

Gasanalyzer for determination of oxygen BA 6000 - O₂



The BA 6000 - O₂ gas analyzer is based on the paramagnetic alternating pressure method and is used to measure oxygen in gases. It is designed for use in non-potentially explosive atmospheres.

- for measuring ranges with free parameter settings, also with zero offset, all measuring ranges linear
- potential free signal output selectable as 0 / 2 / 4 to 20 mA (also inverted)
- autoranging or manual range switching possible
- storage of measured values possible during adjustment
- time constants selectable within broad range
- simple handling using menu based operation
- short response time
- low long-term drift
- two-stage access code
- internal pressure sensor for correction of pressure variations in sample gas (range 0.5 bar to 2 bar absolute)
- external pressure sensor may be connected
- automatic range calibration can be parameters can be set
- operation based on NAMUR recommendations
- monitoring of sample gas and/or reference gas (option)
- RS 485 serial interface
- several smallest spans (0,5 %, 2,0 % or 5,0 % O₂)

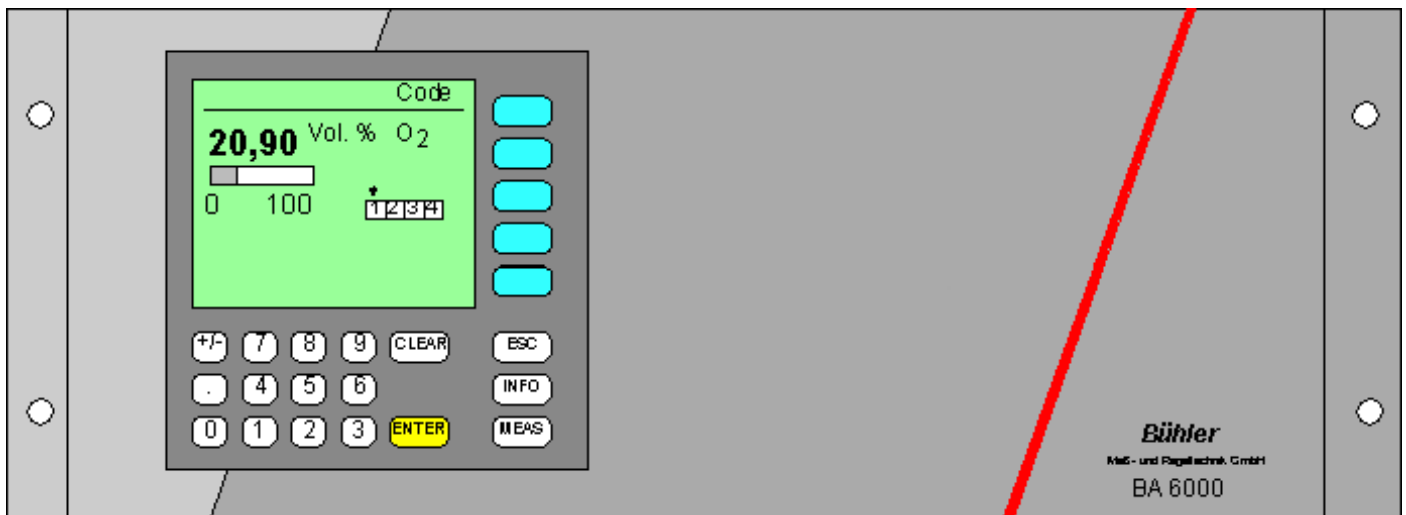
design, characteristics

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
- measuring chamber (with or without flow-type compensation branch) made of stainless steel or tantalum for highly corrosive sample gases (such as HCl, Cl₂, SO₂, SO₃ 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
 - measuring 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

Table reference gases

| Measuring range | Recommended reference gases | Reference gases- pressure | Remarks |
|--|-----------------------------|--|---|
| 0 to ...%v/v. O ₂ | N ₂ | 2 to 4 bar above sample gas pressure (max. 5 bar absolute) | The reference gas flow sets automatically to 5 to 10 ml/min (up 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% (suppressed zero with 21% v/v O ₂ within the span) | Air | | |

mode of operation

In contrast to almost all other gases, oxygen is paramagnetic. This property is utilized as the measuring principle by the BA 6000 - O₂ gas analysers.

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 - O₂, one gas (1) is a reference gas (N₂, O₂ 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. 120 °C 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.

