

Advance Optima Continuous Gas Analyzers

AO2000 Series

Models AO2020, AO2040

Data Sheet

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- One central unit and various analyzer modules
 - with common controls
 - with a common connection technology
 - in a common system housing
- Analyzer modules with different measurement principles for all process and emissions monitoring applications
- “Safety Concept” for measuring flammable gases in Zone 2 and for measuring corrosive and toxic gases
- Multiple analyzer systems with up to four modules handling a total of six sample components
- Extensive automatic calibration with air or integral calibration cells eliminating the need for test gas cylinders
- Simultaneous digital and analog display of measured values on a large graphics panel
- Menu-driven operator interface
- Clear-text status messages
- Multiple interfaces for communication with host and associated systems
- Flexibly configurable analog and digital inputs and outputs on various input/output modules and boards
- Optional integrated pneumatics module
- Housing design for 19-inch rack mounting (Model AO2020) or wall mounting (Model AO2040)
- Modular design for ease of service
- Self-monitoring function indicates when maintenance is required



	Page
Modular Analyzer Product Line	3
Configuration of Analyzer Units and Multiple Analyzer Systems	5
Infrared Analyzer Module Uras26	6
Process Photometer Analyzer Module Limas11	8
Process Photometer Analyzer Module Limas11 HW	11
Oxygen Analyzer Module Magnos206	14
Oxygen Analyzer Module Magnos27	16
Trace Oxygen Analyzer Module ZO23	18
Thermal Conductivity Analyzer Module Caldos25	20
Thermal Conductivity Analyzer Module Caldos27	22
FID Analyzer Module MultiFID14	24
FID Analyzer Module MultiFID14 NMHC	26
Laser Analyzer Module LS25	28
Electrochemical Oxygen Sensor	32
Pneumatics Module	33
Gas Connections Uras26, Limas11	34
Gas Connections Limas11, Limas11 HW, Magnos206	35
Gas Connections Magnos27, ZO23	36
Gas Connections Caldos25, Caldos27, MultiFID14	37
Explosion Protected Model in Category 3G	38
Electronics Module	40
I/O Modules and I/O Boards	41
Power Supply and Housing	44
Dimensional Drawings	45
Certifications	46
Sample Components and Analyzer Modules	47

Overview

Advance Optima AO2000 Series is a line of modules used for process gas analysis.

The product line consists of the following modules:

- Analyzer Modules
- Pneumatics Module
- Electronics Module
- I/O Modules and I/O Boards
- Housing with Display and Control Unit
- System Bus

The modules can be arranged in various ways to form single or multiple analyzer systems.

An analyzer unit (see example 1 on page 5) usually consists of:

- One analyzer module
- the electronics module
- the power supply
- the housing with display and control unit

A multiple analyzer system (see example 2 on page 5) in its maximum stage of extension consists of:

- Four analyzer modules handling up to six sample components
- The pneumatics module
- The electronics module
- The required number of power supplies
- The required number of housings

The electronics module, power supply and housing with display and control unit are also collectively referred to as the “central unit”.

Analyzer Modules

Analyzer modules:

- | | |
|-------------------|--------------------------------------|
| • Uras26 | Infrared Analyzer Module |
| • Limas11 | Process Photometer Analyzer Module |
| • Magnos206 | Oxygen Analyzer Module |
| • Magnos27 | Oxygen Analyzer Module |
| • ZO23 | Trace Oxygen Analyzer Module |
| • Caldos25 | Thermal Conductivity Analyzer Module |
| • Caldos27 | Thermal Conductivity Analyzer Module |
| • MultiFID14 | FID Analyzer Module |
| • MultiFID14 NMHC | FID Analyzer Module |
| • LS25 | Laser Analyzer Module |

Each analyzer module consists of the sensor and associated electronics having its own processor. The analyzer modules are linked to the system controller via the system bus. The laser analyzer module is linked to the central unit via Ethernet.

The analyzer modules are supplied with 24-VDC from an integral power supply or an external unit.

The electrochemical oxygen sensor is available as an option in combination with an analyzer module.

Modular Analyzer Product Line

Pneumatics Module

The pneumatics module contains the following elements when fully equipped:

- One or three solenoids to control test gas supply
- One or two disposable elements for fine filtration
- One gas supply pump with coarse filter and capillary
- One or two flow monitors

The pneumatics module is always associated with an analyzer module and installed in the same housing as the analyzer module.

Electronics Module

The electronics module incorporates the system controller with I/O modules and I/O boards.

The **system controller** carries out the following functions:

- Processing and communicating the measured values supplied by the analyzer module sensor electronics
- Compensating measured values, e.g. cross sensitivity correction
- Controlling system functions, e.g. calibration
- Display and control functions
- Controlling associated systems, e.g. gas supply
- Communicating with external systems

The system controller communicates with the other functional units of the gas analyzer (e.g. the I/O boards and analyzer modules) via the system bus.

Interfaces for controlling associated systems and for communicating with external systems are located on the system controller (Ethernet 10/100BASE-T interface) and on the I/O modules and I/O boards.

The **I/O modules** are attached and directly connected to the system controller board. There are four types of I/O modules:

- Analog output modules have two analog outputs.
- Digital I/O modules have four digital inputs and four digital outputs.
- Modbus modules have one RS485 and one RS232 interface.
- Profibus modules have one RS485 and one MBP interface (not intrinsically safe).

The **I/O boards** have their own processor and are linked to the system controller via the system bus. There are four types of I/O boards:

- Analog I/O boards have two analog inputs, two analog outputs, two digital inputs and two digital outputs.
- Digital I/O boards have four digital inputs and four digital outputs.
- 8-way analog output boards have eight analog outputs.
- I/O boards in the SCC-F sample gas feed unit are used to connect sample gas conditioning modules (see below).

Examples of I/O module and I/O board applications include:

- Output of measured values
- Output of status and alarm signals
- Calibration control
- Control of external solenoid valves and pumps
- Measurement range switching and feedback
- Supply of external analyzer current or status signals
- Supply of status signals from peripherals

Housing

The housing is available as a 19-inch (Model AO2020) or wall-mount (Model AO2040) unit with IP20 or IP54 protection. IP54 housing versions can be purged. The display and control unit is located on the front panel of the housing when the electronics module is installed.

System Bus

The gas analyzer's functional units are interconnected via the system bus. The system bus structure is linear with a maximum length of 350 meters. Only one electronics module with up to five I/O modules and three I/O boards should be connected to a system bus structure.

Connection of Sample Gas Conditioning Modules

The SCC-F sample gas feed unit and the SCC-C sample gas cooler can be connected to the gas analyzer via the system bus by means of an I/O board installed in the sample gas feed unit. Thus it is possible to display, monitor and control individual sample gas conditioning functions in the gas analyzer such as cooler temperature or condensate and flow status. For further information please refer to the "System Components and Accessories for Sample Gas Conditioning" data sheet.

Explosion Protected Versions in Category 2G

For information about the explosion protected versions

- AO2060-Uras14, -Caldos15, -Caldos17 and -Magnos106 Analyzer Modules in Category 2G and
 - AO2040-CU Ex Central Unit in Category 2G
- please refer to the "AO2000 Series Continuous Gas Analyzers" data sheet, January 2006 edition.

Note Regarding the Analyzer Module Performance Characteristics

The analyzer module performance characteristics indicated apply only when operated in conjunction with the central unit.

The performance characteristics have been determined according to the international standard IEC 1207-1: 1994 "Expression of performance of gas analyzers". They are based on N₂ as the associated gas. Compliance with these characteristics when measuring other gas mixtures can only be assured if their composition is known.

Configuration of Analyzer Units and Multiple Analyzer Systems

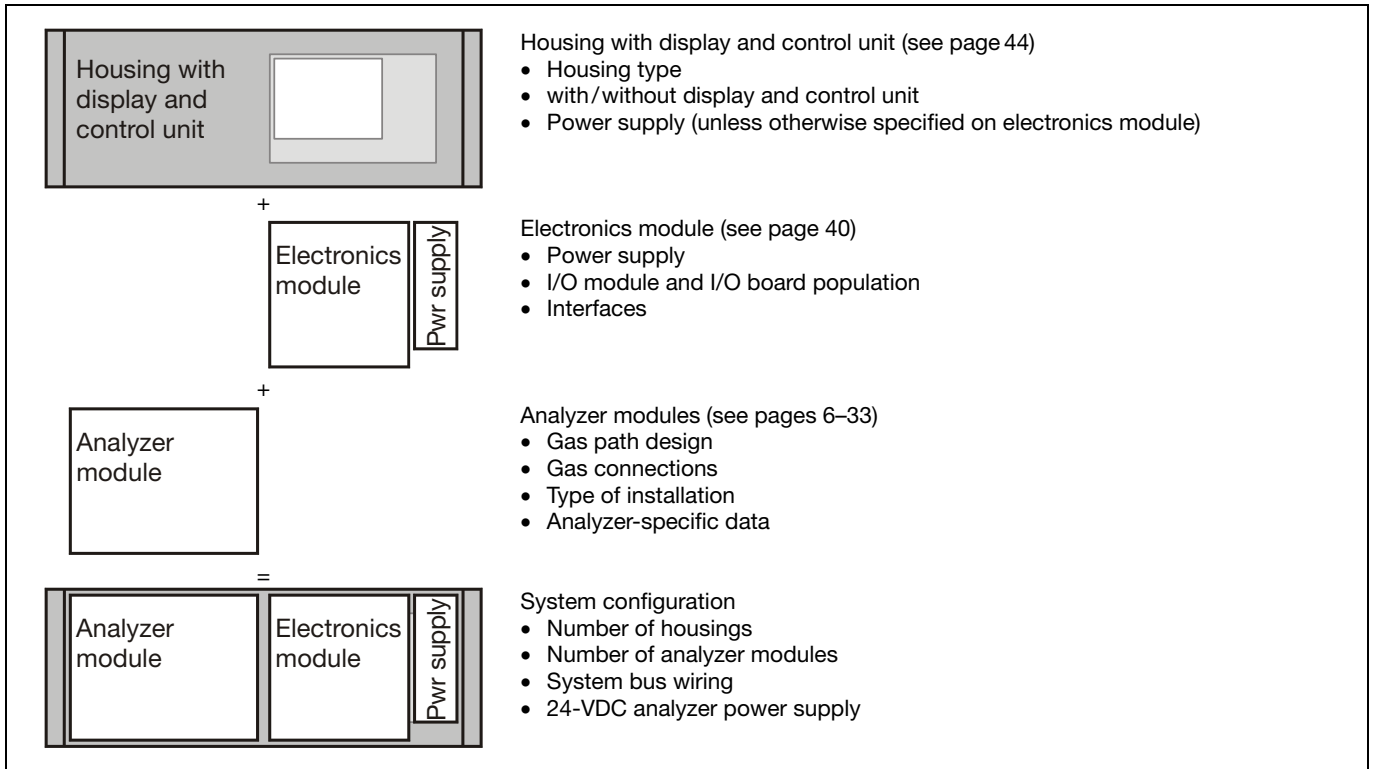
This data sheet contains specifications for all modules and components in the Advance Optima AO2000 Series modular product line.

This data sheet was not intended to be used for configuring an analyzer unit or a multiple analyzer system. For a quotation please contact your ABB Analytical representative who can also provide advice and support.

