Data Sheet 10/24-4.10 EN Rev. 12

# EasyLine EL3000 Series Continuous Gas Analyzers Models EL3020, EL3040

## Measurement made easy


- Detectors with different measurement principles for numerous process and emission monitoring applications
- Up to five measurement components per gas analyzer
- Suitable for measuring flammable gases
- Version with protection type II 3G for measurement of non-flammable gases
- Performance-tested versions for emission monitoring according to Directive 2001/80/EC
- QAL3 monitoring according to EN 14181 (optional)
- Automatic calibration including pump and valve control
- Simplified calibration with air or integral calibration cells eliminating the need for test gas cylinders
- Customizable analog outputs, digital inputs and digital outputs
- Modbus and Profibus interfaces
- Simple menu-driven operator interface
- Clear-text status messages
- Configuration of rarely required functions with included configuration program
- Self-monitoring function indicates when maintenance is required
- Housing versions for 19-inch rack mounting (Model EL3020) and wall mounting (Model EL3040)
- Integral gas feed (optional in Model EL3020)

# Overview of the gas analyzers

## Measuring technology (analyzers)

The following analyzers are available for selection:

- Uras26 infrared photometer for the measurement of infrared-active gas components e.g. CO, NO, $SO_2$
- Limas23 ultraviolet photometer for the measurement of NO, $NO_2$ and $SO_2$
- Magnos206 oxygen analyzer for the measurement of $O_2$ in process gas or in $N_2$
- Magnos27 oxygen analyzer for the measurement of $O_2$ in flue gas or in $N_2$
- ZO23 trace oxygen analyzer for the measurement of $O_2$ in pure gases ($N_2$, $CO_2$, Ar)
- Caldos27 thermal conductivity analyzer for the measurement of binary gas mixtures with different thermal conductivity e.g. Ar in $O_2$, $H_2$ in Ar, $CH_4$ in $N_2$
- Fidas24 flame-ionization detector for the measurement of hydrocarbons
- Electrochemical oxygen sensor for the measurement of $O_2$

Magnos206 can also be used in combination with Uras26 or Limas23.

Magnos27 and Caldos27 can also be used in combination with Uras26.

Fidas24 and ZO23 cannot be used in combination with one of the other analyzers. Only one ZO23 can be installed in the gas analyzer.

The electrochemical oxygen sensor can only be used in combination with Uras26 or Limas23. Two electrochemical oxygen sensors can be used in combination with Uras26 with separate gas paths (only in model EL3020).

Each analyzer has one physical measurement range per sample component. A section of the physical measurement range can be mapped to the current output (analog output) by on-site configuration.

Calibration is always executed in the physical measurement range. The permissible measurement range limits are given by the specification of the smallest and largest measurement ranges for the individual analyzers.

A total of up to five measurement components can be measured with one gas analyzer.

## Calibration

Calibration can be performed automatically or manually. Automatic calibration – for all sample components together – is normally started on a cyclically time-controlled basis; it can also be started by an external control signal or via the Modbus as well as manually on the display and operator control unit of the gas analyzer.

Normally, simplified calibration methods with the built-in calibration cells or the so-called single-point calibration are used for automatic calibration. If calibration with test gases is required the control of solenoid valves for switching on five test gases, zero gas and sample gas via digital outputs can be configured.

## QAL3 monitoring

QAL3 monitoring is available as an option in the gas analyzer. It is used to fulfill the requirements according to EN 14181 for storage and analysis of device adjustment data. The QAL3 monitoring option features the following functions:

- Automatic acquisition, verification and documentation of drift and precision at zero and reference points
- Reporting via CUSUM and Shewhart control charts
- QAL3 data storage in the gas analyzer (maximum 1 year)
- QAL3 data display and read-out as well as parameter setting via web browser
- Status messages on deviations beyond requirements
- Data export for further processing with spreadsheet programs

### Electrical interfaces

The electrical interfaces for the output of measured values and communication with external systems include

- The integrated Ethernet-10/100BASE-T interface (for gas analyzer configuration, software update and QAL3 data transfer)

as well as the integrated I/O modules depending on the functional range and order

- 2-way and 4-way analog output modules with two or four analog outputs,
- Digital I/O module with four digital inputs and four digital outputs,
- Modbus module with one RS485 and one RS232 interface,
- Profibus module with one RS485 and one MBP interface.

### Integral gas feed

The integral gas feed (optional in model EL3020) is available in two versions. It includes

- either the solenoid valve, pump, coarse filter, capillary tube and flow sensor modules
- or a flow sensor module.

### Housing design

The housing for the EL3020 gas analyzer model is designed as 19-inch housing with 3 height units (4 height units with Magnos27) and degree of protection IP20.

The housing for the EL3040 gas analyzer model is designed as wall-mount housing with degree of protection IP65.

## Measurement principle

Non-dispersive infrared absorption

Photometer with 1 or 2 beam paths (gas paths) to measure up to 4 components

## Sample components and measurement ranges

Sample components and smallest measurement ranges

| Sample component | Smallest measurement range |
|---|---|
| CO | 0–100 ppm |
| $CO_2$ | 0–100 ppm |
| NO | 0–150 ppm |
| $SO_2$ | 0–100 ppm |
| $N_2O$ | 0–100 ppm |
| $CH_4$ | 0–100 ppm |

Measurement range quantity
2 measurement ranges

Measurement range limits

| Smallest measurement range | Largest measurement range |
|---|---|
| 0–100 ppm (NO: 0–150 ppm) | 0–500 ppm (NO: 0–750 ppm) |
| 0–200 ppm | 0–1000 ppm |
| 0–600 ppm | 0–3000 ppm |
| 0–2000 ppm | 0–10000 ppm |
| 0–0.6 vol.% | 0–3 vol.% |
| 0–2 vol.% | 0–10 vol.% |
| 0–6 vol.% | 0–30 vol.% |
| 0–20 vol.% | 0–100 vol.% |

An individual measurement range within the limits shown in the table can be factory-set on special order.
Measurement ranges are freely adjustable within the limits shown in the table.
Measurement ranges should not be set within ignition limits.

Version for use in air separation units
Only for binary gas mixtures consisting of the sample component in Ar, $N_2$ or $O_2$

| Sample component | Smallest / Largest measurement range |
|---|---|
| CO | 0–10 ppm / 0–50 ppm |
| $CO_2$ | 0–5 ppm / 0–25 ppm |
| $N_2O$ | 0–10 ppm / 0–50 ppm |
| $CH_4$ | 0–20 ppm / 0–100 ppm |

Other than the data valid for the standard version the following data apply for this version (in % of the smallest measurement range shown in the table):
Zero drift: ≤ 1.5 % per day
Sensitivity drift: ≤ 1 % per week
Output fluctuation (2 σ): ≤ 0.5 % at T90 = 15 s
Temperature effect: ≤ 2 % per 10 °C

## Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They relate to the smallest measurement range.

Linearity deviation
≤ 1 % of span

Repeatability
≤ 0.5 % of span

Zero drift
≤ 1 % of span per week

Sensitivity drift
≤ 1 % of measured value per week

Output fluctuation (2 σ)
≤ 0.2 % of span at electronic T90 time (static / dynamic)
= 5 / 0 sec

Detection limit (4 σ)
≤ 0.4 % of span at electronic T90 time (static / dynamic)
= 5 / 0 sec

## Influence effects

Flow effect
Flow rate in the 20 to 100 l/h range: within detection limits

Associated gas effect / cross sensitivity
The knowledge of the sample gas composition is necessary for the analyzer configuration.
Selectivity measures to reduce associated gas effect (optional): Incorporation of interference filters or filter cells, internal electronic cross-sensitivity correction for one sample component by other sample components measured with the gas analyzer.

Temperature effect
Ambient temperature in permissible range
- At zero-point: ≤ 2 % of span per 10 °C
- On sensitivity without thermostat: ≤ 3 % of measured value per 10 °C
- On sensitivity with thermostat (optional): ≤ 2 % of measured value per 10 °C
  Thermostat temperature = 55 °C

Air pressure effect
- At zero-point: No effect
- On sensitivity with pressure correction by means of integral pressure sensor: ≤ 0.2 % of measured value per 1 % barometric pressure change

The pressure sensor is located in the sample gas path if hoses are used as the internal gas lines.
If stainless-steel tubing is used for internal gas lines the pressure sensor is routed to the outside via a hose.
Pressure sensor working range: $p_{abs}$ = 600 to 1250 hPa

Power supply effect
Voltage and frequency in the permissible range: No effect

## Dynamic response

Warm-up time
Approx. 30 minutes without thermostat; approx. 2 hours with thermostat

90% response time
$T_{90}$ = 2.5 sec for measurement cell length = 175 mm, sample gas flow = 60 l/h and electronic T90 time (static/dynamic) = 5/0 sec

## Calibration

Zero-point calibration
With inert gas, e.g. nitrogen, or with ambient air that is free of the sample component.

End-point calibration
With gas-filled calibration cells (optional) or with test gas mixtures. It is recommended to verify the calibration cell set values once a year.

## Materials in contact with the sample medium

Analyzer (sample cells)
Tubing: aluminum; windows: $CaF_2$ or $BaF_2$; connectors: stainless steel 1.4305 (SAE 303)

Gas lines and connectors
Gas lines: FPM hoses or PTFE tubes; connectors: stainless steel 1.4305 (SAE 303); solenoid valve (option in model EL3020): PVDF.
When flammable components are present in the sample gas:
Gas lines: stainless steel tubes 1.4571 (SAE 316Ti); connectors: stainless steel 1.4305 (SAE 303).

## Gas connections

See page 25 and page 26

## Sample gas inlet conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet pressure
$p_e$ = 2 to 500 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet pressure
Atmospheric pressure

Flow rate
20 to 100 l/h

Corrosive gases
Highly corrosive associated gas components, e.g. chlorine ($Cl_2$) and hydrogen chloride (HCl), as well as gases or aerosols containing chlorine must be cooled or undergo prior absorption.

Flammable gases
In the version with gas lines and connectors made of stainless steel the analyzer is suitable for measuring flammable gases in general purpose environment (see page 20).

## Measurement principle

UV-RAS (UV Resonance Absorption Spectroscopy) method for sample component NO,
NDUV (Interference filter correlation) method for sample components $NO_2$ and $SO_2$

Photometer to measure up to 3 components

## Sample components and measurement ranges

Sample components and measurement ranges

| Sample component | Smallest / Largest measurement range |
|---|---|
| NO | 0–50 ppm / 0–5000 ppm |
| $NO_2$ | 0–50 ppm / 0–500 ppm |
| $SO_2$ | 0–100 ppm / 0–5 vol.% |

The NOx measurement value can be evaluated as the sum of the NO and $NO_2$ measurement values and output at an analog output. The NOx measurement range results from the sum of the NO and $NO_2$ measurement ranges.
NO processed through a converter can be indicated as sample component “NOx” on the display (factory-set).
For indication of the NOx measurement value in mg/m³, the factor 1.53 is taken into account for conversion of NO to NOx (factory-set).

Measurement range quantity
2 measurement ranges

Measurement range limits

| Smallest measurement range | Largest measurement range |
|---|---|
| 0–50 ppm | 0–250 ppm |
| 0–100 ppm | 0–500 ppm |
| 0–200 ppm | 0–1000 ppm |
| 0–400 ppm | 0–2000 ppm |
| 0–1000 ppm | 0–5000 ppm |
| 0–4000 ppm | 0–20000 ppm |
| 0–1 vol.% | 0–5 vol.% |

An individual measurement range within the limits shown in the table can be factory-set on special order.
Measurement ranges are freely adjustable within the limits shown in the table.

## Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They relate to the smallest measurement range.

Linearity deviation
≤ 1 % of span

Repeatability
≤ 0.5 % of span

Zero drift
- For NO: ≤ 2 % of span per week
- For $NO_2$ and $SO_2$: ≤ 3 ppm per week for measurement ranges ≤ 100 ppm (daily automatic baseline check is recommended), ≤ 2.5 % of span per week for measurement ranges > 100 ppm

Sensitivity drift
≤ 1 % of measured value per week

Output fluctuation (2 σ)
≤ 0.5 % of span at electronic T90 time = 20 sec

Detection limit (4 σ)
≤ 1 % of span at electronic T90 time = 20 sec

## Influence effects

Flow effect
Flow rate in the 20 to 100 l/h range: within detection limits

Associated gas effect / cross sensitivity
The knowledge of the sample gas composition is necessary for the analyzer configuration.
Selectivity measures to reduce associated gas effect (optional): Internal adjustment or internal electronic cross-sensitivity correction for one sample component by other sample components measured with the gas analyzer.

Temperature effect
Ambient temperature in permissible range
- At zero-point: ≤ 1 % of span per 10 °C
- On sensitivity: ≤ 1.5 % of measured value per 10 °C

Air pressure effect
- At zero-point: No effect
- On sensitivity with pressure correction by means of integral pressure sensor: ≤ 0.2 % of measured value per 1 % barometric pressure change

The pressure sensor is located in the sample gas path.
Pressure sensor working range: $p_{abs}$ = 600 to 1250 hPa

Power supply effect
Voltage and frequency in the permissible range: No effect

## Dynamic response

Warm-up time
Approx. 2 hours

90% response time
$T_{90} \leq 3$ sec for measurement cell length = 220 mm, sample gas flow = 60 l/h and electronic T90 time = 0 sec

## Calibration

Zero-point calibration
With inert gas, e.g. nitrogen, or with ambient air that is free of the sample component.

End-point calibration
With gas-filled calibration cells (optional) or with test gases (for each sample component). It is recommended to verify the calibration cell set values once a year.

## Materials in contact with the sample medium

Analyzer (sample cell)
Tubing: aluminum; windows: $CaF_2$; connectors: stainless steel 1.4305 (SAE 303). Option: Tubing, windows and connectors made of quartz glass.

Gas lines and connectors
Gas lines: FPM hoses; gas connectors: stainless steel 1.4305 (SAE 303)

## Gas connections

See page 27

## Sample gas inlet conditions

The analyzer must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.
The internal temperature of the gas analyzer is at least 10 °C above ambient temperature.

Inlet pressure
$p_e$ = 2 to 500 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet pressure
Atmospheric pressure

Flow rate
20 to 100 l/h

Corrosive gases
Highly corrosive associated gas components, e.g. chlorine ($Cl_2$) and hydrogen chloride (HCl), as well as gases or aerosols containing chlorine must be cooled or undergo prior absorption.

## Note

The analyzer cannot be used in combination with the integral gas feed.

## Measurement principle

Paramagnetic behavior of oxygen

Magnetomechanical oxygen analyzer; short 90% response time

## Sample component and measurement ranges

Sample component
Oxygen ($O_2$)

Smallest measurement range
0 to 2 vol.% $O_2$

Measurement range quantity and limits
2 measurement ranges
Measurement ranges are freely adjustable; they are factory-set per order to 0 to 5 or 0 to 100 or 98 to 100 vol.% $O_2$.