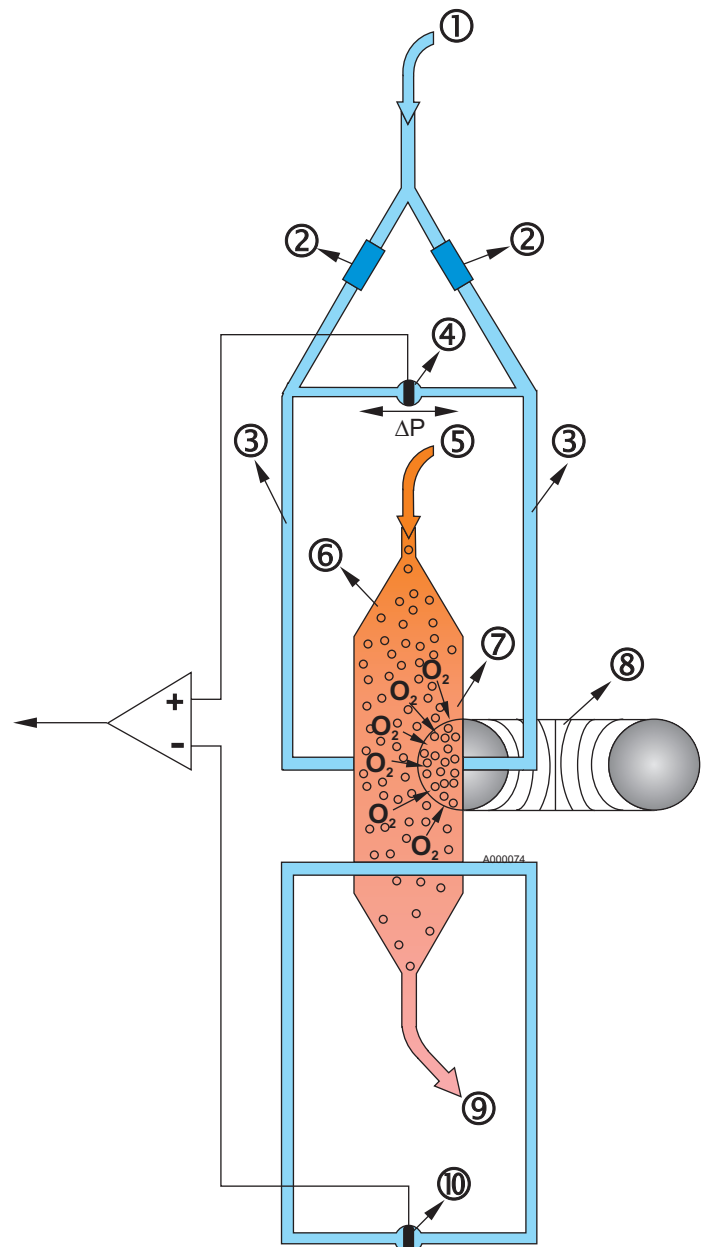
Because the flow sensor is located in the reference gas stream, the measurement is not influenced by thermal conductivity, specific heat or internal friction of the sample gas. This also provides a high corrosion resistance because the flow sensor is not exposed to the sample gas.

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 - O₂.

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 one of 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

| | | | |
|--|---|--|--|
| measuring ranges | 4, internally and externally switchable; autoranging is also possible | measuring response ³⁾ noise (electric time constant 1 s, range 2 δ) | 0,5% of smallest possible span specified on type plate |
| measuring range Smallest possible | 0,5% v/v, 2% v/v or 5% v/v O ₂ | zero drift | < 0,5% / 3 months of smallest possible measuring range according to rating plate |
| largest possible | 100% v/v O ₂ | drift of measured value | < 0,5% / 3 months of respective measuring range |
| measuring 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) | repeatability | < 1% of respective measuring range |
| characteristic | linear (nature of technique) | influencing variables ³⁾ ambient temperature | < 0,5% / 10 K < 1% with span 0,5 % v/v O ₂ referred to the smallest possible measuring range acc. to type plate |
| control panel | LCD with LED backlighting and contrast control, softkeys, numeric keypad and function keys | sample gas pressure | without pressure compensation: < 2% of measuring range with 1% change in pressure. with pressure compensation: < 0,2% of measuring range with 1% change in pressure |
| measured-value display | 4½ -digit, resolution depends on selected measuring range; selectable number of digits following decimal point | residual gases | deviation of zero point due to corresponding paramagnetic or diamagnetic deviation of residual gas (see application note AD 55 0012) |
| EMC (electromagnetic compatibility) | according to NAMUR requirements NE21 (05/93); CE designation EN 50081 part 1, EN 50082: part 2 | 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. |
| position of use | front panel vertical | power supply | < 0,1% of output signal span with rated voltaged ± 10% |
| dimensions | 19", 4 HU = 177 x 483 x 476 mm | electric inputs and outputs analog output | 0/2/4 to 20 mA floating, load ≤750 Ω |
| weight | appr. 20 kg | relais outputs | 6 changeover contacts, freely selectable e.g. for range identification: AC/DC 24V / 1A floating |
| 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) | 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) |
| power consumption | appr. 35 VA | binary inputs | 6, designed for 24V, floating, freely selectable e.g. for range switching |
| 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 | serial interface | RS 485 |
| sample gas flow | 20 to 60 l/h (0,3 to 1 l/min.) | options | additional electronics with 8 binary inputs and 8 binary outputs, e.g. for triggering automatic calibration |
| sample gas temp. | 0 to 50 °C | climatic conditions permissible ambient | -30 to +70 °C during storage and transport +5 to +45 °C during operation |
| sample gas humidity | < 90% RH ¹⁾ | permissible humidity | < 90% RH as annual average during storage and transport ⁴⁾ |
| time response warm-up time | < 30 min at room temperature ²⁾ | degree of protection | IP 20 (EN 60529) |
| display delay time (T ₉₀ time) | min. 1,5 to 3,5 s depending on version | | |
| damping (electrical time constant) | 0 to 100 s settable | | |
| 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 | | |

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