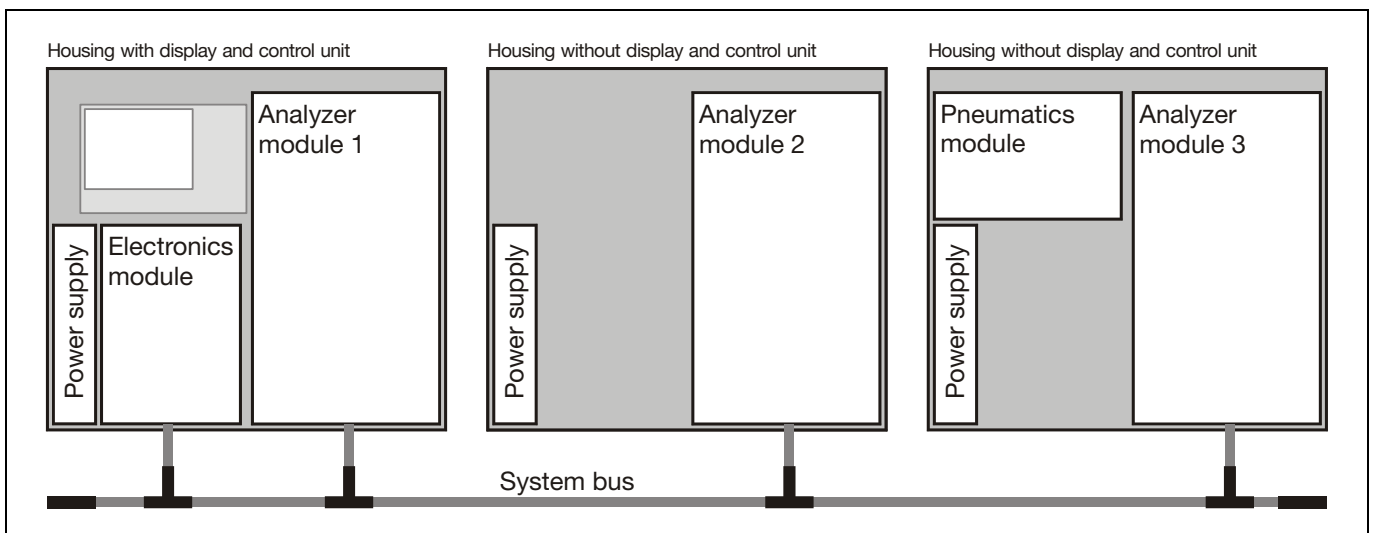
Example 1 shows the modules and components that normally make up an analyzer unit as well as the possibilities for configuring an analyzer unit.

The modular product line allows modules and components to be formed into an analyzer unit (see Example 1) or into multiple analyzer systems (see Example 2).

Example 1: Analyzer Unit Configuration (19-inch Housing)



Example 2: Multiple Analyzer System Variant (Wall-Mount Housing)



Infrared Analyzer Module Uras26

Measurement Principle

Non-dispersive infrared absorption in the $\lambda = 2.5\text{--}8\ \mu\text{m}$ wavelength range

Photometer to measure from 1 to 4 components with 1 or 2 beam paths and 1 or 2 receivers in each beam path

Sample Components and Smallest Measurement Ranges

The Uras26 analyzer module has one physical measurement range per sample component. As an option, smaller measurement ranges can be electronically derived from the physical measurement range. The smallest range is measurement range 1.

The smallest measurement ranges shown in the following table are based on the first sample component in beam path 1.

Sample Component	Class 1 Range	Class 2 Range	Class 2 Range with Calibration Cell	Gas Group ¹⁾
CO	0– 50 ppm	0– 10 ppm	0– 50 ppm ²⁾	A
CO ₂	0– 50 ppm	0– 5 ppm	0– 25 ppm ²⁾	A
NO	0– 75 ppm	0– 75 ppm	0– 75 ppm ²⁾	A
SO ₂	0– 100 ppm	0– 25 ppm	0– 25 ppm ²⁾	A
N ₂ O	0– 50 ppm	0– 20 ppm	0– 50 ppm ²⁾	A
CH ₄	0– 100 ppm	0– 50 ppm	0– 50 ppm ²⁾	A
NH ₃	0– 500 ppm	0– 30 ppm	–	B
C ₂ H ₂	0– 200 ppm	0– 100 ppm	0– 100 ppm	B
C ₂ H ₄	0– 500 ppm	0– 300 ppm	0– 300 ppm	B
C ₂ H ₆	0– 100 ppm	0– 50 ppm	0– 50 ppm ²⁾	B
C ₃ H ₆	0– 250 ppm	0– 100 ppm	0– 100 ppm ²⁾	B
C ₃ H ₈	0– 100 ppm	0– 50 ppm	0– 50 ppm ²⁾	B
C ₄ H ₁₀	0– 100 ppm	0– 50 ppm	0– 50 ppm ²⁾	B
C ₆ H ₁₄	0– 500 ppm	0– 100 ppm	0– 100 ppm ²⁾	B
R 134a	0– 100 ppm	0– 50 ppm	0– 50 ppm ²⁾	B
SF ₆	0–2000 ppm	0–1900 ppm	0–2000 ppm	B
H ₂ O	0–1000 ppm	0– 500 ppm	0– 500 ppm	C

1) See price information

2) Measurement range 1 the smallest is shown. The largest measurement range should be at least four times larger.

Other sample components on request.

The following data apply to measurement range 1 in a delivered analyzer module.

Stability

Linearity Deviation

≤ 1 % of span

Option: Linearization for automobile exhaust gas measurement according to EPA specifications

Repeatability

≤ 0.5 % of span

Zero Drift

≤ 1 % of span per week;

for ranges smaller than Class 1 to Class 2:

≤ 3 % of span per week

Sensitivity Drift

≤ 1 % of measured value per week

Output Fluctuation (2 σ)

≤ 0.2 % of span at electronic T90 time = 5 sec (Class 1) or = 15 sec (Class 2)

Detection Limit (4 σ)

≤ 0.4 % of span at electronic T90 time = 5 sec (Class 1) or = 15 sec (Class 2)

Measurement Ranges

Quantity

1 to 4 ranges per sample component

Largest Measurement Range

0 to 100 Vol.-% or 0 Vol.-% to saturation or 0 Vol.-% to LEL

Measurement ranges within ignition limits cannot be provided.

Measurement Range Ratio

≤ 1:20

Measurement Ranges with Suppressed Zero-Point

Electronic zero-point suppression or differential measurement based on a base level > 0 with flowing reference gas, max. suppression ratio of 1:10

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Zero-Point Calibration

With inert gas, e.g. N₂, 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.

During calibration of a multi-component analyzer, possible cross-sensitivity and/or carrier gas corrections by internal or external measurement components are switched off.

Therefore, corrected measurement components should be calibrated only using a test gas consisting of the measurement component and an inert gas like N₂.

Influence Effects

Flow Effect

Flow rate in the 20–100 l/h range: within determination 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, filter vessels or internal electronic cross-sensitivity correction or carrier gas correction for a sample component by other sample components measured with the Uras26.

Infrared Analyzer Module Uras26

Temperature Effect

- Ambient temperature in permissible range
 - At zero-point: $\leq 1\%$ of span per $10\text{ }^{\circ}\text{C}$;
for ranges smaller than Class 1 to Class 2:
 $\leq 2\%$ of span per $10\text{ }^{\circ}\text{C}$
 - On sensitivity with temperature compensation:
 $\leq 3\%$ of measured value per $10\text{ }^{\circ}\text{C}$
 - On sensitivity with thermostat effect at $55\text{ }^{\circ}\text{C}$ (optional):
 $\leq 1\%$ of measured value per $10\text{ }^{\circ}\text{C}$

Air Pressure Effect

- At zero-point: No effect
- On sensitivity with pressure correction by means of integral pressure sensor: $\leq 0.2\%$ 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 tubing is used for internal gas lines the pressure sensor is routed to the outside via a hose.

Pressure sensor working range: $p_{\text{abs}} = 600\text{--}1250\text{ hPa}$

Power Supply Effect

$24\text{ VDC} \pm 5\%: \leq 0.2\%$ of span

Dynamic Response

Warm-Up Time

Approx. 30 minutes without thermostat; approx. 2 hours with thermostat

90% Response Time

$T_{90} = 2.5\text{ sec}$ for measurement cell length = 200 mm and sample gas flow = 60 l/h without signal damping (low pass filter). Low-pass time constant adjustable from 0 to 60 sec

Materials in Contact with the Sample Medium

Analyzer (Sample Cells)

Tubing: Aluminum or gold-plated aluminum;
Window: CaF_2 , Option: BaF_2 ;
Connectors: Rust- and acid-resistant steel 1.4571

Gas Lines and Connectors

FPM hoses and PTFE tubing with stainless steel connectors;
Option: Rust- and acid-resistant steel tubes 1.4571

Gas Connections

Layout and Design

Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 34 for connection drawing.

Electrical Connections

System Bus

3-pin female plug

External 24-VDC Power Supply

4-pin male plug

Gas Inlet Conditions

Temperature

The sample gas dew point should be at least $5\text{ }^{\circ}\text{C}$ below the ambient temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet Pressure

$p_e = 2\text{--}500\text{ hPa}$
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure

Atmospheric pressure

Flow Rate

20–100 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. Provide for housing purge.

Flammable Gases

The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ($p_{\text{abs}} \leq 1.1\text{ bar}$, oxygen content $\leq 21\text{ Vol.-%}$). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation $p_e \leq 100\text{ hPa}$; in case of a sample gas supply failure the pressure must not exceed the maximum value $p_e = 500\text{ hPa}$. The version with gas paths designed as stainless steel tubes should be selected and housing purge with N_2 should be provided when measuring flammable gases and vapors. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked.

Purge Gas

The purge gas should not contain any sample gas components.

Power Supply

Input Voltage, Power Consumption

$24\text{ VDC} \pm 5\%$, max. 95 W

Installation Site Requirements

Vibration

max. $\pm 0.04\text{ mm}$ at 5 to 55 Hz, 0.5 g at 55 to 150 Hz
Slight transient effect on sample value in the region of the beam modulation frequency

Ambient Temperature

Operation: $+5$ to $+40/45\text{ }^{\circ}\text{C}$ when installed in housing with/without electronics module;
Storage and transport: -25 to $+65\text{ }^{\circ}\text{C}$

Process Photometer Analyzer Module Limas11

Measurement Principle

Gas filter correlation or wavelength comparison in ultraviolet and visible spectrum range $\lambda = 200\text{--}600\text{ nm}$ (Limas11 UV) and in infrared spectrum range $\lambda = 2.5\text{--}10\ \mu\text{m}$ (Limas11 IR)

Photometer to measure from 1 to 5 components (including the optionally installed oxygen sensor)

Use in emission and process monitoring applications

Sample cells made from various materials are available for measuring in corrosive, toxic and flammable gases (see page 10)

Sample Components and Smallest Measurement Ranges

The Limas11 analyzer module has one physical measurement range per sample component. As an option, smaller measurement ranges can be electronically derived from the physical measurement range. The smallest range is measurement range 1.

In the following table the smallest measurement ranges are shown.