Largest measurement range
0 to 100 vol.% $O_2$
Measurement ranges should not be set within ignition limits.

Measurement ranges with suppressed zero-point
Suppressed measurement ranges are freely adjustable in the range 0 to 100 vol.% $O_2$. Smallest span 2 vol.% $O_2$. The combination of a suppressed and an initial measurement range is not possible.
Pressure correction with a pressure sensor is required.
A pressure sensor is installed when the analyzer has been ordered with suppressed measurement range.

## Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They are based on a span of 2 vol.% $O_2$.

Linearity deviation
≤ 0.5 % of span

Repeatability
≤ 50 ppm $O_2$ (time base for gas exchange ≥ 5 minutes)

Zero drift
≤ 3 % of span of the smallest measurement range (per order) per week, minimum 300 ppm $O_2$ per week; following prolonged transport and storage time the drift can be higher during the first weeks of operation.

Sensitivity drift
≤ 0.1 vol.% $O_2$ per week or ≤ 1 % of measured value per week (not cumulative), whichever is smaller.
≤ 0.25 % of measured value per year, minimum 0.05 vol.% $O_2$ per year

Output fluctuation (2 $\sigma$)
≤ 25 ppm $O_2$ at electronic T90 time (static/dynamic) = 3/0 sec

Detection limit (4 $\sigma$)
≤ 50 ppm $O_2$ at electronic T90 time (static/dynamic) = 3/0 sec

## Influence effects

Flow effect
≤ 0.1 vol.% $O_2$ in the 30 to 90 l/h range

Associated gas effect
Data regarding the effect of associated gases can be found in IEC 61207-3:2002 “Gas analyzers – Expression of performance – Part 3: Paramagnetic oxygen analyzers”.

Temperature effect
Ambient temperature in the permissible range
- At zero-point: ≤ 1 % of span per 10 °C, ≤ 2 % of span per 10 °C in combination with Uras26
- On sensitivity: ≤ 0.2 % of measured value per 10 °C

Thermostat temperature = 64 °C

Air pressure effect
- At zero-point: No effect
- On sensitivity with no pressure correction:
  ≤ 1 % of measured value per 1 % air pressure change
- On sensitivity with pressure correction using integrated pressure sensor (optional):
  ≤ 0.01 % of measured value per 1 % pressure change or
  ≤ 0.002 vol.% $O_2$ per 1 % pressure change, whichever is greater
  Pressure sensor working range: $p_{abs}$ = 600 to 1250 hPa

Power supply effect
Voltage and frequency in the permissible range: ≤ 0.2 % of span

Position effect
Zero-point shift ≤ 0.05 vol.% $O_2$ per 1° deviation from horizontal orientation. Position has no effect on the hard-mounted unit.

## Dynamic response

Warm-up time
< 1 hour

90% response time
$T_{90}$ approx. 4 sec at a sample gas flow of 90 l/h and electronic T90 time (static/dynamic) = 3/0 sec, gas change from nitrogen to air

## Calibration

Zero-point calibration
With oxygen-free process gas or substitute gas

End-point calibration
With process gas with a known oxygen concentration or a substitute gas such as dried air

Single-point calibration
Zero-point calibration with any oxygen concentration, e.g. with nitrogen or ambient air, processed through a cooler or $H_2O$ absorber.
Pressure correction by means of pressure sensor is recommended for single-point calibration with air.
Depending on the measurement task involved, the zero- and end-points should be verified periodically (recommendation: once a year).

Calibration of measurement ranges with suppressed zero-point
Highly suppressed measurement ranges (≥95 to 100 vol.% $O_2$) should only be calibrated with test gases with concentrations in the selected measurement range.

## Materials in contact with the sample medium

Analyzer
Sample chamber (direct connection): stainless steel 1.4305 (SAE 303), glass, platinum, rhodium, epoxy resin; seals: FPM (Fluorocarbon rubber), PEEK, FFKM

Gas connectors of the solenoid valve (option in model EL3020)
PVDF

## Gas connections

See page 28

## Sample gas inlet conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required. Water vapor content variations cause volume errors.

Inlet pressure
$p_e$ = 2 to 100 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet pressure
Atmospheric pressure

Flow rate
30 to 90 l/h
Abrupt changes in gas flow rates should be avoided when using highly suppressed measurement ranges.

Corrosive gases
Consultation with ABB Analytical is required if the sample gas contains $Cl_2$, HCl, HF or other corrosive components.
The AO2000-Magnos206 analyzer should be used if the sample gas contains $NH_3$.

Flammable gases
The analyzer is suitable for measuring flammable gases in general purpose environment (see page 20).

## Measurement principle

Paramagnetic behavior of oxygen

Heavy-duty thermomagnetic analyzer

## Sample component and measurement ranges

Sample component
Oxygen ($O_2$) in flue gas or in nitrogen ($N_2$)

Smallest measurement range
0 to 10 vol.% $O_2$

Measurement range quantity
1 measurement range
The measurement range is factory-set per customer order.

Largest measurement range
0 to 100 vol.% $O_2$
Measurement ranges within ignition limits cannot be provided.

## Stability

Linearity deviation
≤ 2 % of span

Repeatability
≤ 1 % of span

Zero drift
≤ 1 % of span per week

Sensitivity drift
≤ 2 % of measured value per week

Output fluctuation (2 σ)
≤ 0.5 % of smallest measurement range span at electronic T90 time = 0 sec

Detection limit (4 σ)
≤ 1 % of smallest measurement range span at electronic T90 time = 0 sec

## Influence effects

Flow effect
≤ 1 % of span at a flow change of ±10 l/h. At an identical flow rate for test and sample gases the flow rate effect is automatically compensated.

Associated gas effect
Magnos27 calibration applies only to the sample gas shown on the identification plate (= sample component + associated gas).

Temperature effect
Ambient temperature in permissible range
– At zero-point: ≤ 2 % of span per 10 °C
– On sensitivity: ≤ 0.5 % of measured value per 10 °C
relative to temperature at the time of calibration
Thermostat temperature = 63 °C

Air pressure effect
– At zero-point: < 0.05 vol.% $O_2$ per 1 % air pressure change
– On sensitivity without pressure correction:
≤ 1.5 % of measured value per 1 % air pressure change
– On sensitivity with pressure correction using integrated pressure sensor (optional):
≤ 0.25 % of measured value per 1 % air pressure change
Option: Operating altitude over 2000 m

Power supply effect
24 VDC ± 5 %: ≤ 0.2 % of span

Position effect
Approx. 3 % of smallest measurement range span per 1° deviation from horizontal orientation. Position has no effect on the hard-mounted unit.

## Dynamic response

Warm-up time
2 to 4 hours

90% response time
$T_{90}$ = 10 to 22 sec, depending on sample gas flow and on measurement cell connection (see “Gas connections”, applies to an analyzer unit with 1 analyzer module)

## Calibration

Zero-point calibration
With oxygen-free process gas or substitute gas

End-point calibration
With process gas having a known oxygen concentration or with substitute gas

## Materials in contact with the sample medium

Analyzer
Rust- and acid-resistant steel 1.4580 (SAE 316Cb) and 1.4305 (SAE 303), glass

Gas lines and connectors
Rust- and acid-resistant steel 1.4571 (SAE 316Ti) and 1.4305 (SAE 303), PVC-C, FPM

## Gas connections

See page 29

## Sample gas inlet conditions

The analyzer must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required. Water vapor content variations cause volume errors.

Inlet pressure
$p_e$ = 2 to 100 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet pressure
Atmospheric pressure

Flow rate
20 to 90 l/h

## Note

The analyzer can only be mounted in the 19-inch housing (dimensional drawing see page 29). The analyzer cannot be used in combination with the integral gas feed.

# Trace oxygen analyzer ZO23

## Measurement principle

Potentiometric measurement; zirconium dioxide cell for determination of the oxygen concentration in accordance with Nernst's equation; reference gas: ambient air.

The analyzer is used for the continuous measurement of oxygen in pure gases ($N_2$, $CO_2$, Ar). The measuring cell is catalytically inactivated to the extent that flammable carrier components in stoichiometric concentrations only negligibly reduce the oxygen value.

## Sample component and measurement ranges

Sample component
Oxygen ($O_2$)

Measurement range quantity and limits
2 measurement ranges
Measurement ranges are freely adjustable within the range 0 to 1 ppm to 0 to 250,000 ppm $O_2$; they are factory-set to 0 to 1/0 to 10 ppm $O_2$.
The following measurement data refer to a measurement span of 100 ppm $O_2$ with a regulated flow rate of 8 ± 0.2 l/h.

## Stability

Linearity
Owing to the measurement principle, zirconium dioxide cells are base linear.

Repeatability
< 1 % of the measurement range or 100 ppb $O_2$ (whichever is greater)

Zero drift
The zero point (reference point) is displayed if ambient air is present on the sample gas side. The value for air of 20.6 % vol. of $O_2$ (for 25 °C and 50 % relative humidity) may deviate through aging of the cell.
< 1 % of the measurement range per week or 250 ppb $O_2$ (whichever is greater)

Sensitivity drift
Depends on possible interfering components (catalyst poisons) in the sample gas and the aging of the cell.
For pure gas measurements in $N_2$ and Ar:
< 1 % of the measurement range per week or 250 ppb $O_2$ (whichever is greater)

Output fluctuation (2 $\sigma$)
< ±0.5 % of the measured value or 50 ppb $O_2$ (whichever is greater)

## Influence effects

Flow effect
≤ 300 ppbv $O_2$ in the permissible range

Associated gas effect
Inert gases (Ar, $CO_2$, $N_2$) have no effect. Flammable gases (CO, $H_2$, $CH_4$) in stoichiometric concentrations to the oxygen content: Conversion of $O_2$ < 20 % of the stoichiometric conversion. If higher concentrations of flammable gases are present, higher $O_2$ conversions must be expected. The concentration of flammable gases in the sample gas must not exceed 100 ppm.

Temperature effect
The effect of the ambient temperature in the permissible range of +5 to +45 °C is < 2 % of the measured value or 50 ppb $O_2$ per 10 °C change in the ambient temperature (whichever is greater).

Air pressure effect
No effect through a change in air pressure; the sample gas must flow out of the outlet without back pressure.

Power supply effect
24 V DC ± 5 %: no effect

Position effect
No position effect for permanently installed instruments

## Dynamic response

Warm-up time
The operating temperature of the cell is reached after approx. 15 minutes. Offset calibration with reference gas (ambient air) after 2 hours flow. The measurement is ready-to-run after valves and lines have been purged with sample gas. Typical purging time for valves and lines: approx. 2 to 5 hours.

90% response time
$T_{90}$ < 60 sec for the alternation of 2 test gases in the measurement range 10 ppm with a sample gas flow rate = 8 l/h and electronic T90 time = 3 sec

## Calibration

Offset calibration
The reference value for ambient air is calibrated at 20.6 vol.% $O_2$ by means of ambient air on the sample gas side.

End-point calibration
By means of test gas $O_2$ in $N_2$ (or in $CO_2$ or in Ar);
$O_2$ concentration in the measurement range, e.g. 10 ppm $O_2$

## Function test

An extended response time or reduced sensitivity are dimensions for the correct functioning of the measuring cell. The function test can be carried out by feeding the sample gas without any additional test gases. On the basis of the progression of the test, it can be assessed whether the reaction time of the sensor lies within a specified tolerance. The function test is started manually and lasts approx. 15 min.

## Materials in contact with the sample medium

Analyzer
Zirconium dioxide cell: $ZrO_2$, electrodes containing platinum; dust filter (option): PP; flow sensor (option): on semiconductor basis, nickel-plated brass

Gas lines and connectors
Stainless steel 1.4571 (SAE 316Ti), FPM and silicon hoses in the gas outlet; gas connections: stainless steel 1.4401 (SAE 316) / 1.4305 (SAE 303)

## Gas connections

See page 30

## Sample gas inlet conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +50 °C

Inlet pressure
$p_e \leq 70$ hPa

Outlet pressure
Atmospheric pressure

Flow rate
4 to 20 l/h. Use a metering valve to set the flow rate.

Corrosive gases
The presence of corrosive gases and catalyst poisons, e.g. halogens, gases containing sulfur and heavy-metal dust, leads to faster aging and / or destruction of the $ZrO_2$ cell.

Flammable gases
The analyzer is suitable for measuring flammable gases in general purpose environment (see page 20). The concentration of flammable gases in the sample gas must not exceed 100 ppm.

Purge gas
If case purging is selected, purging may only be carried out with air (not with nitrogen), since the ambient air is used as a reference gas.

## Note

The analyzer cannot be used in combination with the integral gas feed.

## Measurement principle

Difference in thermal conductivity of various gases
Micromechanical silicon sensor with especially short $T_{90}$ time

## Sample components and measurement ranges

| Sample component and associated gas | Smallest Meas. range | Smallest meas. range with suppr. zero-point |
|---|---|---|
| Air in Ar | 0– 6 Vol.-% | 94–100 Vol.-% |
| Ar in air | 0– 6 Vol.-% | 94–100 Vol.-% |
| Air in $CO_2$ | 0–10 Vol.-% | 90–100 Vol.-% |
| $CO_2$ in air | 0–10 Vol.-% | 90–100 Vol.-% |
| Air in $H_2$ | 0– 3 Vol.-% | – |
| $H_2$ in air | 0– 1 Vol.-% | – |
| Air in He | 0– 3 Vol.-% | 98–100 Vol.-% |
| He in air | 0– 2 Vol.-% | 97–100 Vol.-% |
| Ar in $CO_2$ | – | 50–100 Vol.-% |
| $CO_2$ in Ar | 0–50 Vol.-% | – |
| Ar in $H_2$ | 0– 3 Vol.-% | 99–100 Vol.-% |
| $H_2$ in Ar | 0– 1 Vol.-% | 97–100 Vol.-% |
| Ar in He | 0– 3 Vol.-% | 99–100 Vol.-% |
| He in Ar | 0– 1 Vol.-% | 97–100 Vol.-% |
| Ar in $N_2$ | 0– 6 Vol.-% | 94–100 Vol.-% |
| $N_2$ in Ar | 0– 6 Vol.-% | 94–100 Vol.-% |
| Ar in $O_2$ | 0–10 Vol.-% | 90–100 Vol.-% |
| $O_2$ in Ar | 0–10 Vol.-% | 90–100 Vol.-% |
| $CH_4$ in $H_2$ | 0– 4 Vol.-% | 99–100 Vol.-% |
| $H_2$ in $CH_4$ | 0– 1 Vol.-% | 96–100 Vol.-% |
| $CH_4$ in $N_2$ | 0– 6 Vol.-% | 94–100 Vol.-% |
| $N_2$ in $CH_4$ | 0– 6 Vol.-% | 94–100 Vol.-% |
| CO in $H_2$ | 0– 3 Vol.-% | 99–100 Vol.-% |
| $H_2$ in CO | 0– 1 Vol.-% | 97–100 Vol.-% |
| $CO_2$ in $H_2$ | 0– 3 Vol.-% | 99–100 Vol.-% |
| $H_2$ in $CO_2$ | 0– 1 Vol.-% | 97–100 Vol.-% |
| $CO_2$ in $N_2$ | 0–10 Vol.-% | 90–100 Vol.-% |
| $N_2$ in $CO_2$ | 0–10 Vol.-% | 90–100 Vol.-% |
| $H_2$ in $N_2$ | 0– 1 Vol.-% | 97–100 Vol.-% |
| $N_2$ in $H_2$ | 0– 3 Vol.-% | 99–100 Vol.-% |
| $H_2$ in $NH_3$ | 0–10 Vol.-% | 90–100 Vol.-% |
| $NH_3$ in $H_2$ | 0–10 Vol.-% | 90–100 Vol.-% |
| He in $N_2$ | 0– 2 Vol.-% | 97–100 Vol.-% |
| $N_2$ in He | 0– 3 Vol.-% | 98–100 Vol.-% |

Sample components and measurement ranges for monitoring hydrogen-cooled turbo generators

| Sample component and associated gas | Measurement range |
|---|---|
| $CO_2$ in air or Ar in air | 0–100 vol.% |
| $H_2$ in $CO_2$ or $H_2$ in Ar | 100–0 vol.% |
| $H_2$ in air | 100–80 vol.% |

Other sample components on request.

