Oxygen Analyser
BA 6000 - O_2

The BA 6000 oxygen analyzer is based on the para-pneumatic principle which is derived from paramagnetic technology. Unlike traditional paramagnetic (dumb-bell) analyzers, this instrument has no moving parts in the measurement cell and is impervious to the effects of vibration. This analyzer is ideally suited for reactive gas mixtures or where corrosion of a traditional paramagnetic (dumb-bell) sensor is a concern.

The standard configuration of this analyzer is designed for non-explosive atmospheres.

- **0 / 2 / 4 to 20 mA output**
- **Auto-ranging or manual range switching**
- **Storage of measured values during adjustment**
- **Selectable time constants**
- **Simple operation using menu based system**
- **Short response time**
- **Low long-term drift**
- **Two-stage access code**
- **Pressure corrections**
- **Optional external pressure sensor**
- **Automatic range calibration**
- **Monitoring of sample gas and/or reference gas (option)**
- **RS 485 serial interface**
- **Several standard low ranges available such as 0.5 %, 2.0 % or 5.0 % O_2**

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Design, characteristics

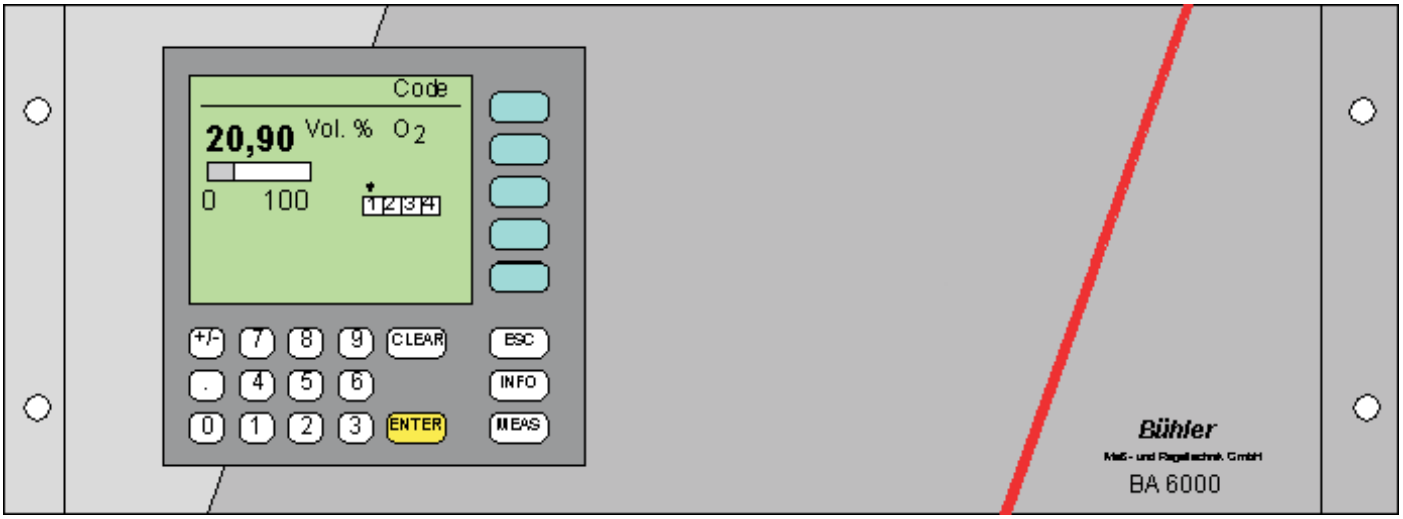
Housing

- 19“ unit with 4 HU for installation in hinged bays
- 19“ unit with 4 HU for installation in cabinets, with or without telescopic rails
- front panel can be swung down for servicing (laptop connection)
- internal pressure sensor for correction of pressure variations in sample gas
- internal gas paths: FPM (Viton) hose or titanium piping
- measurement cell (with or without flow-type compensation branch) made of stainless steel or tantalum for highly corrosive sample gases (such as HCl, Cl_2,SO_2, SO_3 etc.)
- gas connections for sample gas inlet and outlet and for reference gas: piping diameter 6 mm or 1/4“

Display and control panel

- large LCD panel for simultaneous display of:
  - measured value (digital and analog display)
  - status line
  - measurement ranges

  contrast of LCD panel adjustable using menu
- permanent LED backlighting
- cleanable membrane keyboard with five softkeys
- menu based operation for settings, test functions and calibration
- user help in plain text
- graphic display of concentration trend; adjustable time intervals



Inputs / outputs

- six binary inputs freely configurable (e.g. range switching)
- six relay outputs freely configurable (e.g. failure, maintenance request, maintenance switch, limit alarm, external solenoid valves)
- two analog inputs configurable (e.g. correction of cross-interferences, external pressure sensor)
- optional extension with eight additional binary inputs and eight additional relay outputs for automatic calibration with up to four calibration gases