Sample Component	Class 1 Range	Class 2 Range	Gas Group ¹⁾
Limas11 UV:			
NO ²⁾	0– 50 ppm	0– 10 ppm	A
SO ₂	0– 70 ppm	0– 25 ppm	A
NO ₂	0– 100 ppm	0– 50 ppm	B
H ₂ S	0– 50 ppm	0– 25 ppm	B
Cl ₂	0– 250 ppm	0– 100 ppm	D
CS ₂	0– 100 ppm	0– 50 ppm	C
COS	0– 500 ppm	0– 250 ppm	C
Limas11 IR:			
CO	0–1000 ppm	0– 500 ppm	A
CO ₂	0– 300 ppm	0– 150 ppm	A
HCl	0–5000 ppm	0–2500 ppm	D
CH ₄	0–2000 ppm	0–1000 ppm	A
C ₂ H ₂	0–2500 ppm	0–1250 ppm	B
C ₂ H ₄	0–3000 ppm	0–1500 ppm	B
C ₂ H ₆	0– 500 ppm	0– 250 ppm	B
C ₃ H ₆	0–1000 ppm	0– 500 ppm	B
C ₃ H ₈	0– 300 ppm	0– 150 ppm	B
C ₄ H ₁₀	0– 500 ppm	0– 250 ppm	B

1) See price information

2) The UV-RAS (ultra-violet resonant absorption spectroscopy) method is used to make the analyzer selective to the sample component NO.

Other sample components on request.

The following data apply to measurement range 1 in a delivered analyzer module.

Stability

Linearity Deviation

≤ 1% of span

Option: Linearization acc. to EPA specifications for automotive exhaust gas measurement

Repeatability

≤ 0.5 % of span

Zero Drift

≤ 1 % of span per week;

for ranges smaller than Class 1 to Class 2: ≤ 3 % of span per week, for NO ≤ 1 % of span per day (Recommendation: daily automatic zero-point calibration)

Sensitivity Drift

≤ 1 % of measured value per week

Output Fluctuation (2 σ)

Limas11 UV: ≤ 0.5 % of span at electronic T90 time = 10 sec;

Limas11 IR: ≤ 0.5 % of span at electronic T90 time (static/dynamic) = 60/5 sec;

for ranges smaller than Class 1 to Class 2: ≤ 1 % of span, for NO ≤ 0.5 % of span

Detection Limit (4 σ)

≤ 1 % of span;

for ranges smaller than Class 1 to Class 2: ≤ 2 % of span, for NO ≤ 1 % of span

Measurement Ranges

Quantity

1 to 4 ranges per sample component

Largest Measurement Range

0 to 100 Vol.-% or 0 Vol.-% to saturation or 0 Vol.-% to LEL

Measurement ranges within ignition limits cannot be provided.

Measurement Range Ratio

Measurement ranges freely adjustable within a range ratio of 1:20 relative to the factory-set reference measurement range.

Measurement Ranges with Suppressed Zero-Point

Electronic zero-point suppression, max. suppression ratio of 1:10

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Zero-Point Calibration

With inert gas, e.g. N₂, or with ambient air that is free of the sample component

End-Point Calibration

With gas-filled calibration cells (optional) or with test gas.

It is recommended to verify the calibration cell set values once a year.

During calibration of a multi-component analyzer, possible cross-sensitivity and/or carrier gas corrections by internal or external measurement components are switched off.

Therefore, corrected measurement components should be calibrated only using a test gas consisting of the measurement component and an inert gas like N₂.

Process Photometer Analyzer Module Limas11

Influence Effects

Flow Effect

Flow rate in the 20–100 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 filters cells or internal electronic cross-sensitivity correction or carrier gas correction for a sample component by other sample components measured with the Limas11.

Temperature Effect

Ambient temperature in permissible range,
Sample cell thermostat control to +60 °C

- At zero-point: $\leq 1\%$ of span per 10 °C; for ranges smaller than Class 1 to Class 2: $\leq 2\%$ of span per 10 °C
- On sensitivity: $\leq 1\%$ 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: $\leq 0.2\%$ 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 tubing is used for internal gas lines the pressure sensor is routed to the outside via a hose.

Pressure sensor working range: $p_{\text{abs}} = 600\text{--}1250$ hPa

Power Supply Effect

24 VDC $\pm 5\%$: $\leq 0.2\%$ of span

Dynamic Response

Warm-Up Time

Approx. 2.5 hours

90% Response Time

$T_{90} = 4$ sec for measurement cell length = 262 mm and sample gas flow = 60 l/h without signal damping (low pass filter).

Low-pass time constant adjustable from 0 to 60 sec

Materials in Contact with the Sample Medium

see page 10

Gas Connections

Layout and Design

Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module. See page 10 for material and design; see pages 34 and 35 for connection drawings.

Electrical Connections

System Bus

3-pin female plug

External 24-VDC Power Supply

4-pin male plug

RS232 Interface

4-pin female plug (for connection to TCT)

Gas Inlet Conditions

Temperature

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

Inlet Pressure

$p_e = 2\text{--}500$ hPa (maximum pressure see page 10, section "Sample Cells")

Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure

Atmospheric pressure

Flow Rate

20–100 l/h

Corrosive, Toxic and Flammable Gases

see page 10

Purge Gas

see page 10

Power Supply

Input Voltage, Power Consumption

24 VDC $\pm 5\%$, max. 85 W

Installation Site Requirements

Vibration

max. ± 0.04 mm/0.5 g at 5 to 150 Hz

Ambient Temperature

Operation: +5 to +45 °C when installed in housing with or without electronics module, +5 to +40 °C when I/O modules are installed in the electronics module;
Storage and transport: –25 to +65 °C

Note

The Limas11 IR analyzer module is available only with IP54 housing protection type.

Process Photometer Analyzer Module Limas11

Sample Cells

	Standard Cell	Quartz Cell	Safety Cell
Application	Standard applications	Corrosive gases	Corrosive, toxic and flammable gases
Wavelength Range	200 to 10000 nm	200 to 4000 nm	CaF ₂ window: 200 to 10000 nm SiO ₂ window: 200 to 4000 nm
Resistance ¹⁾			
Suitable for measurement of ...	Non-corrosive gases	Corrosive gases, e.g. wet Cl ₂ , wet HCl, H ₂ SO ₄ , SO ₃ , ozone	Corrosive gases, e.g. dry HCl, dry COCl ₂ (< 50 ppm H ₂ O)
Not suitable for measurement of ...	Highly corrosive gases, e.g. gases containing chlorine, H ₂ SO ₄ , SO ₃ , fluorine compounds	Fluorine compounds	Wet gases containing chlorine, H ₂ SO ₄ , SO ₃ , fluorine compounds
Safety Principle			
Toxic Gases	Housing purge (≤ 20 l/h) with sample component-free air or with N ₂	Housing purge (≤ 20 l/h) with sample component-free air or with N ₂	Cell purge ²⁾ with N ₂ or with sample component-free air with negative pressure and flow monitoring; additional monitoring for sample gas traces possible
Corrosive Gases	PTFE gas lines, housing purge (≤ 20 l/h) with sample component-free air or with N ₂	Housing purge (≤ 20 l/h) with sample component-free air or with N ₂	Cell purge ²⁾ with N ₂ or with sample component-free air with excess pressure ³⁾ and flow monitoring
Flammable Gases ⁴⁾	Stainless steel gas lines, housing purge (≤ 20 l/h) with N ₂	Housing purge (≤ 20 l/h) with N ₂	Cell purge ²⁾ with N ₂
Category 3G Flammable Gases	–	–	Cell purge ²⁾ with N ₂ with excess pressure ³⁾ and flow monitoring
Seal Integrity	< 1 x 10 ⁻³ hPa l/s	< 1 x 10 ⁻⁶ hPa l/s	< 1 x 10 ⁻⁶ hPa l/s
Pressure Rating			
Continuous	p _e < 500 hPa	p _e < 500 hPa	p _e < 500 hPa
Spike	–	p _{abs} < 300 kPa	p _{abs} < 500 kPa
Sample Cell Material			
Cell Tube	Aluminum	Silica glass (SiO ₂)	Stainless steel 1.4571
Window	CaF ₂ , adhesive fastening	Silica glass	CaF ₂ or SiO ₂ , threaded fastening
Seal	–	FFKM75	FFKM70
Connectors	Stainless steel 1.4571	PFA	Stainless steel 1.4571
Gas Line Materials	FPM or PTFE	PFA	Stainless steel 1.4571
Gas Connector Materials	Stainless steel 1.4571	PFA	Stainless steel 1.4571
Gas Connection Design	Connectors with 1/8 NPT internal threads	Hoses 6/4 mm	Pipes with 4-mm OD
Connection Drawing	Page 34	Page 34	Page 35

1) see page 9 “Gas Inlet Conditions”

2) purge curtain

3) p_e = 7 to 20 hPa, 15 to 20 l/h

4) The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions (p_{abs} ≤ 1.1 bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation p_e ≤ 100 hPa; in case of a sample gas supply failure the pressure must not exceed the maximum value p_e = 500 hPa. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked.

Process Photometer Analyzer Module Limas11 HW

Measurement Principle and Application

Limas11 HW is a multi-component analyzer for simultaneous measurement of nitrogen compounds in wet sulfur-free flue gas without converter.

Measurement Principle

Photometer to measure from 1 to 4 components such as NO, NO₂, NH₃

Wavelength comparison in ultraviolet spectrum range $\lambda = 200$ to 600 nm for sample components NO₂, NH₃ and SO₂.

The UV-RAS method (ultra-violet resonant absorption spectroscopy) is used to make the analyzer selective to the sample component NO.

Applications

Exhaust gas measurement for the development of combustion engines and methods for exhaust gas after-treatment, in particular for pure gas measurement after catalyst in

- Four-stroke gasoline and diesel engines
- Catalysts for nitrogen oxide reduction
- DeNOx SCR catalysts for passenger car and freight vehicle diesel engines.

Process measurement for flue gas scrubbing systems in gas turbines and gas-fired burners, in particular for monitoring, controlling and optimizing DeNOx SCR processes.

Sample Components and Measurement Ranges (Recommendations), Stability Data

Exhaust Gas Measurement for Four-Stroke Gasoline and Diesel Engines

Sample Component	Smallest Range	Largest Range
NO	0 to 100 ppm	0 to 5000 ppm
NO ₂	0 to 100 ppm	0 to 2500 ppm

Linearity Deviation

- ≤ 1% of span
- ≤ 2% of measured value acc. to EPA specifications for automotive exhaust gas measurement

Repeatability

- ≤ 0.25% of span

Zero Drift

- ≤ 1 ppm or ≤ 1% of span per 24 hours based on the smallest recommended measurement range (daily automatic zero-point calibration recommended)

Sensitivity Drift

- ≤ 1% of measured value per week

Output Fluctuation (2 σ)

- ≤ 400 ppb or ≤ 0.4% of span at electronic T90 time = 5 sec

Detection Limit (4 σ)

- ≤ 800 ppb or ≤ 0.8% of span at electronic T90 time = 5 sec

Diluted Exhaust Gas Measurement for Four-Stroke Gasoline and Diesel Engines, Bag Measurement

Sample Component	Smallest Range	Largest Range
NO	0 to 10 ppm	0 to 500 ppm
NO ₂	0 to 10 ppm	0 to 500 ppm

Linearity Deviation

- ≤ 1% of span
- ≤ 2% of measured value acc. to EPA specifications for automotive exhaust gas measurement

Repeatability

- ≤ 0.25% of span

Zero Drift

- ≤ 200 ppb or ≤ 2% of span per 8 hours based on the smallest recommended measurement range (daily automatic zero-point calibration recommended)

Sensitivity Drift

- ≤ 1% of measured value per week

Output Fluctuation (2 σ)

- NO ≤ 50 ppb,
- NO₂ ≤ 60 ppb
- at electronic T90 time = 15 sec

Detection Limit (4 σ)

- NO ≤ 100 ppb or ≤ 1% of span,
- NO₂ ≤ 120 ppb or ≤ 1% of span
- at electronic T90 time = 15 sec

Exhaust Gas Measurement after DeNOx SCR Catalysts, Especially for Passenger Car and Freight Vehicle Diesel Engines

Sample Component	Smallest Range	Largest Range
NO	0 to 100 ppm	0 to 1000 ppm
NO ₂	0 to 100 ppm	0 to 500 ppm
NH ₃	0 to 100 ppm	0 to 500 ppm

Linearity Deviation

- ≤ 1% of span

Repeatability

- ≤ 0.25% of span

Zero Drift

- ≤ 1 ppm or ≤ 1% of span per 24 hours based on the smallest recommended measurement range (daily automatic zero-point calibration recommended)

Sensitivity Drift

- ≤ 1% of measured value per week

Output Fluctuation (2 σ)

- ≤ 150 ppb or ≤ 0.15% of span at electronic T90 time = 30 sec

Detection Limit (4 σ)

- ≤ 300 ppb or ≤ 0.3% of span at electronic T90 time = 30 sec

Process Photometer Analyzer Module Limas11 HW

Measurement Ranges

Quantity

1 to 4 ranges per sample component

Measurement Range Ratio

max. 1:20; Measurement ranges freely adjustable within a range ratio of 1:20 relative to the factory-set reference measurement range.

max. 1:50 for fixed measurement ranges acc. to EPA specifications for automotive exhaust gas measurement

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Zero-Point Calibration

With inert gas, e.g. N₂, or with ambient air that is free of the sample component

End-Point Calibration

With gas-filled calibration cells (optional) or with test gas.