Measurement range quantity and limits
2 measurement ranges. Measurement ranges are freely adjustable within the limits shown in the table.

Largest measurement range
0 to 100 vol.% or 0 vol.% to saturation, depending on measurement task
Measurement ranges should not be set within ignition limits.

## Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They relate to the smallest measurement ranges given in the table. The deviations may be larger for smaller measurement ranges.

Linearity deviation
≤ 2 % of span

Repeatability
≤ 1 % of span

Zero drift
≤ 2 % of smallest possible measurement range per week

Sensitivity drift
≤ 0.5 % of smallest possible measurement range per week

Output fluctuation (2 σ)
≤ 0.5 % of smallest measurement range span at electronic T90 time = 0 sec

Detection limit (4 σ)
≤ 1 % of smallest measurement range span at electronic T90 time = 0 sec

## Influence effects

The following data relate to smallest measurement ranges given in the table. The influence effects will be larger at operating altitudes > 2000 meters.

Flow effect
≤ 0.5 % of span at a flow change of ±10 l/h. At an identical flow rate for test and sample gases the flow rate effect is automatically compensated.

Associated gas effect
The knowledge of the sample gas composition is necessary for the analyzer configuration. If the sample gas contains components in addition to the sample component and associated gas (binary gas mixture), this will result in erroneous measurements.

Temperature effect
Ambient temperature in the permissible range
at each point in the measurement range: ≤ 1 % of span per 10 °C, based on temperature at the time of calibration
Thermostat temperature = 60 °C

Air pressure effect
≤ 0.25 % of span per 10 hPa for the smallest possible ranges given; for larger spans the effect is correspondingly lower.
Pressure sensor working range: $p_{abs}$ = 600 to 1250 hPa

Power supply effect
Voltage and frequency in the permissible range: ≤ 0.2 % of span

Position effect
< 1 % of span up to 30° deviation from horizontal orientation

## Dynamic response

Warm-up time
Approx. 30 minutes

90% response time
$T_{90} \leq 2$ sec at sample gas flow of 60 l/h and electronic T90 time (static/dynamic) = 0/0 sec

## Calibration

Zero-point calibration
With test gas, measurement component-free process gas or substitute gas

End-point calibration
With test gas, process gas having a known sample gas concentration or substitute gas

Single-point calibration
A single-point calibration can be performed with standard gas, since the zero- and end-points will not drift independently due to the sensor principle employed. This technique leaves out safety-related measurements. Depending on the measurement task involved, the zero- and end-points should be verified periodically (recommendation: once a year).

## Materials in contact with the sample medium

Analyzer
Sample chamber (direct connection): stainless steel 1.4305 (SAE 303); sensor: gold, silicon oxi-nitride; seal: FFKM75 (Perfluoro rubber)

Gas connectors of the solenoid valve (option in model EL3020)
PVDF

## Gas connections

See page 31

## Sample gas inlet conditions

The analyzer must not be used for measurement of ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +50 °C
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required. Water vapor content variations cause volume errors.

Inlet pressure
$p_e$ = 2 to 100 hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet pressure
Atmospheric pressure

Flow rate
Normally 10 to 90 l/h, minimum 1 l/h

Pressure drop
< 2 hPa at 60 l/h nitrogen

Corrosive gases
Consultation with ABB Analytical is required if the sample gas contains $Cl_2$, HCl, HF, $SO_2$, $NH_3$, $H_2S$ or other corrosive components.

Flammable gases
The analyzer is suitable for measuring flammable gases in general purpose environment (see page 20).

# Flame-ionization detector Fidas24

## Measurement principle

Flame-ionization detector

## Sample components and measurement ranges

Sample components
Hydrocarbons (THC)

Number of sample components
1 sample component

Smallest measurement range
0 to 5 mg org. C/$m^3$ or
0 to 10 ppm C1

Largest measurement range
0 to 5 g org. C/$m^3$ or
0 to 1 vol.% C1
The sample component concentration in the sample gas should not exceed 100 % of the LEL.

Measurement range quantity
2 measurement ranges
Measurement ranges are factory-set per customer order.

## Stability

The following data apply only if all influence factors (e.g. flow rate, temperature, atmospheric pressure) are constant. They apply to measurement ranges ≥ 50 mg org. C/$m^3$, for smaller ranges these only apply if they are factory-set per customer order.

Linearity deviation
≤ 2 % of the span to 5000 mg org. C/$m^3$
this value applies in one (calibrated) measurement range

Repeatability
≤ 0.5 % of measurement range

Zero-point and sensitivity drift
≤ 0.5 mg org. C/$m^3$ per week

Output fluctuation (2 σ)
≤ 0.5 % of span at electronic T90 time = 20 sec,
not smaller than 10 µg org. C/$m^3$

Detection limit (4 σ)
≤ 1 % of span at electronic T90 time = 20 sec,
not smaller than 20 µg org. C/$m^3$

## Influence effects

Oxygen dependence
≤ 2 % of measured value for 0 to 21 vol.% $O_2$ or
≤ 0.3 mg org. C/$m^3$, the larger value applies

Temperature effect
Ambient temperature in permissible range
at zero-point and on sensitivity: ≤ 2 % per 10 °C in measurement range of 0 to 15 mg org. C/$m^3$

Power supply effect
24 VDC ± 5 %: ≤ 0.2 % of span or
230 VAC ± 10 %: ≤ 0.2 % of span

## Dynamic response

Warm-up time
≤ 2 hours

90% response time
$T_{90}$ < 1.5 s at sample gas flow = 80 l/h and electronic T90 time = 1 sec

## Calibration

Zero-point calibration
With synthetic air or catalytically purified air or nitrogen, depending on application

Sensitivity calibration
With propane or another hydrocarbon (substitute gas) in air or nitrogen, depending on application

## Materials in contact with the sample medium

Analyzer, gas lines and connectors
Stainless steel 1.4305 (SAE 303) and 1.4571 (SAE 316Ti), FPM, PTFE, FFKM

## Gas connections

See page 32

## Operating gases and test gases

Instrument air
Quality per ISO 8573-1 class 2 (max. particle size 1 µm, max. particle concentration 1 mg/m³, max. oil content 0.1 mg/m³, pressure dew point at least 10 °C below the lowest foreseeable ambient temperature)
Inlet pressure $p_e$ = 4000 ± 500 hPa
Flow rate typically approx. 1500 l/h (1200 l/h for air injector and approx. 300 l/h for housing purge), maximum approx. 2300 l/h (1800 l/h + 500 l/h)

Combustion air
Synthetic air or catalytically purified air with an organic C content < 1 % span
Inlet pressure $p_e$ = 1200 ± 100 hPa
Flow rate < 20 l/h

Combustion gas
Hydrogen, grade 5.0, or $H_2$/He mixture (40/60 %)
Inlet pressure $p_e$ = 1200 ± 100 hPa
Flow rate ≤ 3 l/h ($H_2$) or approx. 10 l/h ($H_2$/He)
A flow limiting device must be provided on the hydrogen supply (see section “Safe operation of the gas analyzer”).

Test gases
Zero-point calibration: Nitrogen, grade 5.0, or synthetic air or catalytically purified air
Sensitivity calibration: Sample component or substitute gas component in nitrogen or air
Inlet pressure $p_e$ = 1000 ± 100 hPa
Flow rate 130 to 250 l/h

## Sample gas inlet conditions

Temperature
≤ thermostat temperature
(Thermostat temperature for measurement gas path, detector and air injector ≤ 200 °C, factory-set to 180 °C)

Inlet pressure
$p_{abs}$ = 800 to 1200 hPa

Outlet pressure
Atmospheric pressure

Flow rate
Approx. 80 to 100 l/h at atmospheric pressure (1000 hPa)

Flammable gases
The analyzer can be used for measurement of flammable gases as long as the total flammable portion does not exceed 15 vol.% $CH_4$ or C1 equivalents.

## Note

The analyzer cannot be used in combination with the integral gas feed.

## Safe operation of the gas analyzer

The device concept ensures that a concentration of combustible gas or an explosive mixture of combustible gas and ambient air cannot occur in the interior of the gas analyzer during normal operation. The interior of the gas analyzer cannot be allocated to an (explosion protection) zone; an explosive gas mixture cannot escape to the outside.

The end user must make the following provisions to ensure safe operation of the gas analyzer:
- The gas analyzer is safe to operate even in case of a defect in the combustion gas feed path (e.g. a loose screw connection inside the gas analyzer) with an additional flow restriction in the combustion gas supply (outside the gas analyzer) of 10 l/h for $H_2$ or 25 l/h for an $H_2$/He mixture.
- The installation of an external combustion gas shut-off valve must be provided. ABB recommends the automatic shut-off of the combustion gas supply in case the instrument air supply fails by the installation of a pneumatic valve, which controls the combustion gas supply and is actuated by the instrument air supply.

# Electrochemical oxygen sensor

## Measurement principle

Electrochemical oxygen sensor

## Sample component and measurement range

Sample component
Oxygen ($O_2$)

Smallest measurement range
0 to 5 vol.% $O_2$

Measurement range
Factory-set to 0 to 25 vol.% $O_2$.
Adjustable from 0 to 5 vol.% $O_2$ to 0 to 25 vol.% $O_2$

## Stability

Linearity deviation
Linear in the range > 1 vol.% $O_2$

Repeatability
≤ 0.5 % of span

Zero drift
Stable over long-term due to absolute zero point

Sensitivity drift
≤ 1 % of the measurement range per week

Output fluctuation (2 σ)
≤ 0.2 % of the measurement range at electronic T90 time (static/dynamic) = 5/0 sec

Detection limit (4 σ)
≤ 0.4 % of the measurement range at electronic T90 time (static/dynamic) = 5/0 sec

## Influence effects

Flow effect
Flow rate in the 20 to 100 l/h range:
≤ 2 % of the measurement range

Temperature effect
Ambient temperature in the +5 to +40 °C range:
≤ 0.2 vol.% $O_2$ per 10 °C

Air pressure effect
- At zero-point: No effect
- On sensitivity with no pressure correction:
  ≤ 1 % of measured value per 1 % air pressure change
- On sensitivity with pressure correction:
  ≤ 0.2 % of sample value per 1 % air pressure change
  Pressure correction is only possible if the oxygen sensor is connected to the Uras26 infrared photometer with an integral pressure sensor.

Power supply effect
Voltage and frequency in the permissible range: ≤ 0.2 % of span

## Dynamic response

90% response time
$T_{90}$ ≤ 30 sec at sample gas flow of 60 l/h and electronic T90 time (static/dynamic) = 5/0 sec

## Calibration

Zero-point calibration
The oxygen sensor zero is not calibrated since it is fundamentally stable.

End-point calibration
With ambient air at 20.96 vol.% $O_2$

## Materials in contact with the sample medium

Sensor: Polystyrol-ABS, PTFE, FPM (Fluorocarbon rubber);
Housing body: PVC, FPM (Fluorocarbon rubber) seals;
Gas ports: Stainless steel 1.4571 (SAE 316Ti)

## Sample gas inlet conditions

The oxygen sensor must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures.

Temperature
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Moisture content
$H_2O$ dew point ≥ 2 °C
The oxygen sensor should not be used with dry sample gas.

Inlet pressure
$p_e$ = 2 to 500 hPa

Outlet pressure
Atmospheric pressure

Flow rate
20 to 100 l/h

Associated gas
The oxygen sensor must not be used if the associated gas contains the following components: $H_2S$, chlorine or fluorine compounds, heavy metals, aerosols, mercaptans, and alkaline components.

## Note

The oxygen sensor can only be used in combination with Uras26 or Limas23. Two oxygen sensors can be used in combination with Uras26 with separate gas paths (only in model EL3020).
The oxygen sensor cannot be used when the internal gas lines in the Uras26 are made up of stainless steel or PTFE pipes.

# Integral gas feed

## Versions

The integral gas feed (optional in model EL3020) is available in two versions. It includes
- either the solenoid valve, pump, coarse filter, capillary tube and flow sensor modules
- or the flow sensor module.

## Test gas supply

Type
3/2-way solenoid valve

Power consumption
Approx. 3 W

Materials in contact with the sample medium
PVDF, FPM

## Gas feed

Type
Magnetic piston pump

Feed rate
Max. 60 l/h, depending on the analyzer type and inlet/outlet pressure

Flow rate
Adjustable

Power consumption
Approx. 10 W

Materials in contact with the sample medium
PVDF, EPDM, stainless steel 1.4571 (SAE 316Ti)

## Flow monitor

Type
Miniature flow sensor

Materials in contact with the sample medium
$Al_2O_3$, silicon, gold, GRP

## Sample gas inlet conditions

The integral gas feed modules must not be used for measurement of flammable gases and ignitable gas/air or gas/oxygen mixtures.

Temperature
+5 to +45 °C
The sample gas dew point should be at least 5 °C below the temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Flow rate
30 to 60 l/h

Corrosive gases
Corrosive associated gas components and aerosols must be cooled or undergo prior absorption.