Interfaces

- RS 485 serial

Reference Gas Table

Measurement range	Recommended reference gases	Reference gases pressure	Remarks
0 to ...%.v/v O_2	N_2	29 to 58 psi above sample gas pressure (max. 72.5 psi absolute)	The reference gas flow sets automatically to 5 to 10 ml/min (up to 20 ml/min when also flowing through compensation branch)
to 100% v/v O_2 (suppressed zero with full-scale value 100% v/v O_2)	O_2		
around 21% (suppresses zero with 21% v/v O_2 within the span)	Air	1.45 psi with respect to sample gas pressure which may vary by max. ± 0.73 psi compared to atmospheric pressure	

Mode of Operation

In contrast to almost all other gases, oxygen is paramagnetic. This property is utilized as the measurement principle by the BA 6000 - O_2 gas analyzers.

Oxygen molecules in an inhomogeneous magnetic field are drawn in the direction of increased field strength due to their paramagnetism. When two gases with different oxygen concentrations meet in a magnetic field, a pressure difference is produced between them.

In the case of BA 6000 - O_2 , one gas (1) is a reference gas (N_2, O_2 or air), the other is the sample gas (5). The reference gas is led into the sample chamber (6) through two channels (3). One of these reference gas streams meets the sample gas within the area of the pulsating magnetic field (7).Because the two channels are connected, the pressure, which is proportional to the oxygen concentration, causes a flow between them. This flow is converted into an electrical signal by a microflow sensor (4).

The microflow sensor consists of two nickel grids heated to approx. 250 °F which form a Wheatstone bridge together with two additional resistors. The pulsating flow results in a change in the resistance of the Ni-grids. This leads to a bridge offset which depends on the oxygen concentration in the sample gas.

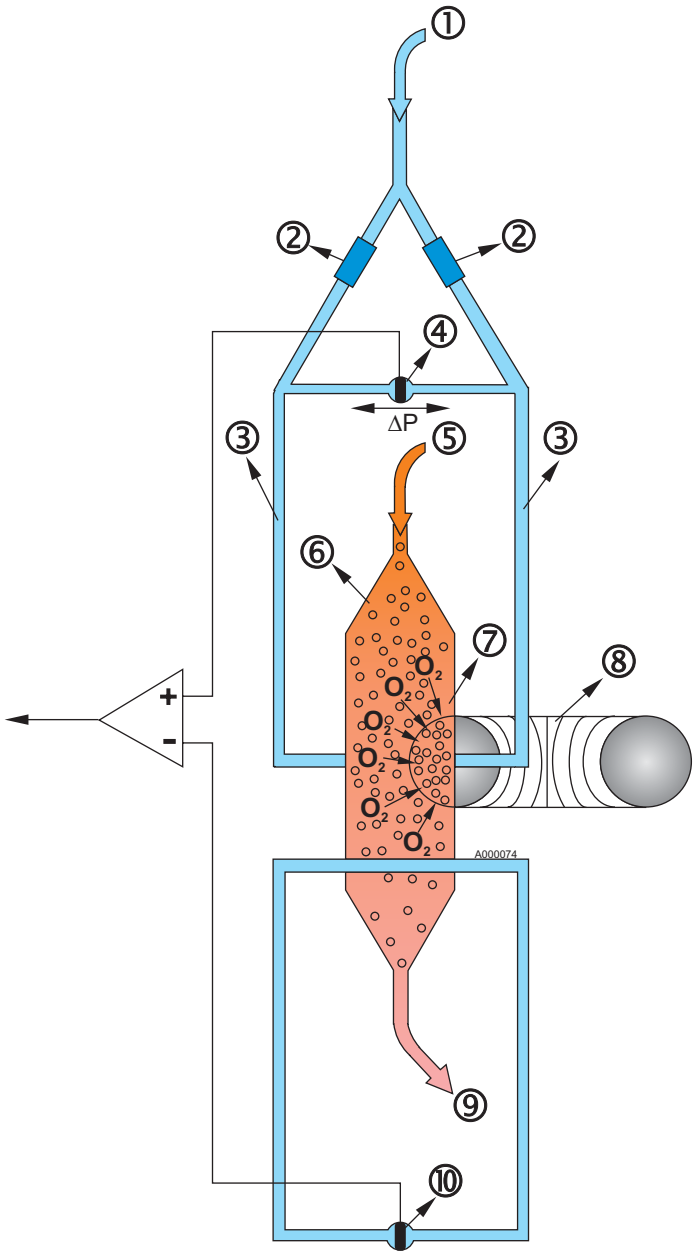
Because the flow sensor is located in the reference gas stream, the measurement is not influenced by thermal conductivity, specific heat or internal friction of the sample gas. This also provides a high corrosion resistance because the flow sensor is not exposed to the sample gas.