It is recommended to verify the calibration cell set values once a year.

During calibration of a multi-component analyzer, possible cross-sensitivity and/or carrier gas corrections by internal or external measurement components are switched off.

Therefore, corrected measurement components should be calibrated only using a test gas consisting of the measurement component and an inert gas like N₂.

Influence Effects

Flow Effect

Flow rate in the 20 to 90 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: Internal electronic cross-sensitivity correction or carrier gas correction for a sample component by other sample components measured with the Limas11 HW.

Temperature Effect

Ambient temperature in permissible range,

Sample cell thermostat control to +80 °C

– At zero-point: ≤ 2 % of span per 10 °C

– On sensitivity: ≤ 2 % 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 routed to the outside via a hose.

Pressure sensor working range: p_{abs} = 600 to 1250 hPa

Power Supply Effect

24 VDC ± 5 %: ≤ 0.2 % of span

Dynamic Response

Warm-Up Time

Approx. 4 hours

90% Response Time

T₉₀ ≤ 5 sec for measurement cell length = 260 mm and sample gas flow = 60 l/h with non-linear filter (static/dynamic) = 15/1 sec.

Low-pass time constant adjustable from 0 to 30 sec.

Materials in Contact with the Sample Medium

Sample Cell

Tubing and window: Silica glass, Screw connection: PVDF;

Connectors: PTFE

Gas Lines and Connectors

Stainless steel 1.4305, 1.4571

Housing Purge

Purge Gas

Sample component-free air or N₂

Purge Gas Flow Rate

≤ 10 l/h

Gas Connections

Layout and Design

Connectors with 1/8 NPT internal threads. See page 35 for connection drawing.

Electrical Connections

System Bus

3-pin female plug

External 24-VDC Power Supply

4-pin male plug

RS232 Interface

4-pin female plug (for connection to TCT)

Gas Inlet Conditions

Sample Gas Composition

Sulfur-free exhaust gas of combustors,

SO₂ concentration < 25 ppm, H₂O < 20 Vol.-%,

filtered with pore width ≤ 0.5 μm

Temperature

Sample gas dew point ≤ 65 °C

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 90 l/h

Process Photometer Analyzer Module Limas11 HW

Power Supply

Input Voltage, Power Consumption
24 VDC \pm 5 %, max. 85 W

Installation Site Requirements

Vibration

max. \pm 0.04 mm/0.5 g at 5 to 150 Hz

Ambient Temperature

Operation: +5 to +35 °C when installed in housing with or without electronics module;
Storage and transport: -25 to +65 °C

Notes

The analyzer module Limas11 HW can only be mounted in the 19-inch housing.

SO₂ influences the NH₃ reading. If the sample gas mixture contains SO₂, the requirement of internal corrections must be scrutinized.

When ordering the average water vapor concentration has to be specified. The influence is corrected internally.

For proper operation the following "Sample Conditioning System Requirements" have to be considered.

Sample Conditioning System Requirements

Sample Gas Feed-In

The various applications require the sample gas feed-in to the gas analyzer at temperatures of 150 to 190 °C. It is imperative to eliminate condensation and sublimation since NH₃ and NO₂ are easy soluble in water and can result in salification. It is also imperative to prevent condensation of potentially present low-boiling hydrocarbons.

Sample Gas Inlet Temperature (on the process side)
150 to 190 °C

Sample Gas Filter

For NO and NO₂ measurement: Sintered metal;
For NH₃ measurement: Ceramics;
pore width \leq 0.5 μ m

Materials in Contact with the Sample Medium

PTFE, PVDF or Silicosteel

Exhaust Gas Conditions

Outlet pressure = atmospheric pressure, no resistance in the gas outlet.

Installation Note

Route the exhaust gas line declining to allow for condensate drain-off.

Oxygen Analyzer Module Magnos206

Measurement Principle

Paramagnetic behavior of oxygen

Magnetomechanical oxygen analyzer; short 90% response time

Sample Component and Smallest Measurement Range

Sample Component
Oxygen (O₂)

Smallest Measurement Range
0 to 0.5 Vol.-% O₂

Stability

Linearity Deviation
≤ 0.5 % of span

Repeatability
≤ 50 ppm O₂ (time base for gas exchange ≥ 5 minutes)

Zero Drift
≤ 3 % of span of the smallest measurement range (per order) per week, minimum 300 ppm O₂ per week; following prolonged transport and storage time the drift can be higher during the first weeks of operation.

Sensitivity Drift
≤ 0.1 Vol.-% O₂ per week or ≤ 1 % of measured value per week (not cumulative), whichever is smaller.
≤ 0.25 % of measured value per year

Output Fluctuation (2 σ)
≤ 25 ppm O₂ at electronic T90 time (static/dynamic) = 3/0 sec

Detection Limit (4 σ)
≤ 50 ppm O₂ at electronic T90 time (static/dynamic) = 3/0 sec

Measurement Ranges

Quantity
4 measurement ranges
Measurement ranges are freely adjustable; they are factory-set to 0–10/15/25/100 Vol.-% O₂ or per order.

Largest Measurement Range
0–100 Vol.-% O₂
Measurement ranges within ignition limits cannot be provided.

Measurement Ranges with Suppressed Zero-Point
Max. measurement range suppression 1: 100,
e.g. 99–100 Vol.-% O₂.
Highly suppressed measurement ranges (≥95–100 Vol.-% O₂) and initial measurement ranges in the same analyzer should be avoided. Pressure correction by means of pressure sensor required.

Measurement Range Switching
Manual; available external control or automatic

Limit Value Monitoring
Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

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
For measurement ranges from 0 to 5 Vol.-% O₂ to 0 to 25 Vol.-% O₂
Zero-point calibration with any oxygen concentration, e.g. with nitrogen (N₂) or ambient air, processed through a cooler or H₂O 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).

Measurement Ranges with Suppressed Zero-Point
Highly suppressed measurement ranges (≥95–100 Vol.-% O₂) should only be calibrated with test gases with concentrations in the selected measurement range.
Single-point calibration can also be done within a suppressed measurement range. The O₂ concentration of the test gas must lie within the measurement range.

Influence Effects

Flow Effect
≤ 0.1 Vol.-% O₂ in permissible range

Associated Gas Effect
The effect of associated gases as a shift of the zero-point – expressed in Vol.-% O₂ – can be estimated using the approximate values in the following table:

Associated Gas Concentration		Zero-Point Shift in Vol.-% O ₂
Hydrogen	H ₂	+0.28
Hydrogen Sulfide	H ₂ S	-0.45
Argon	Ar	-0.26
Helium	He	+0.30
Neon	Ne	+0.13
Nitrogen	N ₂	0
Nitrogen Oxide	NO	+43
Nitrogen Dioxide	NO ₂	+28
Nitrous Oxide	N ₂ O	-0.20
Carbon Monoxide	CO	-0.01
Carbon Dioxide	CO ₂	-0.32
Carbon Oxysulfide	COS	-0.90
Ethane	C ₂ H ₆	-0.46
Ethylene	C ₂ H ₄	-0.29
Methane	CH ₄	-0.24
Propane	C ₃ H ₈	-0.98
Propylene	C ₃ H ₆	-0.55
Trichloroethane	C ₂ HCl ₃	-2.17
Vinyl Chloride	CH ₂ CHCl	-0.75

For further associated gases refer to EN 61207-3

Oxygen Analyzer Module Magnos206

Temperature Effect

- Ambient temperature in permissible range
 - At zero-point: ≤ 0.02 Vol.-% O_2 per $10^\circ C$
 - On sensitivity: $\leq 0.1\%$ of measured value per $10^\circ C$
- Thermostat temperature = $64^\circ C$

Air Pressure Effect

- At zero-point: No effect
- On sensitivity with no pressure correction:
 $\leq 1\%$ of measured value per 1% air pressure change
- On sensitivity with pressure correction using integrated pressure sensor (optional):
 $\leq 0.1\%$ of measured value per 1% pressure change; for highly suppressed measurement ranges $\leq 0.01\%$ of measured value per 1% pressure change or ≤ 0.002 Vol.-% O_2 per 1% pressure change, whichever is greater.
Pressure sensor working range: $p_{abs} = 600\text{--}1250$ hPa

Power Supply Effect

24 VDC $\pm 5\%$: $\leq 0.4\%$ of span

Position Effect

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

Dynamic Response

Warm-Up Time

< 1 hour

90% Response Time

$T_{90} \leq 3.5$ to 10 sec at a sample gas flow of 90 l/h and electronic T_{90} time (static/dynamic) = $3/0$ sec, gas change from N_2 to air (applies to an analyzer unit with 1 analyzer module)

Materials in Contact with the Sample Medium

Analyzer

Rust- and acid-resistant steel 1.4305, glass, platinum, rhodium, epoxy resin; FPM seals, optional: FFKM75

Pressure Sensor

Silicon gel, plastics, FPM

Gas Connections

Layout and Design

Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with $1/8$ NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 35 for connection drawing.

Sample Cell Connection

The sample cell is connected directly to the gas ports.

Electrical Connections

System Bus

3-pin female plug

External 24-VDC Power Supply

4-pin male plug

Gas Inlet Conditions

Temperature

$+5$ to $+50^\circ C$

The sample gas dew point should be at least $5^\circ C$ below the ambient 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

$p_e = 2\text{--}100$ hPa

Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure

Atmospheric pressure

Flow Rate

$30\text{--}90$ 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. FFKM75 seals must be used if the sample gas contains NH_3 . In this case the pneumatics module cannot be connected to the analyzer module.

Flammable Gases

The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ($p_{abs} \leq 1.1$ bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation $p_e \leq 100$ hPa; in case of a sample gas supply failure the pressure must not exceed the maximum value $p_e = 500$ hPa. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked. Housing purge with N_2 should be provided when measuring flammable gases and vapors. Flame barriers can be used as an option (except for the "Safety Concept" version, see page 38). Pressure drop at the flame barriers approx. 40 hPa for a sample gas flow rate of 50 l/h. Material of the flame barriers: Stainless steel 1.4571.