## Note

The integral gas feed cannot be used when the internal gas lines are made up of stainless steel or PTFE pipes. It cannot be used in combination with Limas23, Magnos27, ZO23 or Fidas24.

# Special versions

### Version for measurement of flammable gases

In the version with gas lines and connectors made of stainless steel the gas analyzer (Models EL3020 and EL3040) with Uras26, Magnos206, Caldos27 and ZO23 (concentration max. 100 ppm) is suitable for measuring flammable gases in general purpose environment.

In model EL3040, housing purge with nitrogen (ZO23: with air) must be provided.

The positive pressure in the sample gas feed path may not exceed a maximum value of 100 hPa in normal operation and a maximum value of 500 hPa in the event of a fault.

The special requirements must be observed (see operator's manual).

### Version with protection type II 3G for installation in hazardous location for measurement of non-flammable gases and vapors

The gas analyzer (Model EL3040) with Uras26, Limas23, Magnos206 and Caldos27 is tested for explosion protection. It is suitable for installation in hazardous locations when the technical data and the special requirements (see operator's manual) are observed.

The gas analyzer may be used for measurement of non-flammable gases and vapors. It is marked according to the European directive 94/9/EC with

Ⓔx II 3G Ex nAC II T4 X

In undisturbed operation there cannot be any sparking, arcing or impermissible temperatures inside the device. Explosion protection through: Non-sparking instruments and devices with low power consumption; sealed or encapsulated devices

Judgment according to EN 60079-15 : 2005: Electrical apparatus for explosive gas atmospheres – Part 15: Type of protection "n", sections 1 to 16, 19, 20, 22, 23, 29

Marking according to EN 60079-15 : 2005, section 35

Housing degree of protection IP65

The special requirements must be observed (see operator's manual).

# General data

### Display and operation

Display
Backlit graphics display with 240 x 160-pixel resolution

Measured value display
- Numerical value with physical unit, also with bar graph indication in single display
- Resolution better than 0.2 % of the measurement span
- Simultaneous display of up to 5 measured values
- Flow: bar graph indication

Status display
Symbols in the display; the active status messages can be accessed directly from the measured value display

Operation
5 keys (cursor cross and OK); menu-assisted operation

Concept of operation
The functions required in normal operation are operated and configured directly on the gas analyzer. The functions which are only seldom required, e.g. during start-up, are configured offline using the configuration software ECT ("EasyLine Configuration Tool" on the enclosed CD-ROM) and then loaded into the gas analyzer.

Measuring range switch-over and feedback
There are three ways of executing the measuring range switch-over:
- Manually on the gas analyzer
- Automatically (autorange) by means of appropriate configured switch-over thresholds
- Externally controlled via appropriately configured digital inputs.

The measuring range feedback can be implemented via appropriately configured digital outputs; it is independent of the selected type of measuring range switch-over.
The gas analyzer is set ex works to measuring range 2 and to manual measuring range switch-over.

Limit value monitoring
Limit values can be set using the configuration software ECT. The limit value signals (alarms) are output via digital outputs.

### Housing

| | Model EL3020 | Model EL3040 |
|---|---|---|
| Version | 19-inch housing | Wall-mount housing |
| Protection type | IP20 | IP65 |
| Materials | | |
| Housing | Galvanized sheet steel<br>Outer surfaces varnished | Stainless steel 1.4016 (SAE 430) |
| Analyzer rear panel | Aluminum, PVC-C | Aluminum, PVC-C |
| Keypad sheet | Polyester | Polyester |
| Colors | Light gray (RAL 7035), basalt gray (RAL 7012) | |
| Weight | Approx. 7 to 15 kg | Approx. 13 to 21 kg |
| Dimensions | See page 33 | See page 34 |

Housing purge
Possible only with model EL3040 (wall-mount housing). Housing purge is mandatory when measuring flammable gases (see page 20). Purge gas flow during operation min. 10 l/h, max. 20 l/h. Purge gas pressure $p_e$ = 2 to 4 hPa.

## Pressure sensor

Use
Standard: with Uras26, Limas23, Caldos27,
Option: with Magnos206 and Magnos27

Materials in contact with the sample medium
Silicone gel, plastics, FPM (Fluorocarbon rubber)

## Fine filtration

Version
Disposable filter with borosilicate glass microfiber filter element (supplied as accessory)

Retention rate
99.99 % for particles > 0.1 µm

Materials in contact with the sample medium
Polyamide, borosilicate glass with PVDF binder

## Electrical safety

Tested per EN 61010-1:2001

Protection class I

Overvoltage category/pollution degree
Power supply: III/2, other circuits: II/2

Safe isolation
The power supply is galvanically isolated from other circuits by means of reinforced or double insulation. Protective extra-low voltage (PELV) on low-voltage side

## Electromagnetic compatibility

Noise immunity
Tested to EN 61326-1:2006. Inspection severity: Industrial area, fulfills at least the rating "continuously monitored operation" to table 2 of EN 61326.

Emitted interference
Tested to EN 61326-1:2006, EN 61000-3-2:2006 and EN 61000-3-3:1995 + A1:2001 + A2:2005. Limit value class B for interference field strength and interference voltage is met.

## Mechanical stress

Operation
Vibration test to EN 60068-2-6:1996
Vibrations up to 0.5g/150 Hz have no influence on the measured value. In Uras26, slight transient effects on the measured value can occur in the region of the modulation frequency.

Transport
Vibration test to EN 60068-2-6:1996,
shock test to EN 60068-2-27:1995
In its original packaging, the gas analyzer will withstand normal shipping conditions.

## Installation site requirements

Installation location
The gas analyzer is intended for indoor installation only. Installation location altitude max. 2000 m above sea level (over 2000 m on request)

Ambient temperature
Operation: +5 to +45 °C
Uras26 in combination with another analyzer, Limas23, Fidas24: +5 to +40 °C
Storage and transport: –25 to +65 °C

Relative humidity
< 75 %, slight condensation allowed

Air circulation
For sufficient air circulation, multiple housings in a 19-inch rack must be installed with a separation of at least one height unit between housings.

## Power supply

Input voltage
100 to 240 V AC – 15/+ 10 %, 50 to 60 Hz ± 3 Hz

Power consumption
Max. 187 VA

Connection
3-pin plug per EN 60320-1/C14; connection cable supplied.
Connection diagrams see page 22.

### Fidas24: Heating of detector and sample gas inlet

Input voltage
115 VAC or 230 VAC, ± 15 % (max. 250 VAC), 47 to 63 Hz

Power consumption
125 VA for detector heating,
125 VA for heated sample gas inlet (optional)

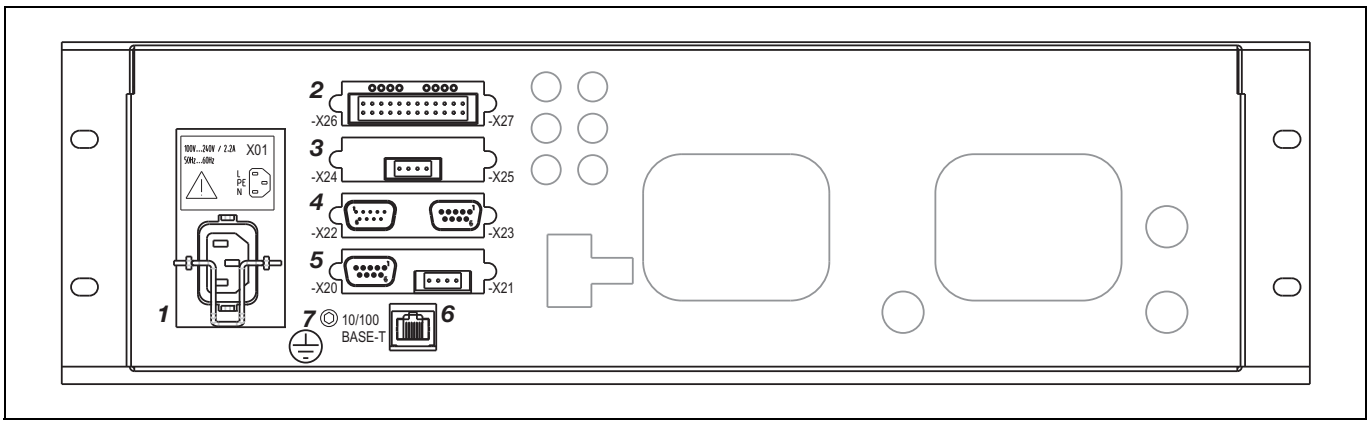
Connection
4-pin plug; connection cable supplied.
Connection diagrams see page 32.

## Note regarding the analyzers performance characteristics

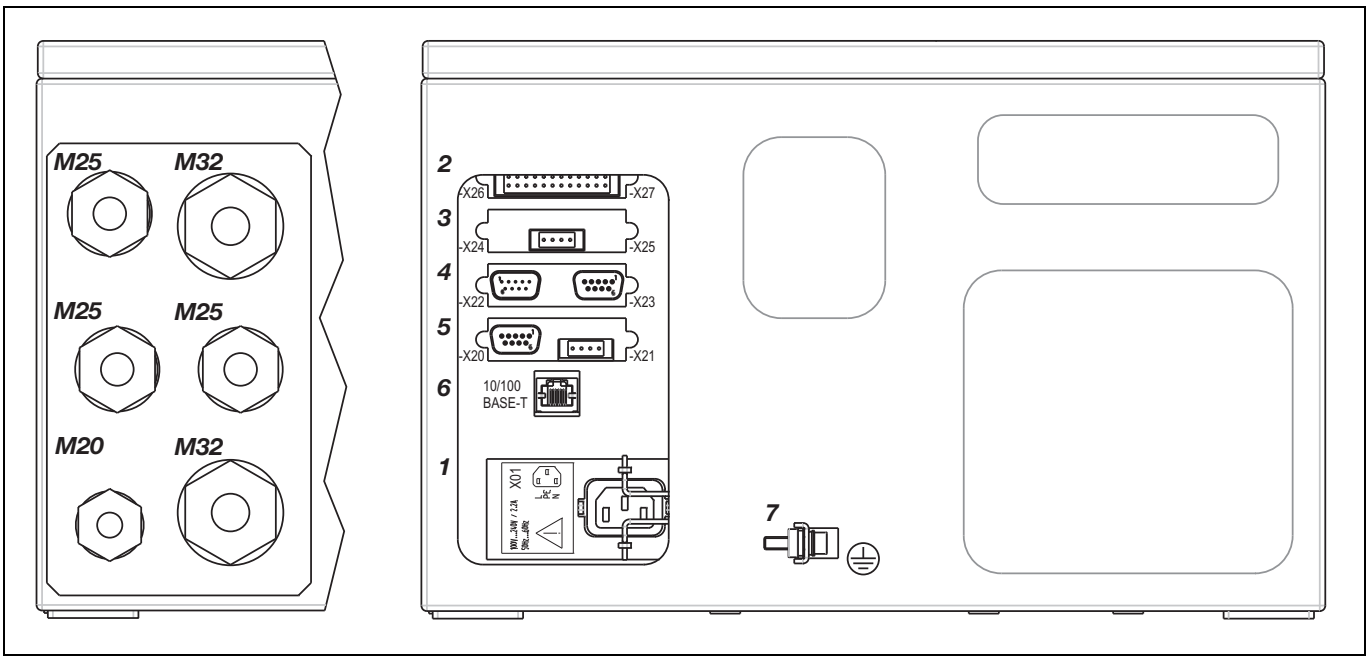
The performance characteristics of the analyzers have been determined according to IEC 61207-1:2010 "Expression of performance of gas analyzers – Part 1: General". They are based on nitrogen as the associated gas. Compliance with these characteristics when measuring other gas mixtures can only be assured if their composition is known.

# Electrical connections

### Power supply and signal lines model EL3020 (view from behind)




### Power supply and signal lines model EL3040 (view from below)




***1*** Power supply connection
(3-pin plug per EN 60320-1/C14; connection cable supplied)

I/O modules (4 slots), options:

***2*** Digital I/O module (max. 3 modules, see page 24)
***3*** Analog output module (max. 2 modules, see page 23)
***4*** Modbus module (RS232 & RS485 interface, see page 23)
***5*** Profibus module (RS485 & MBP interface, see page 23)

***6*** Ethernet-10/100BASE-T interface (8-pin RJ45 plug)

***7*** Potential compensation connection (max. 4 mm²)

Screwed cable glands for cable diameter:

| | | |
|---|---|---|
| ***M20*** | Power supply | 5–13 mm |
| ***M25*** | Modbus/Profibus | 8–17 mm |
| ***M25*** | Network | 8–17 mm |
| ***M25*** | Analog outputs | 8–17 mm |
| ***M32*** | Digital inputs/outputs | 12–21 mm |
| ***M32*** | Digital inputs/outputs | 12–21 mm |

**Notes**

Both drawings show examples for the I/O modules equipment.

I/O module connection:
- The maximum capacity of terminals for stranded or solid conductors is 1 mm² (17 AWG).
- The stranded conductor may be tinned on the tip or twisted for simplified connection.
- When using wire end ferrules the total section should not exceed 1 mm², i.e. the maximum stranded conductor section is 0.5 mm². The Weidmüller PZ 6/5 crimping tool must be used for crimping the ferrules.

Functional scope of the Ethernet interface:
- Communication with configuration software ECT for gas analyzer configuration and software update,
- QAL3 data transfer if the QAL3 monitoring option is integrated in the gas analyzer.

## Profibus module

Electrical connections

RS485 interface:

| | | |
|---|---|---|
| 1 | – | Not used |
| 2 | M24 | 24 V output ground, max. 0.2 A |
| 3 | RxD/TxD-P | Receive/transmit data plus, B-line |
| 4 | – | Not used |
| 5 | DGND | Data transmission potential (Ref. pot. for VP) |
| 6 | VP | Supply voltage plus (5 V) |
| 7 | P24 | 24 V output voltage plus |
| 8 | RxD/TxD-N | Receive/transmit data N, A-line |
| 9 | – | Not used |

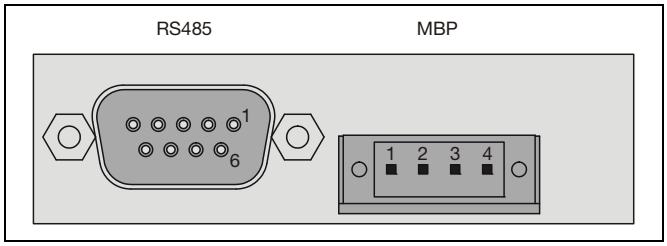
Design: 9-pin sub-D female connector

MBP interface (non-intrinsically safe):

| | |
|---|---|
| 1 | + |
| 2 | Shield |
| 3 | – |
| 4 | Not used |

Design: 4-pin terminal strip. Observe the notes regarding I/O module connection (see page 22)!