By using a magnetic field with alternating strength (8), the effect of a basic flow in the microflow sensor is not detected, and the measurement is thus independent of the sample chamber´s orientation.

The sample chamber is part of the sample path and has a small volume. The microflow sensor thus responds quickly, resulting in a very short response time for the BA 6000 - O_2.

Vibrations frequently occur at the place of measurement and may falsify the measured signal (noise). A further microflow sensor (10) through which no gas passes acts as a vibration sensor. Its signal is connected to the measured signal as compensation.

If the density of the sample gas deviates by more than 50% from the reference gas, the compensation microflow sensor (10) is flushed with reference gas just like the measuring sensor (4).



1 Reference gas inlet
2 Restrictor
3 Reference gas channel
4 Microflow sensor for measurement
5 Sample gas inlet
6 Sample chamber
7 Paramagnetic effect
8 Electromagnet with alternating field strength
9 Sample gas and reference gas outlet
10 Microflow sensor in compensation system (without flow)

Technical Data

Measurement ranges	4, internally and externally switchable; autoranging is also possible
Measurement range	
Smallest possible	0.5% v/v, 2% v/v or 5% v/v O_2
Largest possible	100% v/v O_2
Measurement ranges with suppressed zero	any zero point is possible between 0 to 100% v/v as long as a suitable calibration gas is used (see table)
Characteristic	linear (nature of technique)
Control panel	LCD with LED backlighting and contrast control, softkeys, numeric keypad and function keys
Measured-value display	4½ -digit, resolution depends on selected measurement range; selectable number of digits following decimal point
EMC (electromagnetic compatibility)	according to NAMUR requirements NE21 (05/93); CE designation EN 50081 part 1, EN 50082: part 2
Position of use	front panel vertical
Dimensions	19", 4 HU = 177 x 483 x 476 mm
Weight	appr. 20 kg
Power supply	
Mains connection	AC 100 to 120 V, 48 to 63 Hz (rated range: 90 V to 132 V) AC 200 to 240 V, 48 to 63 Hz (rated range: 180 V to 264 V)
Power consumption	appr. 35 VA
Gas inlet conditions	
Sample gas pressure	0.5 to 1.5 bar absolute for analysers with hose, 0.5 to 3 bar absolute for analysers with piping
Sample gas flow	20 to 60 l/h (0.3 to 1 l/min.)
Sample gas temp.	0 to 50 °C
Sample gas humidity	< 90% RH [1]
Time response	
Warm-up time	< 30 min at room temperature[2]
Display delay time (T_{90} time)	min. 1.5 to 3.5 s depending on version
Damping (electrical time constant)	0 to 100 s setable
Dead time	appr. 0.5 to 2.5 s depending on version (purging time of gas path in analyser at 1 l/min.)
Time for internal signal processing	< 1 s

Measurement response[3]	
Noise (electric time constant 1 s, range 2 δ)	0.5% of smallest possible span specified on type plate
Zero drift	< 0.5% / 3 months of smallest possible measurement range according to rating plate
Drift of measured value	< 0.5% / 3 months of respective measurement range
Repeatability	< 1% of respective measurement range
Influencing variables[3]	
Ambient temperature	< 0.5% / 10 K < 1% with span 0.5 % v/v O_2 referred to the smallest possible measurement range acc. to type plate
Sample gas pressure	without pressure compensation: < 2% of measurement range with 1% change in pressure. with pressure compensation: < 0.2% of measurement range with 1% change in pressure
Residual gases	deviation of zero point due to corresponding paramagnetic or diamagnetic deviation of residual gas (see application note AD 55 0012)
Sample gas flow	< 1% of smallest possible measuring range acc. to type plate with a change in flow of 0.1 l/min. within the permissible flow range.
Power supply	< 0.1% of output signal span with rated voltaged ± 10%
Electric inputs and outputs	
Analog output	0/2/4 to 20 mA floating, load ≤750 Ω
Relay outputs	6 changeover contacts, freely selectable e.g. for range identification: AC/DC 24V / 1A floating
Analog inputs	2, designed for 0 / 2 / 4 to 20 mA for external pressure sensor and correction of influence of residual gas (correction of cross-interference)
Binary inputs	6, designed for 24V, floating, freely selectable e.g. for range switching
Serial interface	RS 485
Options	additional electronics with 8 binary inputs and 8 binary outputs, e.g. for triggering automtic calibration
Climatic conditions	
Permissible ambient	-30 to +70 °C during storage and transport +5 to +45 °C during operation
Permissible humidity	< 90% RH as annual average during storage and transport [4]
Degree of protection	IP 20 (EN 60529)

[1] RH: relative humidity

[2] Maximum accuracy achieved after 2 hours

[3] Referred to 1 bar sample gas pressure, 0.5 l/min. sample gas flow and 25 °C ambient temperature

[4] Keep above dew point