Power Supply

Input Voltage, Power Consumption

24 VDC $\pm 5\%$, max. 50 W

Installation Site Requirements

Vibration

max. ± 0.04 mm at 5 to 20 Hz

Ambient Temperature

Operation: $+5$ to $+45/50^\circ C$ when installed in housing with/without electronics module;
Storage and transport: -25 to $+65^\circ C$

Oxygen Analyzer Module Magnos27

Measurement Principle

Paramagnetic behavior of oxygen

Heavy-duty thermomagnetic oxygen analyzer

Sample Component and Smallest Measurement Range

Sample Component

Oxygen (O₂) in flue gas or in nitrogen (N₂)

Smallest Measurement Range

0–3 Vol.-% O₂

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

Measurement Ranges

Quantity

1–4 measurement ranges

Ranges are factory-set per customer order.

Largest Measurement Range

0–100 Vol.-% O₂

Measurement ranges within ignition limits cannot be provided.

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

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

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: No effect

– On sensitivity: ≤ 1.5 % of measured value per 1 % barometric 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.

Oxygen Analyzer Module Magnos27

Dynamic Response

Warm-Up Time
2–4 hours

90% Response Time
 $T_{90} = 10\text{--}22$ sec, depending on sample gas flow and on measurement cell connection (see “Gas Connections”, applies to an analyzer unit with 1 analyzer module)

Materials in Contact with the Sample Medium

Analyzer
Rust- and acid-resistant steel 1.4580 and 1.4305, glass

Gas Lines and Connectors
Rust- and acid-resistant steel 1.4571 and 1.4305, PVC-C, FPM

Gas Connections

Layout and Design
Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 36 for connection drawings.

Sample Cell Connection
The sample cell can be connected directly to the gas ports (wall-mount housing only) or by means of FPM hoses. Direct sample cell connection e.g. when external gas supply is connected and for short T_{90} times.

Electrical Connections

System Bus
3-pin female plug

External 24-VDC Power Supply
4-pin male plug

Gas Inlet Conditions

Temperature
+5 to +50 °C
The sample gas dew point should be at least 5 °C below the ambient 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
 $p_e = 2\text{--}100$ hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
20–90 l/h

Flammable Gases
Measurement of flammable gases is not possible.

Power Supply

Input Voltage, Power Consumption
24 VDC $\pm 5\%$, max. 35 W

Installation Site Requirements

Vibration
max. ± 0.04 mm at 5 to 60 Hz

Ambient Temperature
Operation: +5 to +45 °C when installed in housing with/without electronics module, +5 to +50 °C with direct sample cell connection and when installed in housing without electronics module and Uras26;
Storage and transport: –25 to +65 °C

Trace Oxygen Analyzer Module 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 module is used for the continuous measurement of oxygen in pure gases (N₂, 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 (O₂)

Measurement Ranges

Factory-set: 0 to 1/10/100/1000 ppm O₂

The following measurement data refer to a measurement span of 100 ppm O₂ with an integrated pump and flow control.

Stability

Linearity

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

Repeatability

< 1 % of the measurement range or 100 ppb O₂ (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 O₂ may deviate through aging of the cell.

< 1 % of the measurement range per week or 250 ppb O₂ (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 N₂ and Ar:

< 1 % of the measurement range per week or 250 ppb O₂ (whichever is greater)

Output Fluctuation (2 σ)

< ±0.5 % of the measured value or 50 ppb O₂ (whichever is greater)

Measurement Ranges

Quantity

4 measurement ranges

The range limits can be user set.

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Offset Calibration

The reference value for ambient air is calibrated at 20.6 % Vol. by means of ambient air on the sample gas side.

End-Point Calibration

By means of test gas O₂ in N₂ (or in Ar); O₂ concentration in the measurement range, e.g. 10 ppm O₂

Function Test

An extended response time or reduced sensitivity are dimensions for the correct functioning of the measuring cell. The function test (patent applied for) 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. An additional function block configuration is required for a cyclic scan.

Influence Effects

Flow Effect

≤ 1 % of the measurement span or 100 ppb O₂ in the permissible range of 5 to 10 l/h (whichever is greater)

Associated Gas Effect

Inert gases (Ar, N₂) have no effect. Flammable gases (CO, H₂, CH₄) in stoichiometric concentrations to the oxygen content: Conversion of O₂ < 20 % of the stoichiometric conversion. If higher concentrations of flammable gases are present, higher O₂ conversions must be expected.

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 O₂ per 10 °C change in the ambient temperature (whichever is greater).

Air Pressure Effect

No effect through a change in air pressure; 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

Trace Oxygen Analyzer Module ZO23

Dynamic Response

Warm-Up Time

The operating temperature of the cell is reached after approx. 15 min. Offset calibration with reference gas (ambient air) after 2 h 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 h.

90% Response Time

$T_{90} < 60$ s 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 s

Materials in Contact with the Sample Medium

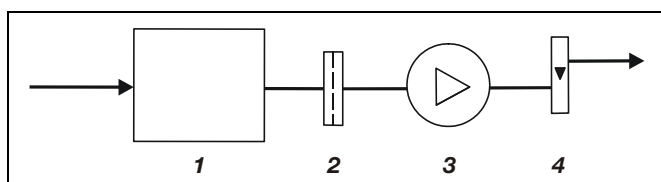
Analyzer

Zirconium dioxide cell: ZrO_2 , electrodes containing platinum;
Dust filter: PP; Pump: EPDM; Flow sensor: on semiconductor basis, nickel-plated brass

Gas Lines and Connectors

Stainless steel 1.4571, FPM in the gas outlet;
Gas connections: stainless steel 1.4401/1.4305

Pneumatics Diagram



- 1 Measuring cell
- 2 Dust filter (option)
- 3 Pump (option)
- 4 Flow sensor (option)

The trace oxygen analyzer module cannot be connected to the pneumatics module.

Gas Connections

Layout and Design

Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module. Gas inlet 3 mm Swagelok®, gas outlet with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 36 for connection drawing.

Measuring Chamber Connection

The measuring chamber is connected to the sample gas inlet connection via a stainless steel tube (inlet side) and to the sample gas outlet connection via a FPM hose (outlet side).

Electrical Connections

System Bus

3-pin female plug

External 24-VDC Power Supply

4-pin male plug

Gas Inlet Conditions

Temperature

+5 to +50 °C

Inlet Pressure

$p_e = 2$ to 20 hPa

Outlet Pressure

Atmospheric pressure

Flow Rate

5 to 10 l/h. Changes to the sample gas flow rate are to be avoided. When using the internal sample gas pump, the flow is regulated at 8 ± 0.2 l/h. The sample gas must be taken from a bypass at zero pressure.

Flammable Gases

The introduction of explosive and flammable gas mixtures is not permissible.

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.

Purge Gas

If case purging is selected, purging may only be carried out with air (not with N_2), since the ambient air is used as a reference gas.

Power Supply

Input Voltage, Power Consumption

24 VDC $\pm 5\%$, approx. 12 W in continuous operation, approx. 35 W during start-up for each analyzer module

Installation Site Requirements

Vibration

max. ± 0.04 mm at 5 to 55 Hz, 0.5 g at 55 to 150 Hz

Ambient Temperature

Operation: +5 to +45 °C, when installed in housing with electronics module;
Storage and transport: -25 to +65 °C

Thermal Conductivity Analyzer Module Caldos25

Measurement Principle

Difference in thermal conductivity of various gases

Highly corrosion-resistant thermal conductivity analyzer, sample cells embedded in glass

Sample Components and Smallest Measurement Ranges

The Caldos25 is specifically designed for measurements of corrosive gas components.

Sample Components and Smallest Measurement Ranges (Examples)

Component and Associated Gas	Smallest Measurement Range	Reference Gas
H ₂ in N ₂ or air	0–0.5 Vol.-%	Air (sealed)
SO ₂ in N ₂ or air	0–1.5 Vol.-%	Air (sealed)
H ₂ in Cl ₂	0–0.5 Vol.-%	Flowing

Stability

Linearity Deviation

≤ 2 % of span

Repeatability

≤ 1 % of span

Zero Drift

≤ 1 % of span per week

Sensitivity Drift

≤ 1 % 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

Measurement Ranges

Quantity

1–4 measurement ranges

Ranges are factory-set per customer order.

Largest Measurement Range

0–100 Vol.-% or 0 Vol.-% to saturation

Measurement ranges within ignition limits cannot be provided.

Measurement Range Switching Ratio

≤ 1:20

Measurement Ranges with Suppressed Zero-Point

Span at least 2 Vol.-%, depending on application

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Zero-Point Calibration

With sample component-free process gas or substitute gas

End-Point Calibration

With process gas having a known sample gas concentration or with substitute gas

Influence Effects

Flow Effect

≤ 1 to 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

Analyzer calibration should be based on an analysis of the sample gas. Measurement results can be greatly distorted by interfering components in complex (non-binary) gas mixtures.

Temperature Effect

Ambient temperature in 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

No effect in permissible operating condition range

Power Supply Effect

24 VDC ± 5 %: ≤ 0.2 % of span

Position Effect

< 1 % of span up to 10° deviation from horizontal orientation

Thermal Conductivity Analyzer Module Caldos25

Dynamic Response

Warm-Up Time
1.5 hours

90% Response Time
Typical $T_{90} = 10\text{--}20$ sec; optional: $T_{90} < 6$ sec
(applies to an analyzer unit with 1 analyzer module)

Materials in Contact with the Sample Medium

Analyzer
Rust- and acid-resistant steel 1.4305, glass

Gas Lines and Connectors
For sealed reference gas: Rust- and acid-resistant steel 1.4305;
For flowing reference gas: PVC-C, FPM seals;
For corrosive sample gas: PVC-C, FFKM seals

Gas Connections

Layout and Design
Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 37 for connection drawings.
Caution: In the versions for flowing reference gas and for corrosive sample gas, the gas ports (sample gas, reference gas and purge gas) are made of PVC-C. Do not use metal adapters!

Sample Cell Connection
The sample cell is connected directly to the gas ports.

Electrical Connections

System Bus
3-pin female plug

External 24-VDC Power Supply
4-pin male plug

Gas Inlet Conditions

Temperature
+5 to +50 °C
The sample gas dew point should be at least 5 °C below the ambient 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
 $p_e = 2\text{--}100$ hPa
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure
Atmospheric pressure

Flow Rate
normal 10–90 l/h, max. 90–200 l/h for option $T_{90} < 6$ sec

Flowing Reference Gas
Gas inlet conditions same as sample gas

Flammable Gases
The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ($p_{\text{abs}} \leq 1.1$ bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation $p_e \leq 100$ hPa; in case of a sample gas supply failure the pressure must not exceed the maximum value $p_e = 500$ hPa. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked. Housing purge with N_2 should be provided when measuring flammable gases and vapors. Flame barriers can be used as an option (except for the “Safety Concept” version, see page 38). Pressure drop at the flame barriers approx. 40 hPa for a sample gas flow rate of 50 l/h. Material of the flame barriers: Stainless steel 1.4571.