Connection diagram




## Modbus module

Electrical connections

RS232 interface:

| | |
|---|---|
| 2 | RxD |
| 3 | TxD |
| 5 | GND |

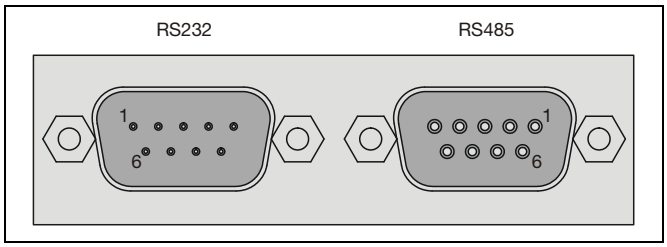
Design: 9-pin sub-D male connector

RS485 interface:

| | |
|---|---|
| 2 | RTxD– |
| 3 | RTxD+ |
| 5 | GND |

Design: 9-pin sub-D female connector

Connection diagram




## Analog output modules

Analog outputs (AO1 to AO4)

0/4 to 20 mA (configurable, factory-set to 4 to 20 mA), common negative pole, galvanically isolated from ground, freely connectable to ground, max. gain relative to protective ground potential 50 V, max. working resistance 750 Ω. Resolution 16 bit. The output signal cannot be lower than 0 mA.

Terminal assignment

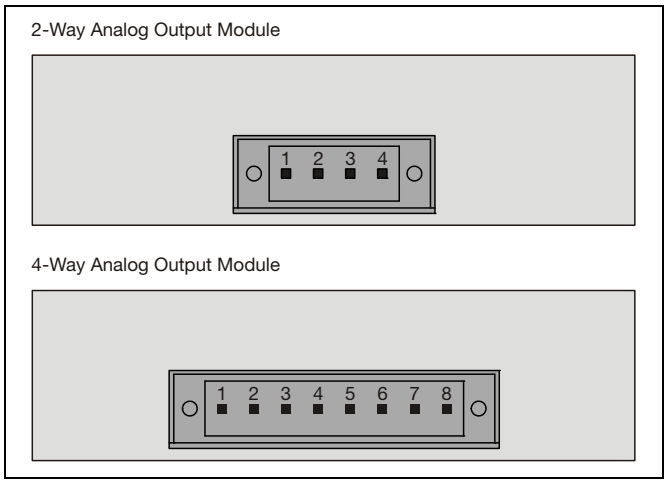
An analog output is allocated in the sequence of the sample components for each sample component. The sequence of the sample components is documented in the analyzer data sheet and on the type plate.

Electrical connections

| | | |
|---|---|---|
| 1 | AO1+ | for 2-way analog output module and 4-way analog output module |
| 2 | AO1– | |
| 3 | AO2+ | |
| 4 | AO2– | |
| 5 | AO3+ | only for 4-way analog output module |
| 6 | AO3– | |
| 7 | AO4+ | |
| 8 | AO4– | |

Design: 4-pin or 8-pin terminal strip. Observe the notes regarding I/O module connection (see page 22)!

Connection diagrams



## Digital I/O module

Digital inputs (DI1 to DI4)

Optocouplers with internal 24 VDC power supply. Control with floating contacts, with external voltage 12 to 24 VDC or with open collector drivers PNP or NPN.

Digital outputs (DO1 to DO4)

Floating double-throw contacts, max. contact load rating 30 VDC / 1 A

Relays must at all times be operated within the specified data range. Inductive or capacitive loads are to be connected with suitable protective measures (self-induction recuperation diodes for inductive loads and series resistors for capacitive loads).

Terminal assignment

| Digital input and output signals | Standard assignment [1] digital I/O module 1 | 2 |
|---|---|---|
| Failure | | |
| Maintenance request | | |
| Maintenance mode | | |
| Overall status | DO1 | |
| Start automatic calibration | DI1 | |
| Stop automatic calibration | | |
| Disable automatic calibration | DI2 | |
| Sample gas valve | DO4 | |
| Zero gas valve | | |
| Span gas valves 1 to 5 | | |
| Pump on / off [2] | | |
| Limit 1 | DO2 | |
| Limit 2 | DO3 | |
| Limit 3 | | DO1 |
| Limit 4 | | DO2 |
| Limit 5 | | DO3 |
| Limit 6 | | DO4 |
| Limit 7 | | |
| Limit 8 | | |
| Limit 9 | | |
| Limit 10 | | |
| Measuring range switch-over | | |
| Measuring range feedback | | |
| Measuring component switch-over | | |
| Measuring component feedback | | |
| Bus DI 1 to 8 | | |
| External failure [3] | DI3 | |
| External maintenance request [3] | DI4 | |

1) Factory-set, can be changed by on-site configuration
2) When a pump (integral gas feed) is installed
3) Multiple external status signals can be configured depending on the number of free digital inputs.

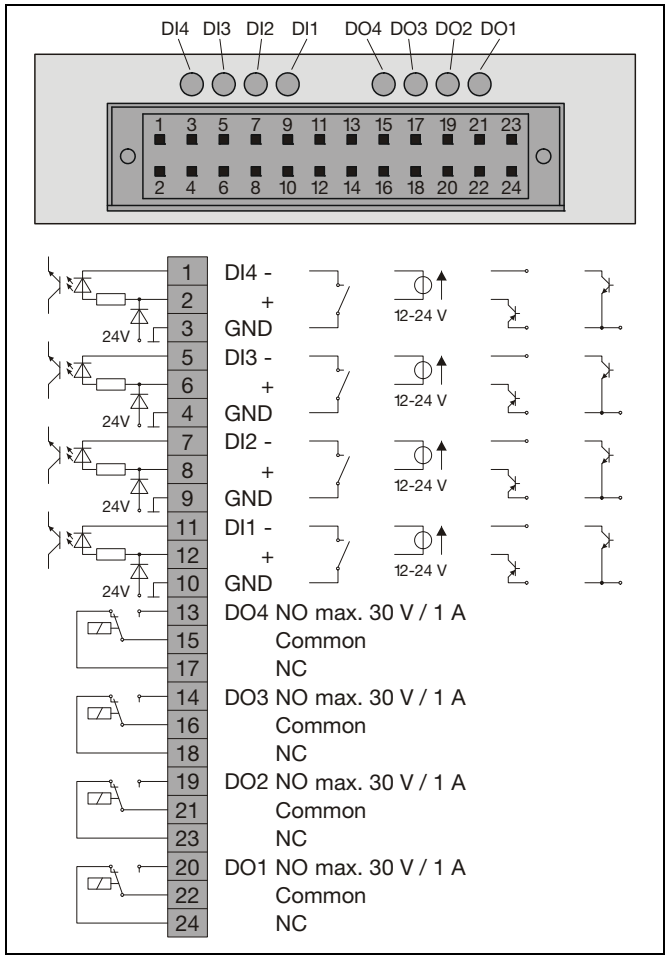
Electrical connections

See connection diagram

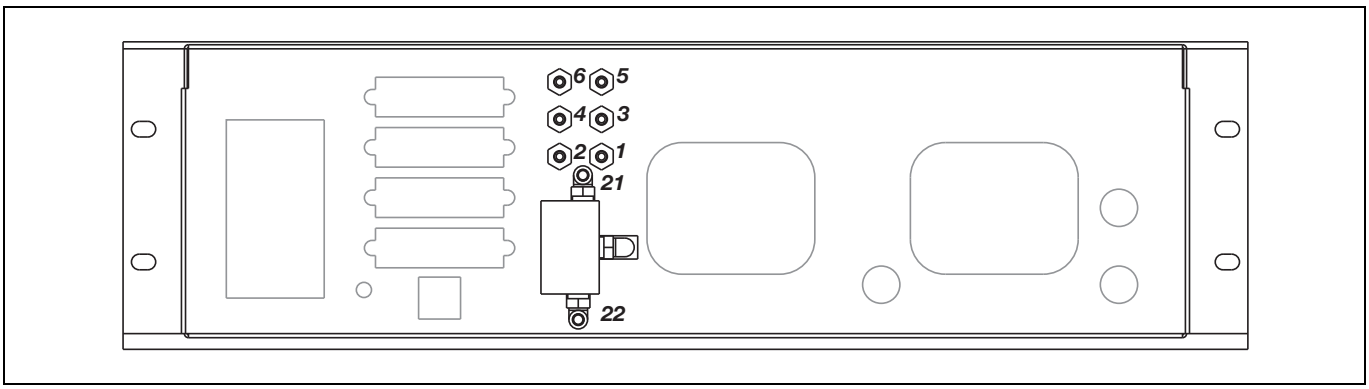
Design: 2x12-pin terminal strip. Observe the notes regarding I/O module connection (see page 22)!

Relays are shown in the unpowered state. The unpowered state is the failure mode.

Connection diagram



### Model EL3020 (Internal gas lines: FPM hoses)




***1*** Sample gas inlet gas path 1 without “Integral gas feed” option
***2*** Sample gas outlet gas path 1 connected to sample gas inlet of Magnos206 or Caldos27 if applicable
***3*** Sample gas outlet for “Integral gas feed” option, factory-connected to sample gas inlet gas path 1
***4*** Sample gas inlet for “Integral gas feed” option with flow sensor only (without solenoid valve)
***5*** Sample gas inlet gas path 2
***6*** Sample gas outlet gas path 2

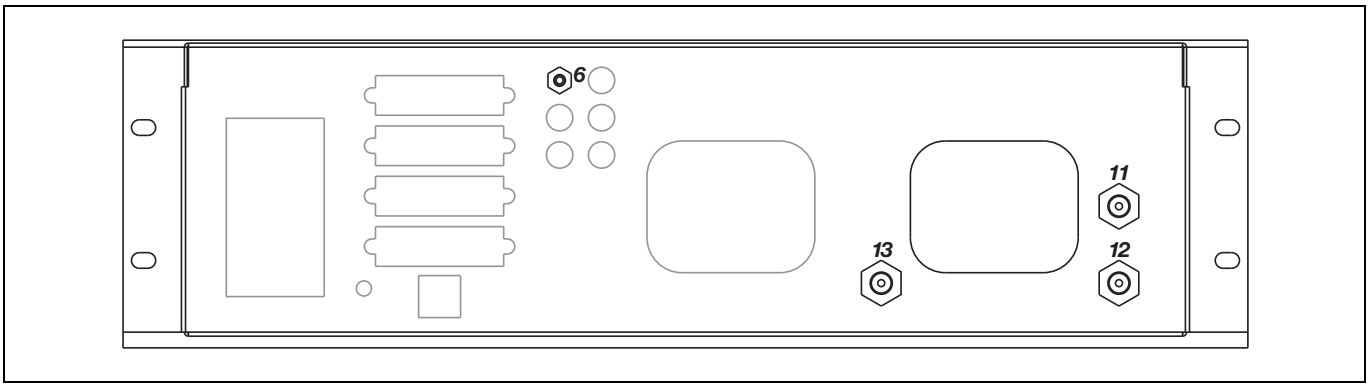
Design: Screwed fittings with hose nozzles (stainless steel 1.4305/SAE 303) for hoses with 4 mm inner diameter (supplied)

***21*** Sample gas inlet at solenoid valve
***22*** Test gas inlet at solenoid valve
} for “Integral gas feed” option with solenoid valve, pump, filter, capillary and flow sensor

Design: Screwed fittings with hose nozzles (PVDF) for hoses with 4 mm inner diameter (supplied)

Note: Pressure sensor (standard) and $O_2$ sensor (option) are connected internally as follows:
downstream the sample cell 1 outlet for one sample cell or for two separate gas paths,
downstream the sample cell 2 outlet for two sample cells in series.
The second $O_2$ sensor (option for version with two separate gas paths) is connected downstream the sample cell 2.

### Model EL3020 (Internal gas lines: PTFE or stainless steel pipes)




***6*** Pressure sensor

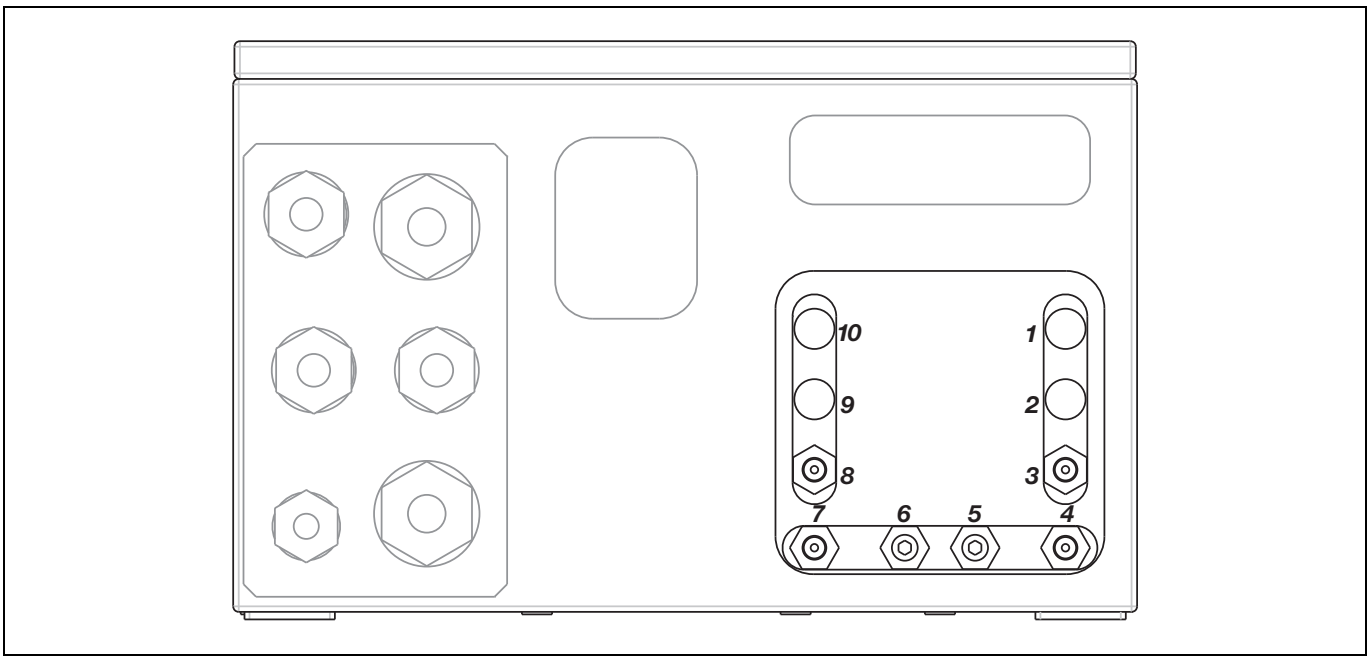
Design: Screwed fitting with hose nozzle (stainless steel 1.4305/SAE 303) for hose with 4 mm inner diameter (supplied)

***11*** Sample gas inlet
***12*** Sample gas outlet for one sample cell
***13*** Sample gas outlet for two sample cells in series
} connected to sample gas inlet of Caldos27 or Magnos206 if applicable

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied)

Notes: $O_2$ sensor, “Integral gas feed” option and version with two separate gas paths cannot be provided.

