-gas flow velocity of 0.7 m•s^{-1} with 13 V heating voltage in steady-state condition		≈ 18 W
Heating current at 13 V in steady-state condition		≈ 1.4 A
Insulation resistance between heater and sensor connection		> 30 MΩ
Values for burner applications		
Lambda control range		1.00...2.00 λ
Sensor output voltage for λ = 1.025...2.00 with ϑ_{Gas} = 220 °C and flow velocity of 0.4...0.9 m•s^{-1}		68...3.5 mV
Sensor internal impedance R_i~ in air at 20 °C and with 13 V heating voltage		≤ 150 Ω
Relative sensitivity with λ = 1.30	$\Delta U_S/\Delta\lambda$	= 0.65 mV/0.01
Effect of exhaust-gas temperature on sensor signal with increase in temperature from 130 °C to 230 °C and flow velocity 0.7 m•s^{-1} with λ = 1.30	max. Δ λ	± 0.01
Effect of 10 % change in heating voltage of 13 V with ϑ_{Gas} = 220 °C		
with λ = 1.30	max. Δ λ	± 0.009
with λ = 1.80	max. Δ λ	± 0.035
Response time with ϑ_{Gas} = 220 °C and approx. 0.7 m•s^{-1} flow velocity; New values for 66% switching point λ step change = 1.10 ↔ 1.30		
t_{RS} for "lean" step change		2.0 s
$t_{\lambda S}$ for "rich" step change		1.5 s
Approximate value for sensor control capability after switching on oil burners and sensor heater; ϑ_{Gas} ≈ 220 °C; flow velocity approx. 1.8 m•s^{-1}; λ = 1.45; sensor in exhaust pipe ∅ 170 mm		70 s
Perm. fuels: gases, residue-free hydrocarbons and light fuel oil.		

Dimension drawing. Dimensions after tightening to M = 50 N·m.
A Signal voltage, B Heating voltage, C Cable bushing and seals, D Protective conduit, E Flexible tube. ws white, sw black, g grey.



Lambda sensor in exhaust pipe (block diagram)
1 Sensor ceramic, 2 Electrodes, 3 Contact, 4 Housing contact, 5 Exhaust pipe, 6 Ceramic protective layer (porous).



Application

Heating systems
- Oil burners, gas burners, coal-fired systems

Gas engines

Industrial processes
- Packaging facilities
- Wood and refuse incineration/gasification
- Process engineering

Measurement and analysis
- Gas analysis
- O_2/CO_2 portable measuring set

Design and function

The ceramic part of the Lambda sensor (solid electrolyte) takes the form of a tube enclosed on one side. The inside and outside surfaces of the sensor ceramic have a micro-porous platinum layer (electrode) which, on the onehand, has a crucial influence on the sensor characteristic due to its catalytic effect and, on the other, is used for contacting purposes. The platinum layer on that part of the sensor ceramic which is in contact withn the exhaust-gas is covered with a firmly bonded, highly porous protective ceramic layer which prevents the residues in the exhaust gas from eroding the catalytic platinum layer. The sensor thus features good long-time stability.
The sensor protrudes into the flow of exhaust gas and is designed such that the exhaust gas flows around one electrode, whilst the other electrode is in connection with the ambient air (atmosphere). Measurements are taken of the residual oxygen content in the exhaust gas.
The catalytic effect of the electrode surface on the exhaust-gas end producesa step-type sensor-voltage profile in the range $\lambda = 1$.
The active sensor ceramic (ZrO_2) is heated from inside by way of a ceramic heating element, so that the temperature of the sensor ceramic remains above the 350 °C function limit irrespective of the temperature of the exhaust gas. The ceramic heating element features a PTC characteristic, which results in rapid warm-up and restricts the power requirement in the event of hot exhaust gas. The connections of the heating element are completely decoupled from the sensor signal voltage ($R \geq 30$ MΩ).
Additional design measures serve to stabilize the lean characteristic-curve profile of the Lambda sensor at $\lambda > 1.0...1.5$ (for special applications up to $\lambda = 2.0$):
- Use of powerful heating element (18W),
- Special design of protective conduit
- Modified electrode/protective-layer system.

The special design makes for:
- Reliable control with low exhaust-gas temperatures (e.g. when internal combustion engines are idling),
- Flexible installation unaffected by external heating
- Hardly any dependence of function parameters on exhaust-gas temperature
- Low exhaust-gas values thanks to high-speed sensor dynamics
- Little danger of contamination and thus long service life
- Waterproof sensor housing

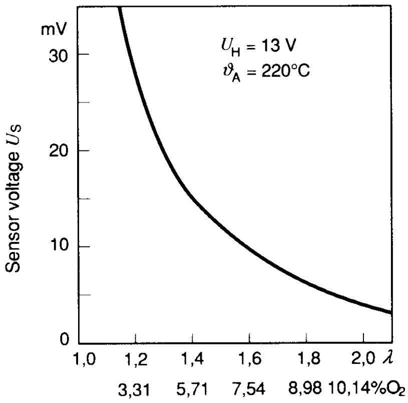
Installation instructions

The Lambda sensor should be installed at a location which makes for a representative exhaust-gas composition whilst complying with the prescribed temperature limits. The installation location is arbitrary; fitting is effected by screwing the sensor into a corresponding mating thread with a tightening torque of 50...60 N•m.
Special grease is to be applied to the thread. The sensor is to be covered when painting a burner system or treating it with oil etc. Contact with lead impairs the sensor function.

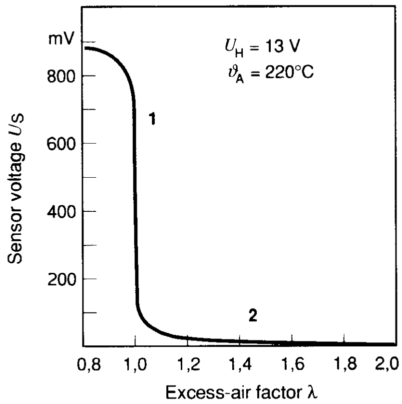
Explanation of symbols:

U_S	Sensor voltage
U_H	Heating voltage
ϑ_A	Exhaust-gas temperature
λ	Excess-air factor
O_2	Oxygen concentration in %
t	Time

Characteristic curve for operation with propane gas.



Characteristic curve for entire range.
1 Control $\lambda = 1$, 2 Lean control.



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