Power Supply

Input Voltage, Power Consumption
24 VDC $\pm 5\%$, max. 25 W

Installation Site Requirements

Vibration
max. ± 0.04 mm at 5 to 30 Hz

Ambient Temperature
Operation: +5 to +45 °C when installed in housing with/without electronics module;
Storage and transport: –25 to +65 °C

Thermal Conductivity Analyzer Module Caldos27

Measurement Principle

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

Sample Components and Smallest Measurement Ranges

Sample Components and Smallest Possible Measurement Ranges in Vol.-% (Examples)

Component and Associated Gas	Class 1 Range	Class 2 Range	Standard Gas ¹⁾ for Calibration
Ar in O ₂	0 – 20	0 – 2	Air, N ₂ , O ₂
H ₂ in Ar	0 – 2.5	0 – 0.25	Air, N ₂ , Ar
H ₂ in N ₂ /Air	0 – 3	0 – 0.3	Air, N ₂
H ₂ in stack gas	0 – 5	0 – 0.5	Air, N ₂
CH ₄ in N ₂	0 – 20	0 – 2	Air, N ₂
CH ₄ in Air	0 – 4	0 – 2	Air, N ₂
CO ₂ in N ₂ /Air	0 – 30	0 – 3	Air, N ₂
Ar in N ₂	75 –100	97.5–100	Air, N ₂ , Ar
H ₂ in N ₂	90 –100	99 –100	N ₂ , H ₂
CH ₄ in N ₂	90 –100	99 –100	N ₂ , CH ₄
He in N ₂	90 –100	97 –100	He

1) Only for measurement ranges \geq Class 1

Measurement Ranges for Monitoring Hydrogen-Cooled Turbo Generators

Component and Associated Gas	Measurement Range
CO ₂ in Air	0–100 Vol.-%
H ₂ in CO ₂	100–0 Vol.-%
H ₂ in Air	100–80/90 Vol.-%

Other sample components on request.

Stability

These data apply only to measurement ranges \geq Class 2.

Linearity Deviation
 $\leq 2\%$ of span

Repeatability
 $\leq 1\%$ of span

Zero Drift
 $\leq 2\%$ of smallest possible measurement range per week

Sensitivity Drift
 $\leq 0.5\%$ of smallest possible measurement range per week

Output Fluctuation (2 σ)
 $\leq 0.5\%$ of smallest measurement range span at electronic
 T_{90} time = 0 sec

Detection Limit (4 σ)
 $\leq 1\%$ of smallest measurement range span at electronic
 T_{90} time = 0 sec

Measurement Ranges

Quantity

1–4 measurement ranges
Ranges are freely adjustable. They are factory-calibrated for the largest possible measurement range.

Largest Measurement Range

0–100 Vol.-% or 0 Vol.-% to saturation, depending on measurement task

Measurement ranges within ignition limits cannot be provided.

Measurement Range Switching Ratio

$\leq 1:20$

Measurement Ranges with Suppressed Zero-Point

See the adjacent table for spans

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

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

Simplified Calibration with Standard Gas

For measurement ranges \geq class 1, 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).

Influence Effects

Flow Effect

$\leq 0.5\%$ 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.

Temperature Effect

Ambient temperature in permissible range
at each point in the measurement range: $\leq 0.5\%$ of span per 10 °C, based on temperature at the time of calibration
Thermostat temperature = 60 °C

Thermal Conductivity Analyzer Module Caldos27

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: $p_{abs} = 600\text{--}1250$ hPa
Option: Operating altitude over 2000 m

Power Supply Effect

24 VDC ± 5 %: ≤ 0.2 % of span

Position Effect

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

Dynamic Response

Warm-Up Time

Approx. 30 minutes for class 1 measurement ranges,
Approx. 60 minutes for class 2 measurement ranges

90% Response Time

$T_{90} \leq 2$ sec for direct sample cell connection and sample gas flow of 60 l/h
(applies to an analyzer unit with 1 analyzer module)

Materials in Contact with the Sample Medium

Analyzer

Sensor: Gold, silicon oxi-nitride; Sample cell: Stainless steel 1.4305; Seal: FFKM75

Gas Connections

Layout and Design

Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 37 for connection drawing.

Sample Cell Connection

The sample cell is connected directly to the gas ports.

Electrical Connections

System Bus

3-pin female plug

External 24-VDC Power Supply

4-pin male plug

Gas Inlet Conditions

Temperature

+5 to +50 °C

The sample gas dew point should be at least 5 °C below the ambient 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

$p_e = 2\text{--}100$ hPa

Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure

Atmospheric pressure

Flow Rate

Normally 10–90 l/h, minimum 1 l/h

Corrosive Gases

Consultation with ABB Analytical is required if the sample gas contains Cl₂, HCl, HF, SO₂, NH₃, H₂S or other corrosive components.

FPM hoses should not be used if the sample gas contains NH₃. In this case the pneumatics module cannot be connected to the analyzer module.

Flammable Gases

The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ($p_{abs} \leq 1.1$ bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample gas supply failure, then only seldom and briefly (in accordance with Zone 2). Pressure in the sample gas path in normal operation $p_e \leq 100$ hPa; in case of a sample gas supply failure the pressure must not exceed the maximum value $p_e = 500$ hPa. Before using the analyzer module the corrosion resistance against the specific sample gas must be checked. Housing purge with N₂ should be provided when measuring flammable gases and vapors. Flame barriers can be used as an option (except for the "Safety Concept" version, see page 38). Pressure drop at the flame barriers approx. 40 hPa for a sample gas flow rate of 50 l/h. Material of the flame barriers: Stainless steel 1.4571.

Power Supply

Input Voltage, Power Consumption

24 VDC ± 5 %, max. 12 W

Installation Site Requirements

Vibration

max. ±0.04 mm at 5 to 55 Hz, 0.5 g at 55 to 150 Hz

Ambient Temperature

Operation: +5 to +45/50 °C when installed in housing with/without electronics module;
Storage and transport: –25 to +65 °C

FID Analyzer Module MultiFID14

Measurement Principle

Flame-ionization detector

Sample Components and Measurement Ranges

Sample Components

Hydrocarbons

Smallest Measurement Range

0–5 mg org. C/m³

Largest Measurement Range

0–100 g org. C/m³

The sample component concentration in the sample gas should not exceed 50 % of the LEL.

Number of Measurement Ranges

1–4 measurement ranges

Ranges are factory-set per customer order. They can be reduced or enlarged by a factor of max. 4 (to the smallest indicated measurement range).

Measurement Range Switching

Manual; available external control or automatic

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Stability

The following data apply to measurement ranges ≥ 50 mg org. C/m³, for smaller ranges these only apply if they are factory-set per customer order.

Linearity Deviation

≤ 2 % of the span to 10,000 mg org. C/m³

this value applies in one (calibrated) measurement range

Repeatability

≤ 0.5 % of measurement range

Zero-Point and Sensitivity Drift

≤ 0.5 mg org. C/m³ per week

Output Fluctuation (2σ)

≤ 0.5 % of span at electronic T90 time = 20 sec

Detection Limit (4σ)

≤ 1 % of span at electronic T90 time = 20 sec

Calibration

Zero-Point Calibration

With synthetic or catalytically purified air or nitrogen (N₂)

Sensitivity Calibration

With propane or another hydrocarbon (substitute gas) in air or nitrogen (N₂), depending on application

If an substitute gas curve is used during factory calibration, the measurement component response factors will also be calculated.

Influence Effects

O₂ Dependence

≤ 2 % of measured value for 0 to 21 Vol.-% O₂ or

≤ 0.3 mg org. C/m³, the greater 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/m³

Power Supply Effect

24 VDC ± 5 %: ≤ 0.2 % of span

Dynamic Response

Warm-Up Time

≤ 2 hours

90% Response Time

T₉₀ < 0.9 sec at sample gas flow = 80 l/h and electronic

T90 time = 1 sec (with unheated sample gas inlet; applies to an analyzer unit with 1 analyzer module)

Materials in Contact with the Sample Medium

Analyzer, Gas Lines and Connectors

Stainless steel, FPM, PTFE

Gas Connections

Layout and Design

Gas ports on back (19-inch rack housing) or bottom (wall-mount housing) of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®. See page 37 for connection drawing.

Sample gas inlet: Heated or unheated, with stainless steel filter, with threaded connection for PTFE or stainless steel tubing with a 6-mm outer diameter.

Exhaust: Threads 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).

Electrical Connections

System Bus

3-pin female plug

External 24-VDC supply

4-pin male plug

Heater Power Supply

4-pin male plug (connecting cable supplied)

FID Analyzer Module MultiFID14

Gas Inlet Conditions

Sample Gas

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

Inlet Pressure
 $p_{\text{abs}} = 800\text{--}1200$ hPa

Outlet Pressure
Atmospheric pressure

Flow Rate
Approx. 80–100 l/h at atmospheric pressure (1000 hPa)

Supply 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 $p_e = 4000 \pm 500$ hPa,
Typical flow rate 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 or catalytically purified air with an organic C content < 1 % span
Inlet pressure $p_e = 1200 \pm 100$ hPa, flow rate < 40 l/h

Combustion Gas
Hydrogen (H₂), grade 5.0
Inlet pressure $p_e = 1200 \pm 100$ hPa, flow rate ≤ 3 l/h
or
H₂/He mixture (40 % / 60 %)
Inlet pressure $p_e = 1200 \pm 100$ hPa, flow rate approx. 8 l/h
A flow limiting device should be provided on the hydrogen supply.

Test Gases

Zero-Point Gas
Depending on application, nitrogen (N₂), grade 5.0, or synthetic air or catalytically purified air
Inlet pressure $p_e = 1000 \pm 100$ hPa, flow rate 130 to 250 l/h

End-Point Gas
Depending on application, sample component or substitute gas in N₂ or air
Inlet pressure $p_e = 1000 \pm 100$ hPa, flow rate 130 to 250 l/h

Power Supply

Analyzer

Input Voltage, Power Consumption
24 VDC ± 5 %, max. 65 W

Heater

Input Voltage
115 VAC or 230 VAC, ± 15 % (max. 250 VAC), 47 to 63 Hz
Power Consumption
120 VA for detector heating,
100 VA for heated sample gas inlet (optional)

Electrical Safety

Tested per EN 61010-1

Protection Class

I

Overload Category/Pollution Level
24-VDC power supply II/2
115/230-VAC power supply: II/2

Safe Isolation

The 115/230 VAC power supply is galvanically isolated from other circuits by means of reinforced or double insulation.
Operational low voltage (PELV) on low-voltage side

Installation Site Requirements

Ambient Temperature

Operation: +5 to +45 °C when installed in housing with or without electronics module; +5 to +40 °C when 2 MultiFID14 are installed in 1 housing;
Storage and transport: –25 to +65 °C


Operating Altitude

Above 2000 m on request

Category 3G Version

The MultiFID14 analyzer module in the Category 3G version is suited to measure hydrocarbons in a non-flammable sample gas mixture when installed in Zone 2 hazardous areas. The heated sample gas inlet is not available in the Category 3G version.

Designation

 II 3G EEx nP II T3

Type Examination Certificate

DMT 01 E 126 X

Housing Protection Type

IP54

FID Analyzer Module MultiFID14 NMHC

Measurement Principle

Flame-ionization detector for non-methane hydrocarbon (NMHC) measurement

Sample Components and Measurement Ranges

Sample Components

Hydrocarbons

The CH₄:NMHC ratio must be in the 1:9 to 9:1 range.

Smallest Measurement Range

0–5 mg org. C/m³

Largest Measurement Range

0–5,000 mg org. C/m³

The sample component concentration in the sample gas should not exceed 50 % of the LEL.

Number of Measurement Ranges

1 measurement range

The range is factory-set per customer order.

Display

The display shows the sample components C_nH_m, CH₄ and NMHC.

Limit Value Monitoring

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Stability

The following data apply to measurement ranges ≥ 50 mg org. C/m³, 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/m³

this value applies in one (calibrated) measurement range

Repeatability

≤ 0.5 % of measurement range

Zero-Point and Sensitivity Drift

≤ 0.5 mg org. C/m³ 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

Calibration

Zero-Point Calibration

With synthetic or catalytically purified air or nitrogen (N₂), depending on application

Sensitivity Calibration

With propane or methane in air or in nitrogen (N₂), depending on application

Influence Effects

O₂ Dependence

≤ 2 % of measured value for 0 to 21 Vol.-% O₂ or

≤ 0.3 mg org. C/m³, the greater 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/m³

Power Supply Effect

24 VDC ± 5 %: ≤ 0.2 % of span

Catalyst

Effectiveness

CH₄: > 85 %, C₂H₆: < 2 %, C₃H₈: < 2 %

Switchover Time

typically 30 to 120 s

Catalyst poisons (e. g. SO₂, NO_x, HCl, H₂S, halogenated hydrocarbons) will shorten the catalyst service life. Their respective concentration should always be < 20 mg/m³.