### Model EL3040 (Internal gas lines: FPM hoses or PTFE or stainless steel pipes)




**One gas path with one sample cell or two sample cells in series**

***1*** not used
***2*** not used
***3*** Sample gas inlet
***4*** Sample gas outlet for one sample cell
***5*** Purge gas inlet housing
***6*** Purge gas outlet housing
***7*** not used
***8*** Sample gas outlet for two sample cells in series
***9*** Pressure sensor (internal gas paths: PTFE or stainless steel pipes)
***10*** not used

**Two separate gas paths with one sample cell each**

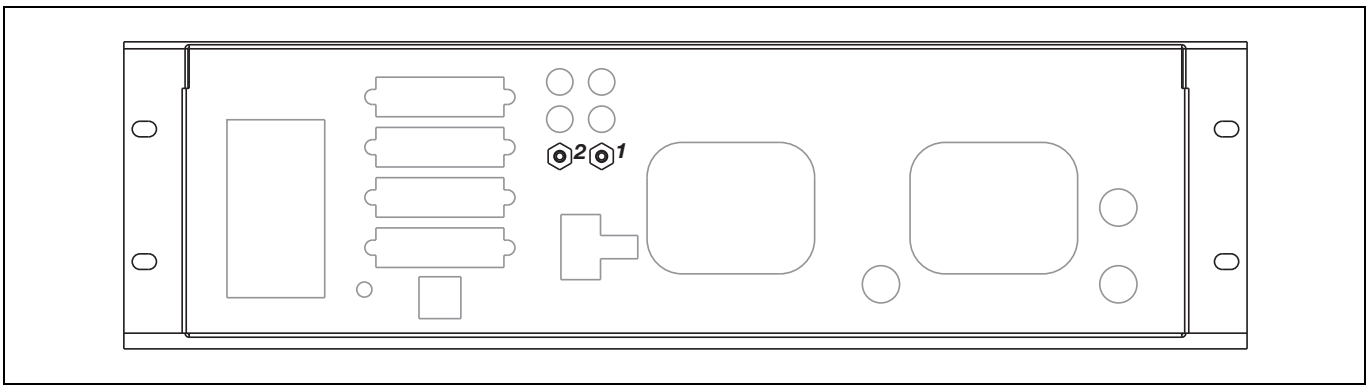
***1*** not used
***2*** not used
***3*** Sample gas inlet gas path 1
***4*** Sample gas outlet gas path 1
***5*** Purge gas inlet housing
***6*** Purge gas outlet housing
***7*** Sample gas inlet gas path 2
***8*** Sample gas outlet gas path 2
***9*** not used
***10*** not used

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied;
screwed fittings with hose nozzles (PP) for hoses with 4 mm inner diameter supplied
for purge gas connections and
for sample gas connections when internal gas paths are made up of FPM hoses.)

Notes: When the internal gas paths are made up of FPM hoses, pressure sensor (standard) and $O_2$ sensor (option) are connected internally as follows:
downstream the sample cell 1 outlet for one sample cell or for two separate gas paths,
downstream the sample cell 2 outlet for two sample cells in series.

When the internal gas paths are made up of PTFE or stainless steel pipes, the $O_2$ sensor cannot be provided.

### Model EL3020

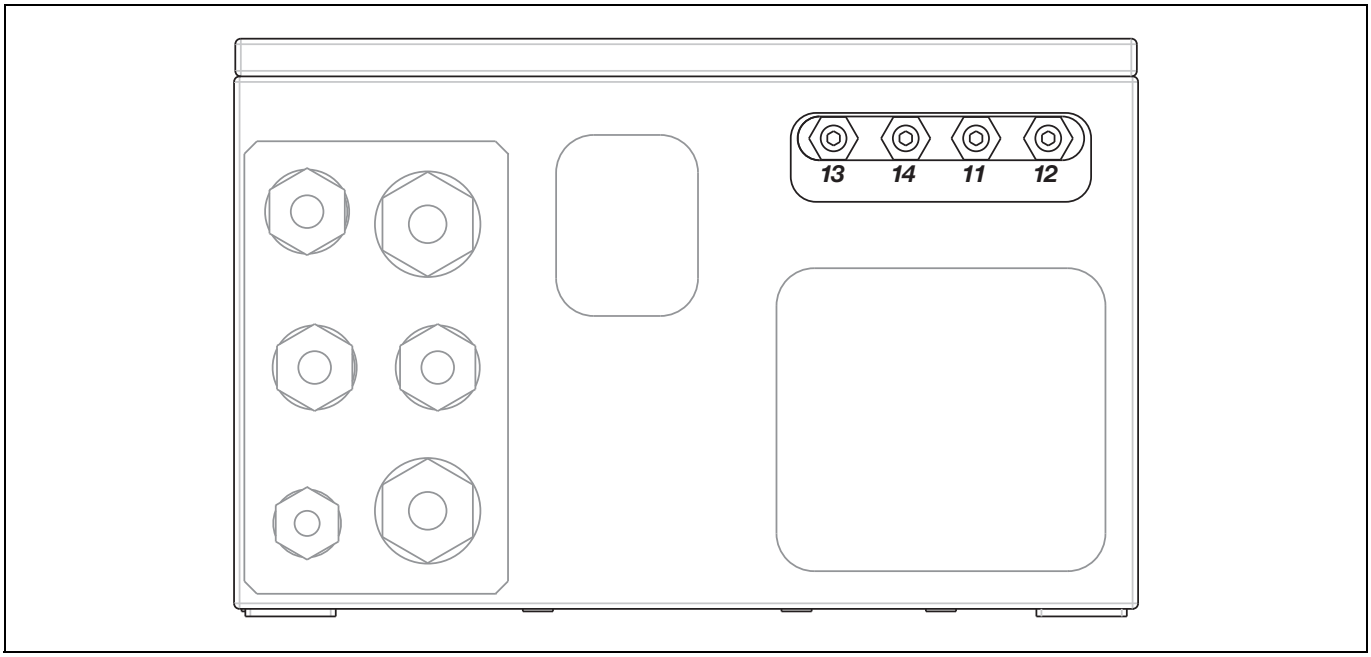



***1*** Sample gas inlet
***2*** Sample gas outlet (connected to sample gas inlet of Magnos206 if applicable)

Design: Screwed fittings with hose nozzles (stainless steel 1.4305/SAE 303) for hoses with 4 mm inner diameter (supplied)

Note: Pressure sensor (standard) and $O_2$ sensor (option) are connected internally downstream the sample cell.

### Model EL3040

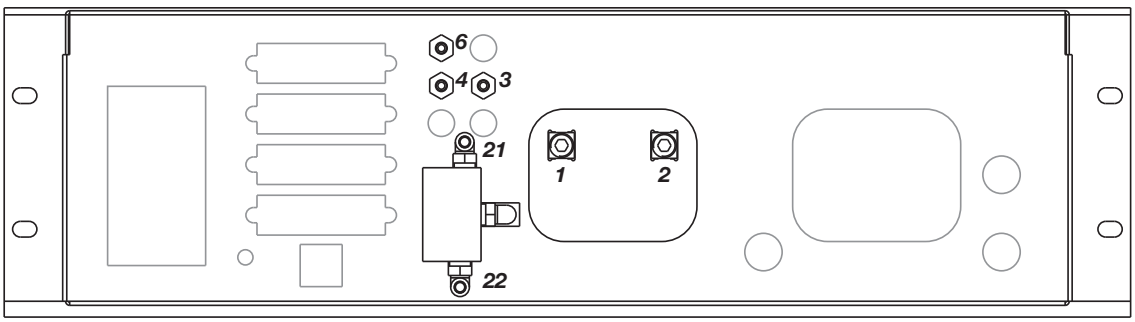



***13*** Sample gas inlet
***14*** Sample gas outlet (connected to sample gas inlet of Magnos206 if applicable)
***11*** Purge gas inlet housing
***12*** Purge gas outlet housing

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied;
screwed fittings with hose nozzles (PP) for hoses with 4 mm inner diameter supplied)

Note: Pressure sensor (standard) and $O_2$ sensor (option) are connected internally downstream the sample cell.

### Model EL3020




***1*** Sample gas inlet
***2*** Sample gas outlet

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied; screwed fittings with hose nozzles (PP) for hoses with 4 mm inner diameter supplied)

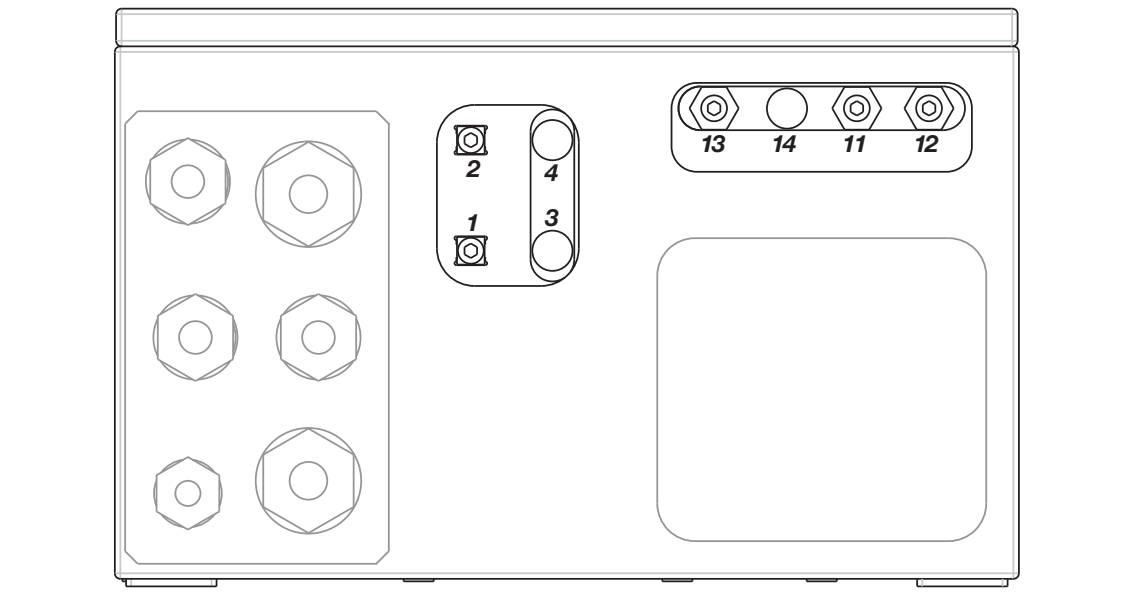
***3*** Sample gas outlet for “Integral gas feed” option, factory-connected to ***1*** sample gas inlet
***4*** Sample gas inlet for “Integral gas feed” option with flow sensor only (without solenoid valve)
***6*** Pressure sensor (option)

Design: Screwed fittings with hose nozzles (stainless steel 1.4305/SAE 303) for hoses with 4 mm inner diameter (supplied)

***21*** Sample gas inlet at solenoid valve ⎫ for “Integral gas feed” option with
***22*** Test gas inlet at solenoid valve ⎭ solenoid valve, pump, filter, capillary and flow sensor

Design: Screwed fittings with hose nozzles (PVDF) for hoses with 4 mm inner diameter (supplied)

### Model EL3040

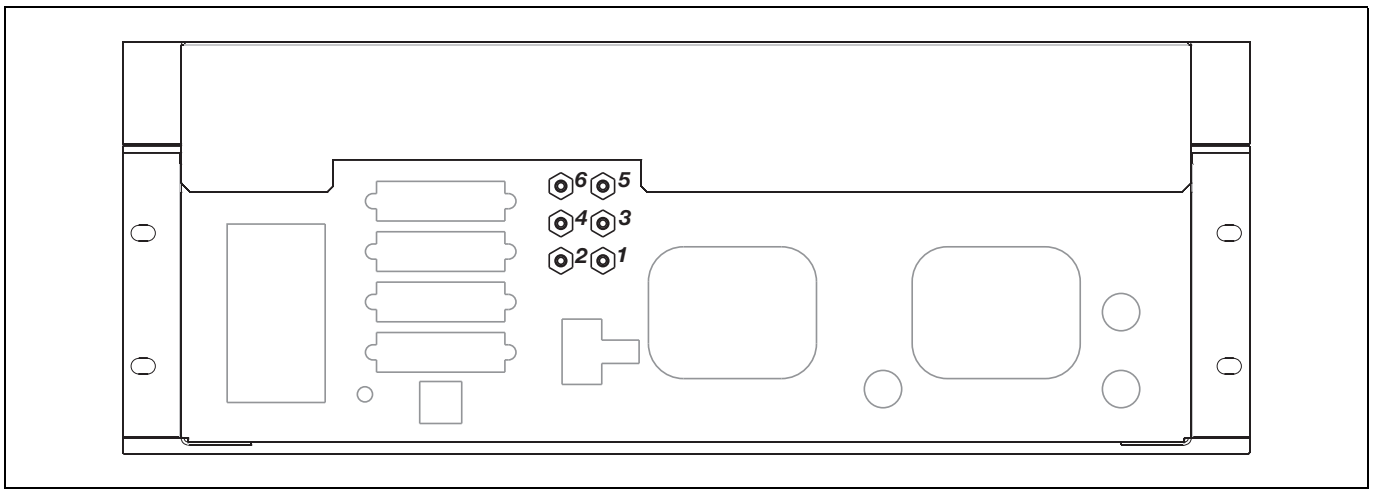



***1*** Sample gas inlet
***2*** Sample gas outlet
***3*** not used
***4*** not used
***11*** Purge gas inlet housing
***12*** Purge gas outlet housing
***13*** Pressure sensor (option)
***14*** not used

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied; screwed fittings with hose nozzles (PP) for hoses with 4 mm inner diameter supplied)

# Gas connections and dimensional drawing Magnos27

## Gas connections




**Magnos27**

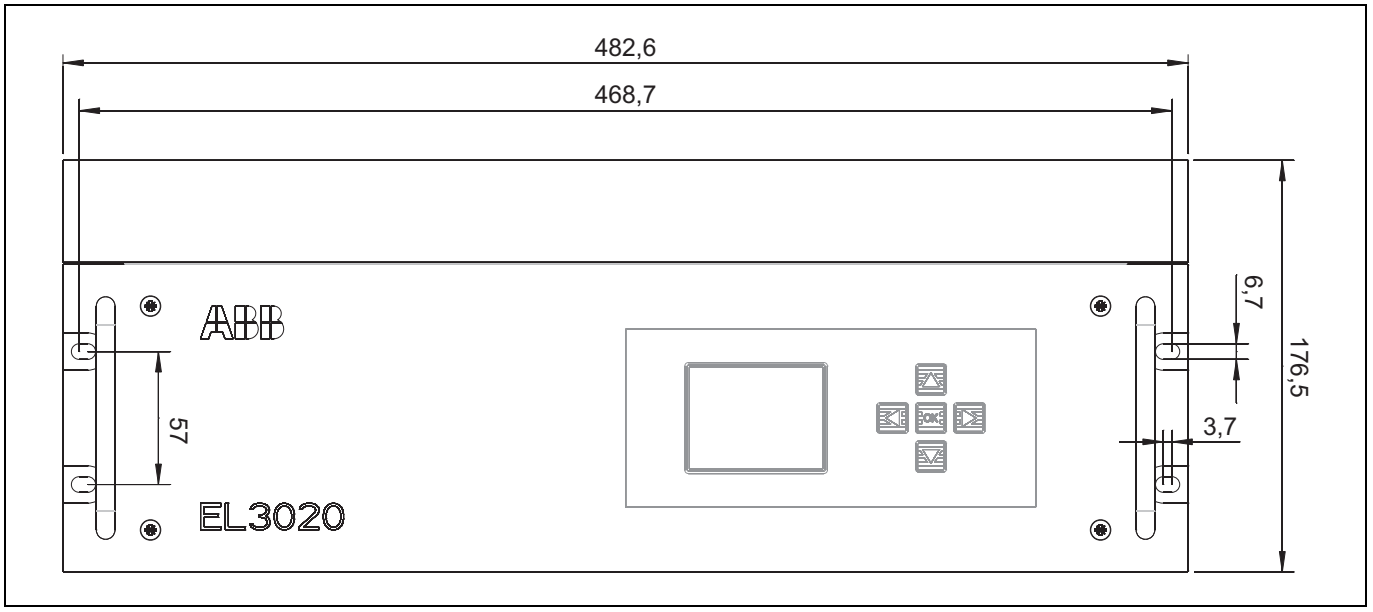
*1* Pressure sensor (option)
*2* not used
*3* Sample gas inlet
*4* Sample gas outlet
*5* Purge gas inlet analyzer
*6* Purge gas outlet analyzer

**Magnos27 in combination with Uras26 (one gas path, internal gas lines: FPM hoses)**

*1* Sample gas inlet Uras26
*2* Sample gas outlet Uras26
*3* Sample gas inlet Magnos27
*4* Sample gas outlet Magnos27
*5* Purge gas inlet Magnos27
*6* Purge gas outlet Magnos27

Design: Screwed fittings with hose nozzles (stainless steel 1.4305/SAE 303) for hoses with 4 mm inner diameter (supplied)

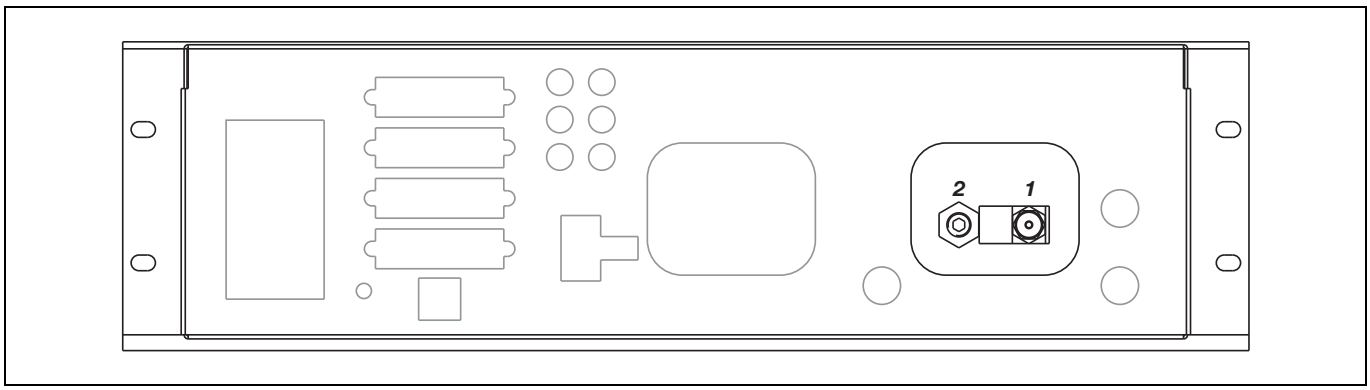
## Dimensional drawing



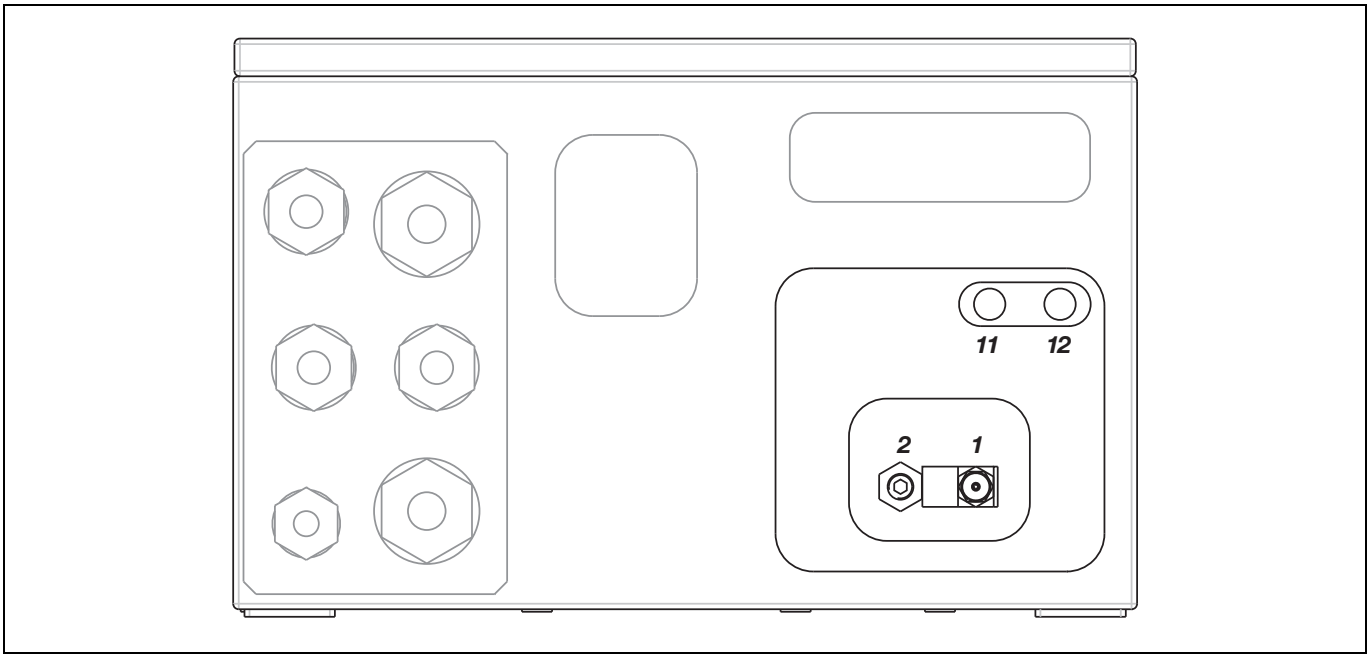

Note: Only the front view of the housing (with its height differing from the standard dimension) is depicted in this dimensional drawing. Refer to the dimensional drawing on page 33 for other views and dimensions of the housing.

# Gas connections ZO23

### Model EL3020



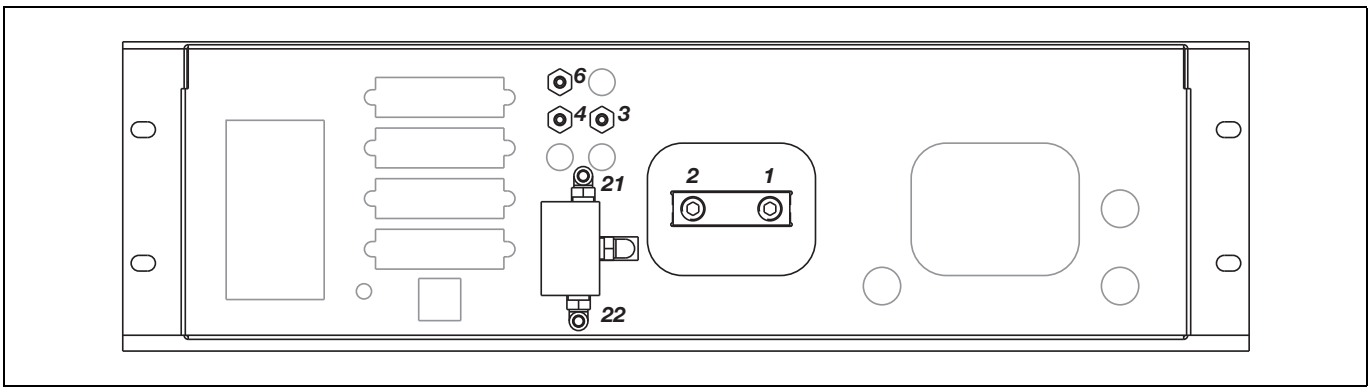

### Model EL3040




***1*** Sample gas inlet
***2*** Sample gas outlet
***11*** Purge gas inlet housing
***12*** Purge gas outlet housing

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied), sample gas inlet 3 mm Swagelok® (stainless steel 1.4401/SAE 316)

### Model EL3020




***1*** Sample gas inlet
***2*** Sample gas outlet

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied; screwed fittings with hose nozzles (PP) for hoses with 4 mm inner diameter supplied)

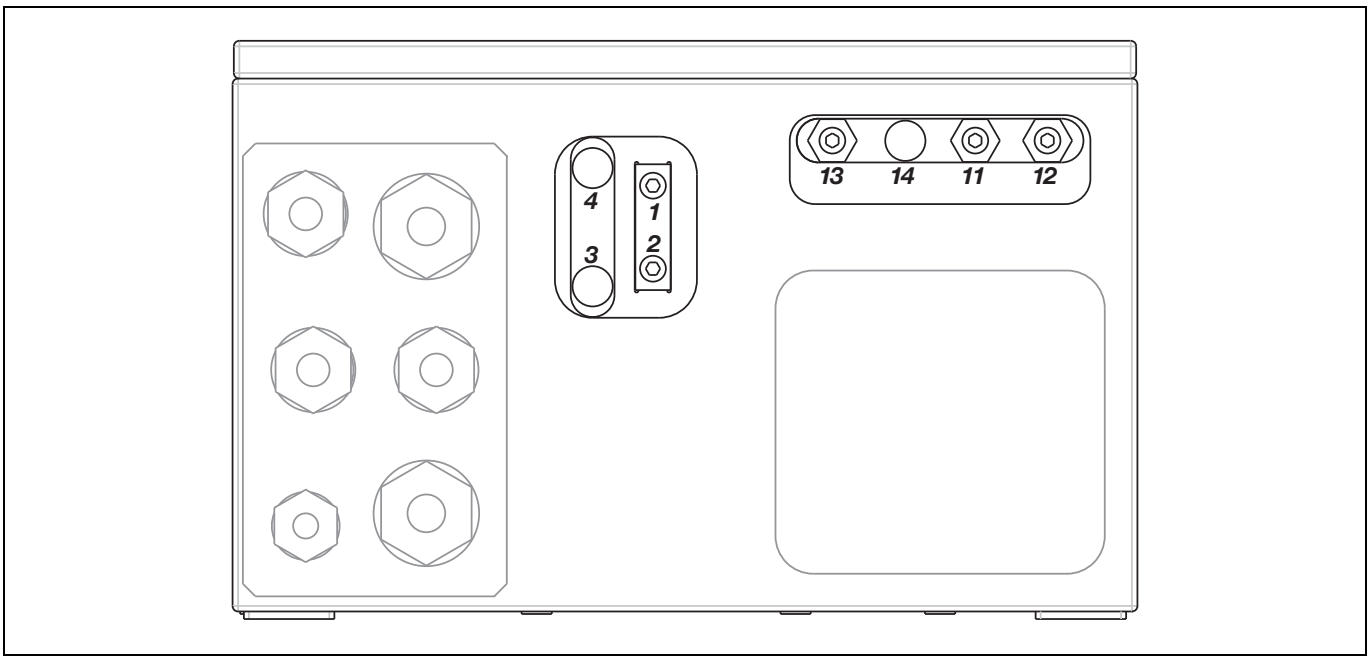
***3*** Sample gas outlet for “Integral gas feed” option, factory-connected to ***1*** sample gas inlet
***4*** Sample gas inlet for “Integral gas feed” option with flow sensor only (without solenoid valve)
***6*** Pressure sensor

Design: Screwed fittings with hose nozzles (stainless steel 1.4305/SAE 303) for hoses with 4 mm inner diameter (supplied)

***21*** Sample gas inlet at solenoid valve ⎫ for “Integral gas feed” option with
***22*** Test gas inlet at solenoid valve ⎭ solenoid valve, pump, filter, capillary and flow sensor

Design: Screwed fittings with hose nozzles (PVDF) for hoses with 4 mm inner diameter (supplied)

### Model EL3040

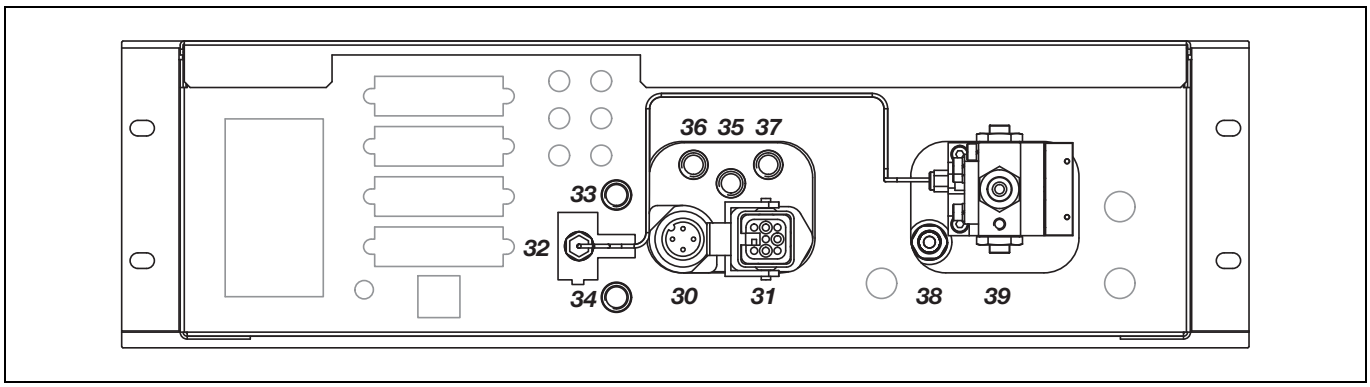



***1*** Sample gas inlet
***2*** Sample gas outlet
***3*** not used
***4*** not used
***11*** Purge gas inlet housing
***12*** Purge gas outlet housing
***13*** Pressure sensor
***14*** not used