Dynamic Response

Warm-Up Time

≤ 2 hours

90% Response Time

T₉₀ < 3 sec at sample gas flow = 80 l/h and electronic

T90 time = 1 sec (with unheated sample gas inlet; applies to an analyzer unit with 1 analyzer module)

Materials in Contact with the Sample Medium

Analyzer, Gas Lines and Connectors

Stainless steel, FPM, PTFE, PEEK

Gas Connections

Layout and Design

Gas ports on bottom of the analyzer module with 1/8 NPT internal threads for commercially available adapters, e.g.

Swagelok®. See page 37 for connection drawing.

Sample gas inlet: Stainless steel filter, heated (with external temperature controller Pt 100) or unheated, with threaded connections for PTFE or stainless steel tubing with a 6-mm outer diameter.

Exhaust: Threads 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).

Electrical Connections

System Bus

3-pin female plug

External 24-VDC supply

4-pin male plug

Heater Power Supply

4-pin male plug (connecting cable supplied)

FID Analyzer Module MultiFID14 NMHC

Gas Inlet Conditions

Sample Gas

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

Inlet Pressure
 $p_{abs} = 850\text{--}1100$ hPa

Outlet Pressure
Atmospheric pressure

Flow Rate
Approx. 80–100 l/h at atmospheric pressure (1000 hPa)

Supply 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 $p_e = 4000 \pm 500$ hPa,
Typical flow rate 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 or catalytically purified air with an organic C content < 1 % span
Inlet pressure $p_e = 1200 \pm 100$ hPa, flow rate < 40 l/h

Combustion Gas
Hydrogen (H₂), grade 5.0
Inlet pressure $p_e = 1200 \pm 100$ hPa, flow rate ≤ 4 l/h
or
H₂/He mixture (40 % / 60 %)
Inlet pressure $p_e = 1200 \pm 100$ hPa, flow rate approx. 10 l/h
A flow limiting device should be provided on the hydrogen supply.

Test Gases

Zero-Point Gas
Nitrogen (N₂), grade 5.0, or synthetic air or catalytically purified air
Inlet pressure $p_e = 1000 \pm 100$ hPa, flow rate 130 to 250 l/h

End-Point Gas
Propane in nitrogen (N₂) or in air
Inlet pressure $p_e = 1000 \pm 100$ hPa, flow rate 130 to 250 l/h

Test Gases for Catalyst Effectiveness Testing
Propane and methane in nitrogen (N₂) or in air (separate test gas containers)
Zero pressure via bypass, flow rate 130 to 250 l/h

Power Supply

Analyzer

Input Voltage, Power Consumption
24 VDC ± 5 %, max. 65 W

Heater

Input Voltage
115 VAC or 230 VAC, ± 15 % (max. 250 VAC), 47 to 63 Hz
Power Consumption
Approx. 200 VA

Electrical Safety

Tested per EN 61010-1

Protection Class
I

Overload Category/Pollution Level
24-VDC power supply II/2
115/230-VAC power supply: II/2

Safe Isolation
The 115/230 VAC power supply is galvanically isolated from other circuits by means of reinforced or double insulation.
Operational low voltage (PELV) on low-voltage side

Installation Site Requirements

Ambient Temperature
Operation: +5 to +38 °C when installed in housing with or without electronics module;
Storage and transport: –25 to +65 °C

Operating Altitude
Above 1500 m on request

Laser Analyzer Module LS25

Measurement Principle

The LS25 laser analyzer module is based on a measuring principle called single-line spectroscopy. One single target gas absorption line with no interference is chosen in the near infrared spectral range. A single mode diode laser operating around room temperature scans this single absorption line. A detector diametrically opposite detects the light and the absorption caused only by the target gas molecules. Once the absorption by the target gas molecules is detected, the gas concentration is calculated. Automatic corrections for temperature and pressure variations are included.

Sample Components and Measurement Ranges

The LS25 laser analyzer module has one physical measurement range per sample component. The indicated measurement range can be freely adjusted within the physical measurement range. The smallest detection limits and corresponding measurement ranges are shown in the table below:

Sample Component	Min. Measurement Range	Max. Pressure	Max. Temperature
O ₂	0– 1 Vol.-%	10 bar	1500 °C
CO	0– 25 mg/m ³	2 bar	1200 °C
	0–3000 mg/m ³	3 bar	1500 °C
CO ₂	0– 40 mg/m ³	2 bar	300 °C
	0–3000 mg/m ³	3 bar	300 °C
	0– 1 Vol.-%	2 bar	1500 °C
HCl	0– 7 mg/m ³	2 bar	300 °C
H ₂ S	0– 300 mg/m ³	1.5 bar	300 °C
HF	0– 1 mg/m ³	2 bar	300 °C
HCN	0– 20 mg/m ³	2 bar	300 °C
NH ₃	0– 10 mg/m ³	1.5 bar	400 °C
CH ₄	0– 20 mg/m ³	2 bar	300 °C
H ₂ O	0– 3 mg/m ³	2 bar	400 °C
	0– 1 Vol.-%	1.5 bar	1500 °C
N ₂ O	0– 700 mg/m ³	1.5 bar	300 °C
NH ₃ + H ₂ O	0– 10 mg/m ³	1.5 bar	400 °C
HCl + H ₂ O	0– 10 mg/m ³	1.5 bar	150–400 °C
	0– 1 Vol.-%		
HCl + H ₂ O	0– 35 mg/m ³	2 bar	150 °C
	0– 5 Vol.-%		
HF + H ₂ O	0– 1 mg/m ³	1.5 bar	300 °C
	0– 1 Vol.-%		
CO + CO ₂	0– 2 Vol.-%	1.5 bar	400 °C
	0– 1 Vol.-%		
O ₂ + Temp.	0– 1 Vol.-%	1.5 bar	1500 °C

All specifications refer to an optical path length (OPL) of 1 meter, tested in ABB's test/calibration jig. The standard optical path length ranges from 0,5 to 6 m. Application-dependent variations may occur. To obtain minimum measurement ranges in some cases additional measures have to be taken: 0–1 Vol.-% O₂ require purging with N₂. Actual detection limit for a specific application will depend on the gas conditions (pressure, temperature and gas composition) and optical path length. If more than one min. measurement range is shown there are different instrument versions available. Other sample components on request.

Min. measurement range, max. pressure and max. temperature cannot necessarily be realized simultaneously. The maximum pressure and temperature given are physical (spectroscopic) limits. Applications with increased temperature or pressure or with toxic or flammable gas may require additional equipment.

Stability

Zero Drift

< 2 % of smallest possible measurement range per 3 months

Span Drift

< 4 % of measurement range per 3 months

Output Fluctuation (2 σ)

≤ 0.5 % of smallest measurement range

Detection Limit (4 σ)

≤ 1 % of smallest measurement range

Measurement Ranges

Quantity

1 range per sample component, 1 x transmission

Largest Measurement Range

Largest measurement range is generally 100 times the minimum measurement range for the same conditions. Larger measurement ranges are normally possible by adaptation of measuring path and choice of a weaker absorption line.

Limit Value Monitoring (Alarm)

Limit values can be set during system configuration. The limit value signal (alarm) is output via the digital ports.

Calibration

Maintenance Interval

Recommended every 3 months (no consumables needed)

Zero-Point Check

With inert gas, e.g. N₂, or with ambient air free of the sample component. Due to the measurement principle, there is no zero-point drift.

Calibration

With test gas and a flow-through test cell

Influence Effects

Flow Effect

No effect on the measurement, but the flow will determine the amount of purge gas needed.

Associated Gas Effect/Cross Sensitivity

No cross sensitivity within normal operation conditions.

Temperature Effect

- Ambient temperature in permissible range:
No significant effect
- Gas temperature:
On sensitivity with temperature compensation:
Typically ≤ 2 % of measured value per 10 °C (dependent on type of gas and gas conditions). For large variations in gas temperature (> ±20 °C) separate temperature measurement for compensation is recommended.

Laser Analyzer Module LS25

Air Pressure Effect

At zero-point: No effect

Automatic compensation by measurement of absorption line width, alternatively by input from pressure sensor.

Power Supply Effect

24 VDC \pm 5 %: \leq 0.2 % of span

Dynamic Response

Warm-Up Time

Approx. 1 hour

Response Time

Less than 2 seconds without signal averaging

Materials in Contact with the Process Gas

Purging Unit

316 SS

Window

BK7 glass, optional: Fused Silica

Mounting

Standard Mounting

DN50/PN10 flange

Alignment Tolerances

Flanges parallel within 1.5°

Purging of Windows

Dry and oil-free pressurized air or gas, or by fan

Gas Ports for Purging

Standard: 3/8-inch hose nozzle for hoses with 10 mm inner diameter. See page 31 for connection drawing.

Electrical Connections on Transmitter Unit

Connection to Central Unit

Ethernet 10/100BASE-T, RJ45 connector;

Cable length: Standard 15 m, max. 100 m

Connection to Receiver Unit

15-pin female Sub-D connector;

Cable length: Standard 5 m, max. 150 m

Power Supply, External Pressure and Temperature Signals

15-pin male Sub-D connector;

Cable length Laser unit–Power supply: Standard 3 m, max. 100 m; Cable length Power supply–Plug: 3 m

Service PC

RS232, 9-pin female Sub-D connector

See page 30 for connection drawing.

Gas Inlet Conditions

Process Gas

Maximum process gas temperature and pressure are given in the "Sample Components and Measurement Ranges" table. Quantification of dust/particle concentration is necessary in order to determine max OPL.

Purge Gas

The purge gas should not contain any sample gas components and must be oil- and dust-free.