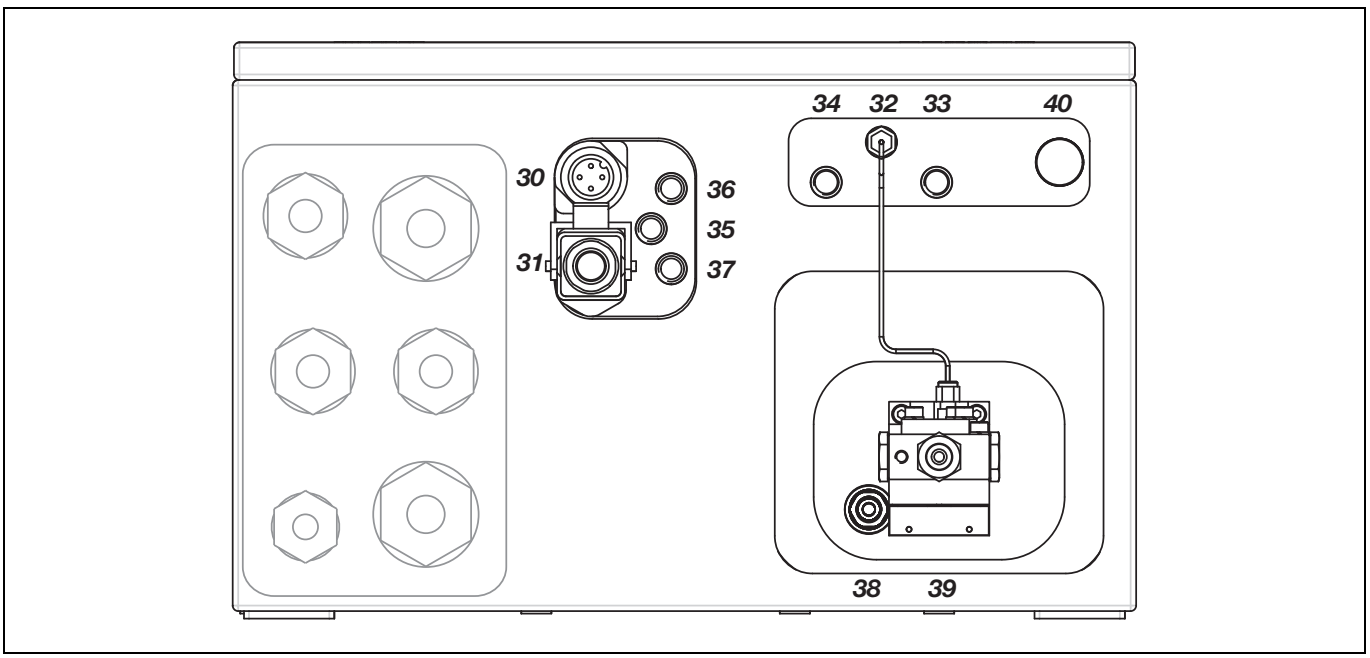
Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied; screwed fittings with hose nozzles (PP) for hoses with 4 mm inner diameter supplied)

# Gas connections and electrical connections Fidas24

## Model EL3020




## Model EL3040




***30*** Power supply 115 VAC or 230 VAC for heating of detector and sample gas inlet (4-pin male plug, connecting cable supplied)
***31*** Electrical connection to heated sample gas inlet (fixed)

***32*** Test gas outlet
***33*** Zero-point gas inlet
***34*** End-point gas inlet
***35*** Combustion air inlet
***36*** Combustion gas inlet
***37*** Instrument air inlet

Design: 1/8 NPT female thread (stainless steel 1.4305/SAE 303) for threaded connections (not supplied)

***38*** Exhaust outlet

Design: Threaded connection for 6-mm outer diameter tubing, permissible maximum length of 30 cm; after that point the inner diameter of the exhaust line should be increased to ≥ 10 mm.

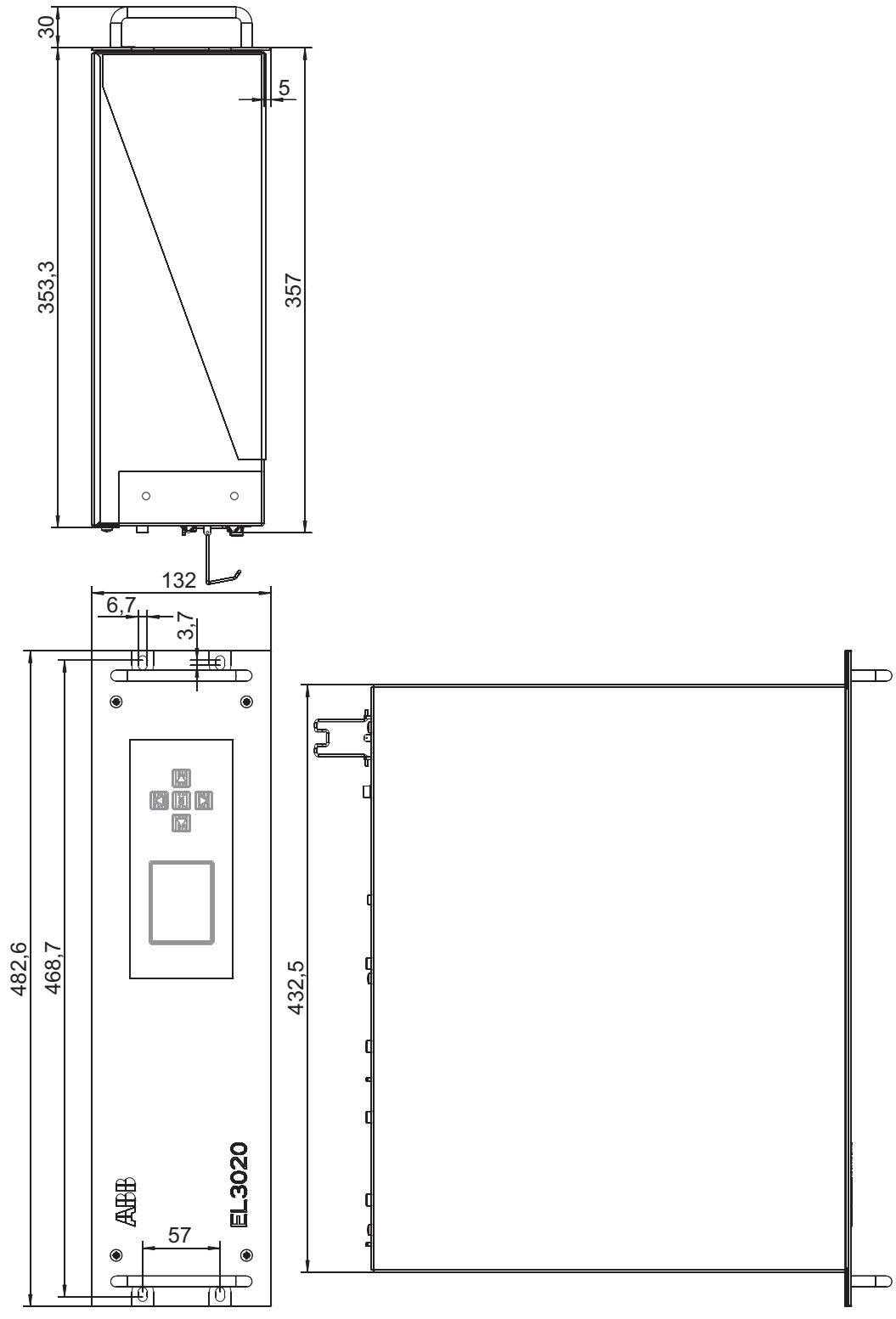
***39*** Sample gas inlet, heated or unheated

Design: Threaded connection for PTFE or stainless steel tubing with a 6-mm outer diameter

***40*** Pressure compensation opening with protection filter (only in wall-mount housing)

# Dimensional drawings

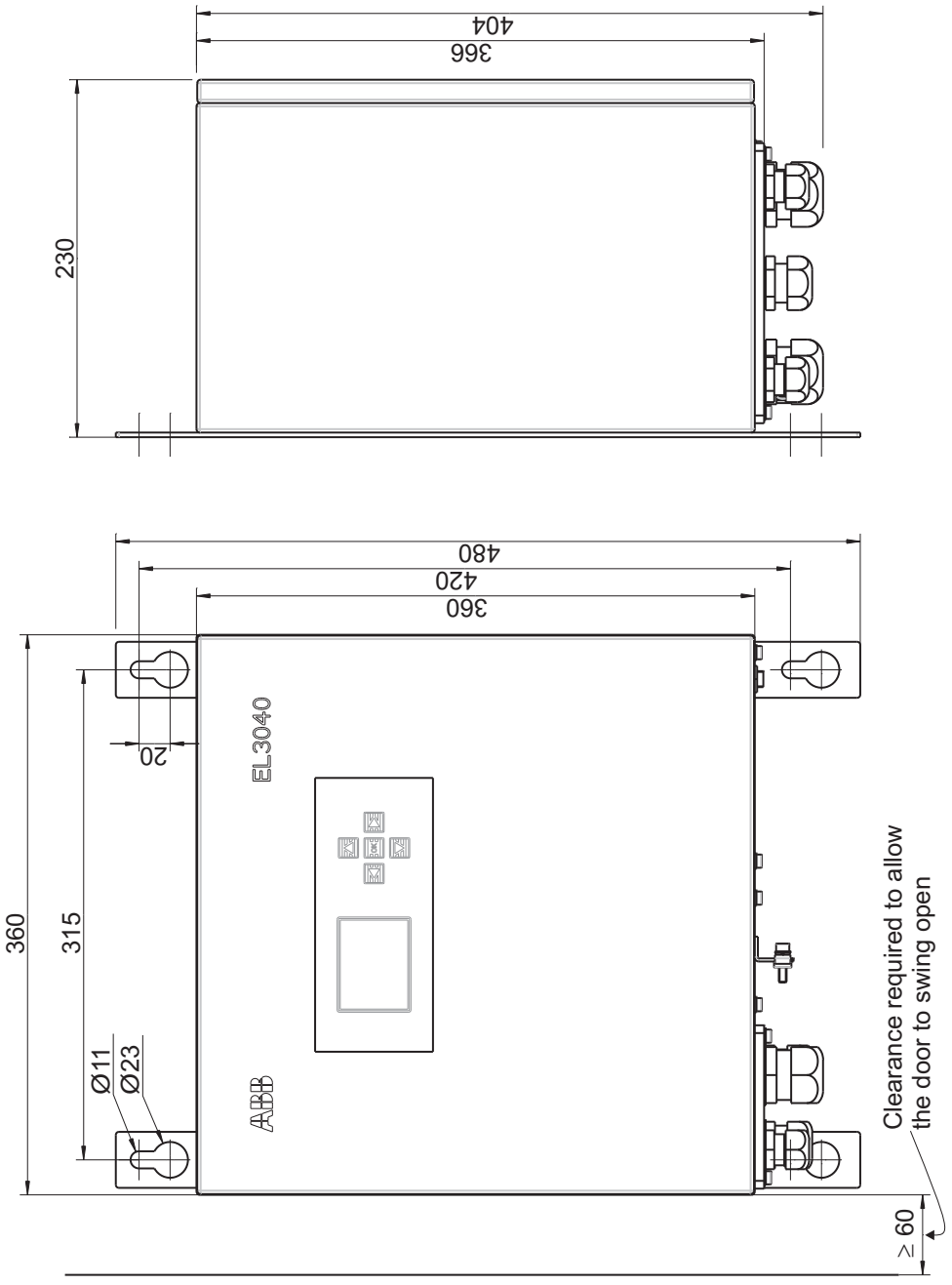
**19-inch rack housing (model EL3020)**




Dimensions in mm

# Dimensional drawings

### Wall-mount housing (model EL3040)




Dimensions in mm

# Certifications

## CE conformity

The EL3000 series gas analyzers satisfy the requirements of the European directives 2006/95/EC (Low voltage directive), 2004/108/EC (EMC directive) and 94/9/EC (ATEX directive).

Compliance with the requirements of directive 2006/95/EC is evidenced by full compliance with European standard EN 61010-1:2001.

Compliance with the requirements of directive 2004/108/EC is evidenced by full compliance with European standards EN 61326-1:2006, EN 61000-3-2:2006, EN 61000-3-3:1995 + A1:2001 + A2:2005.

Compliance of the version in category 3G for measurement of non-flammable gases and vapors with the requirements of directive 94/9/EC is evidenced by full compliance with European standard EN 60079-15:2005.

## Performance test

The EL3000 series gas analyzers Uras26 (sample components CO, NO, $SO_2$, $CO_2$, $N_2O$), Magnos206 (sample component $O_2$) and electrochemical oxygen sensor (sample component $O_2$) are certified for use in facilities requiring approval according to European directive 2001/80/EG and meet the requirements of the 27th/30th BImSchV (Federal Immissions Control Ordinance) and TA-Luft (Technical Instructions on Air Quality) regulations. The requirements of QAL1 according to EN 15267 and EN 14181 are fulfilled.

Report No. 691317 of June 30, 2006. Notification:
Federal Gazette of October 14, 2006, No. 194, page 6715

Report No. 1669640 of September 30, 2011. Notification:
Federal Gazette of March 2, 2012, No. 36, page 925

Report No. 936/21217137/B of October 14, 2011. Notification:
Federal Gazette of March 2, 2012, No. 36, page 924

## Approval for USA and Canada – CSA

The EL3000 series gas analyzers are certified for use in general purpose environment, evidenced by full compliance with standards CAN/CSA-C22.2 No. 61010-1-04 and UL Std. No. 61010-1 (2nd Edition).

Certificate No. 1714030

## Approval for Russian Federation – GOST-R

The EL3000 series gas analyzers are certified for use in general purpose environment. The following documents are available:

GOST-R certificate No. POCC DE.HO03.H04298,
Rostekhnadzor operation permission No. PPC 00-39671,
Pattern approval certificate No. DE.C.31.004.A No. 37984.

## Explosion protection for China – NEPSI

The gas analyzer model EL3040 with Uras26, Limas23, Magnos206 and Caldos27 is certified for use in hazardous locations. The gas analyzer may be used for measurement of non-flammable gases and vapors. It is marked with Ex nAC II CT4.

Certificate No. GYJ101401X

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