Power Supply

Input Voltage

24 VDC \pm 5 % from an external power supply unit 115/230 VAC (part of delivery)

Power Consumption

Approx. 20 W

Installation Site Requirements

Vibration

Max. \pm 0.6 mm around the optical axis, frequency < 500 Hz

Ambient Temperature

Operation: -20 to $+55$ °C, no direct sunlight on transmitter and receiver units;

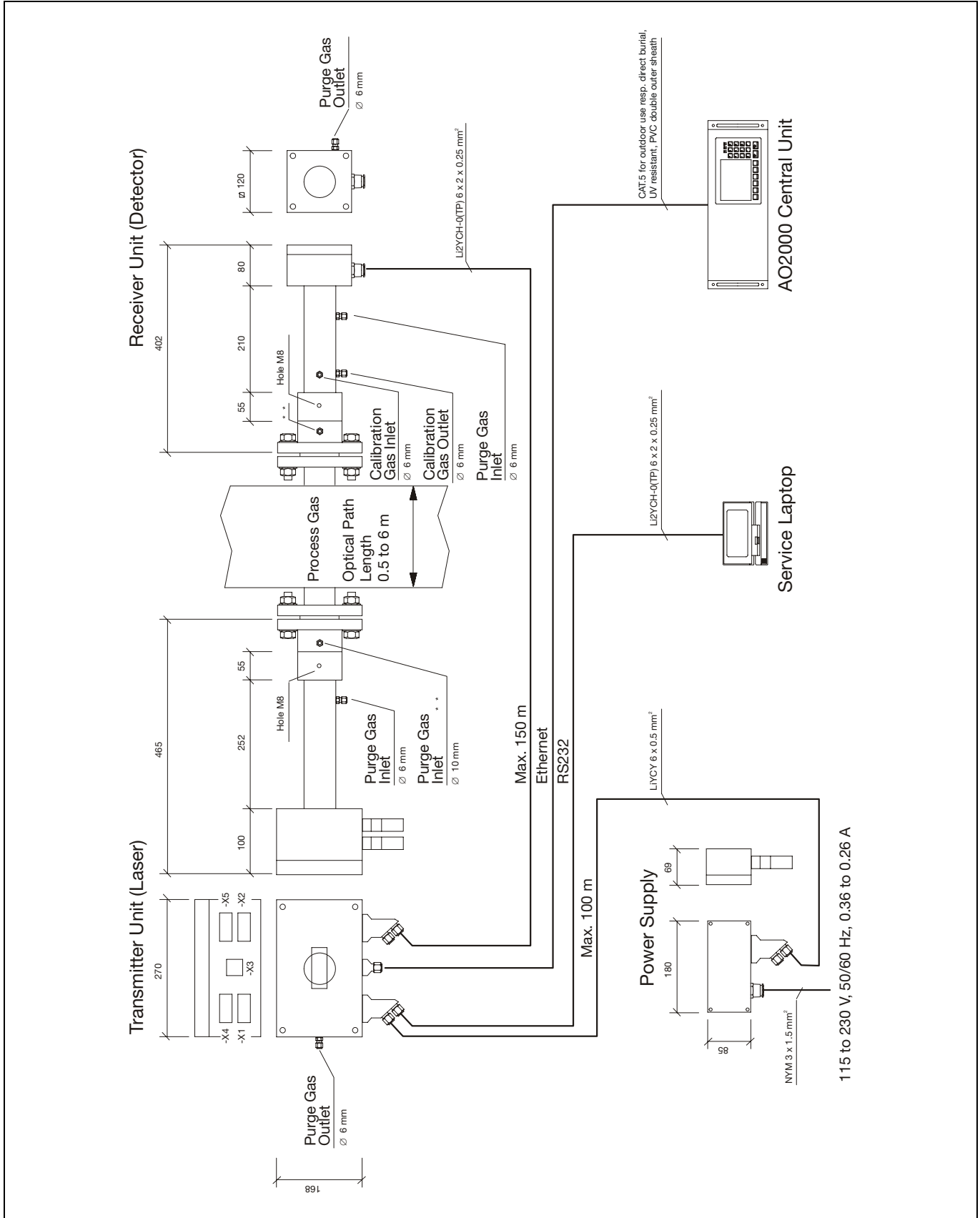
Storage and transport: -25 to $+65$ °C

Mounting Location

The mounting location strongly influences the measurement result. The measurement gas must be well stirred at the selected location to produce a representative measurement result. Stratification in the measurement gas path results in erroneous measurement. If the measurement gas is charged with dust, the LS25 must be mounted at right angles to the process gas flow.

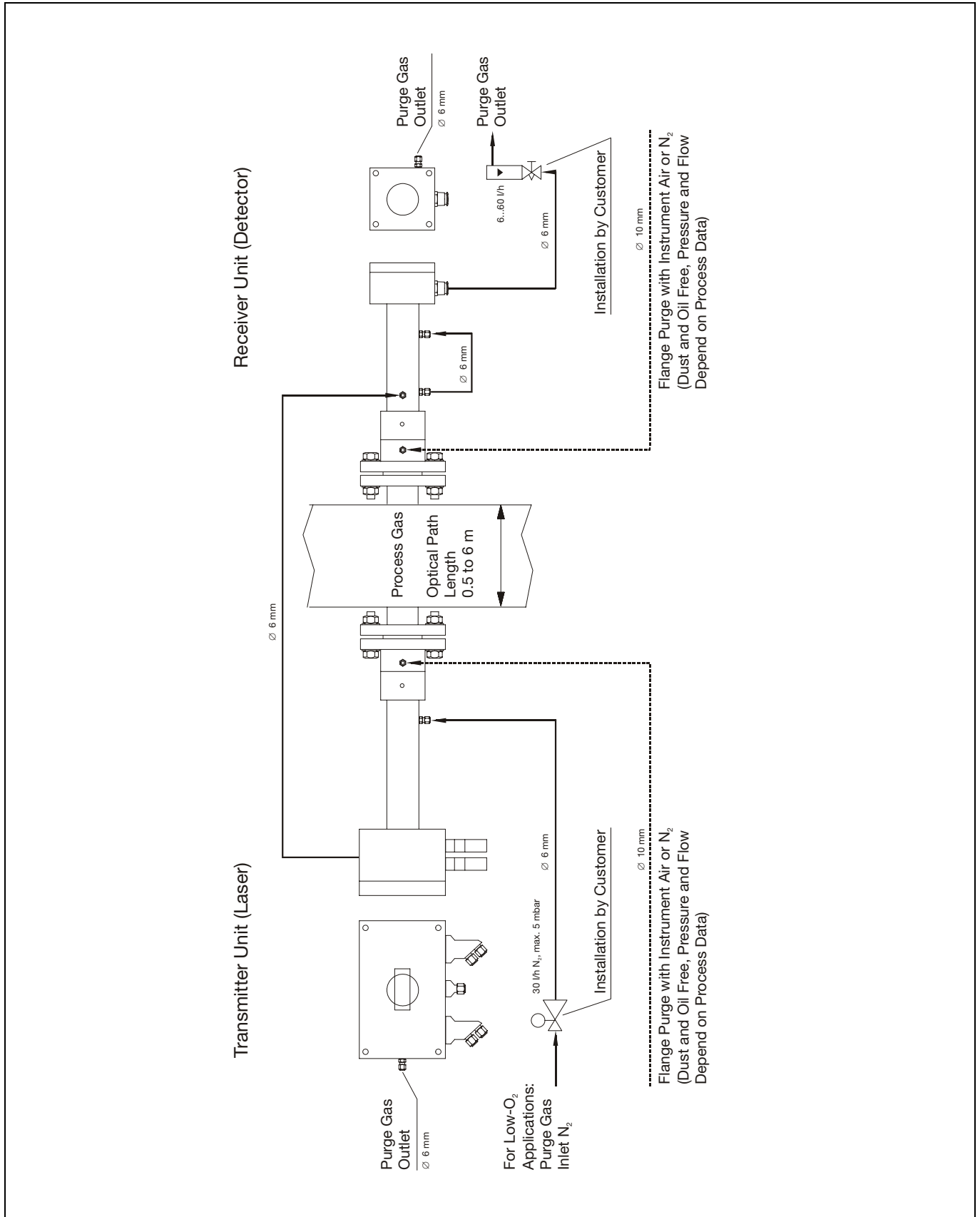
Laser Analyzer Module LS25

Dimensions and Electrical Connections (Ex-free application)



Laser Analyzer Module LS25

Gas Connections (Ex-free application)



Electrochemical Oxygen Sensor

Measurement Principle

Electrochemical oxygen sensor

Sample Component and Measurement Ranges

Sample Component

Oxygen (O₂)

Smallest Measurement Range

0–5 Vol.-% O₂

Measurement Range 1

Adjustable from 0–5 Vol.-% O₂ to 0–25 Vol.-% O₂

Measurement Range 2

Set to 0–25 Vol.-% O₂

Stability

Linearity Deviation

Linear in the range > 1 Vol.-% O₂

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, Corrective Measures

Flow Effect

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

Temperature Effect

Ambient temperature in permissible range:
≤ 0.2 Vol.-% O₂ 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 an analyzer module with an integral pressure sensor.
Pressure sensor working range: p_{abs} = 600–1250 hPa

Dynamic Response

90% Response Time

T₉₀ ≤ 30 sec, depending on sample gas flow and system layout

Calibration

End-Point Calibration

With ambient air at 20.96 Vol.-% O₂

Materials in Contact with the Sample Medium

Sensor: Polystyrol-ABS, PTFE, FPM

Housing Body: PVC-U, FPM seals

Gas Ports: Rust- and acid-resistant steel 1.4571

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 ambient temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Moisture Content

H₂O dew point ≥ 2 °C

The oxygen sensor should not be used with dry sample gas.

Inlet Pressure

p_e = 2–500 hPa

Outlet Pressure

Atmospheric pressure

Flow Rate

20–100 l/h

Associated Gas

The oxygen sensor should not be used if the associated gas contains the following components: H₂S, chlorine or fluorine compounds, heavy metals, aerosols, mercaptane, base components.

Flammable Gas

The oxygen sensor should not be used if the sample gas is flammable.

Installation Site Requirements

Ambient Temperature

Operation: +5 to +40 °C in 19-inch rack housing, +5 to +35 °C in wall-mount housing;
Storage and transport –20 to +60 °C

Notes

The oxygen sensor is always associated with an analyzer module and must be installed in the same housing with that analyzer module.

The oxygen sensor cannot be used with the following analyzer modules:

- Limas11 with stainless steel, PFA or PTFE gas connections
- MultiFID14
- Analyzer modules for measuring corrosive gases
- Analyzer modules in Category 2G

Pneumatics Module

Test Gas Supply

Type

One or three 3/2-way solenoid valves

Power Consumption

Approx. 3 W per solenoid valve

Materials in Contact with the Sample Medium

PVDF, FPM, aluminum, stainless steel 1.4305

Fine Filtration

Type

Disposable filter with borosilicate glass microfiber filter element

Retention Rate

99.99% for particles > 0.1 µm

Materials in Contact with the Sample Medium

Polyamide, borosilicate glass with PVDF binder

Gas Supply

Type

Magnetic piston pump

Feed Rate

Max. of 60 l/h, depending on analyzer module 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

Flow Monitoring

Type

Miniature flow sensor

Readout and Limit Value Monitoring

Configurable

Materials in Contact with the Sample Medium

Al₂O₃, silicon, gold, GFK

Gas Inlet Conditions

The pneumatics module 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 ambient temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet Pressure

$p_e = -80$ to +20 hPa

Flow Rate

30–60 l/h

Corrosive Gases

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

Notes

The pneumatics module is always associated with an analyzer module and must be installed in the same housing with that analyzer module.

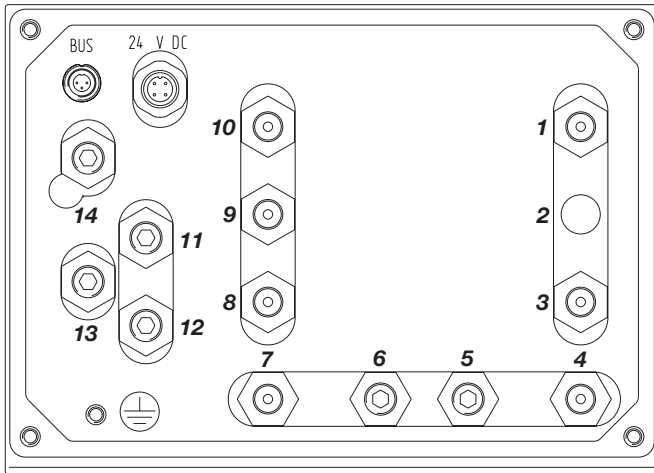
The pneumatics module cannot be used when stainless steel tubes are used for the internal gas lines.

The pneumatics module cannot be used with the following analyzer modules:

- Limas11 with stainless steel, PFA or PTFE gas lines
- MultiFID14
- Analyzer modules in Category 2G

Gas Connections Uras26, Limas11

Uras26 (Example)



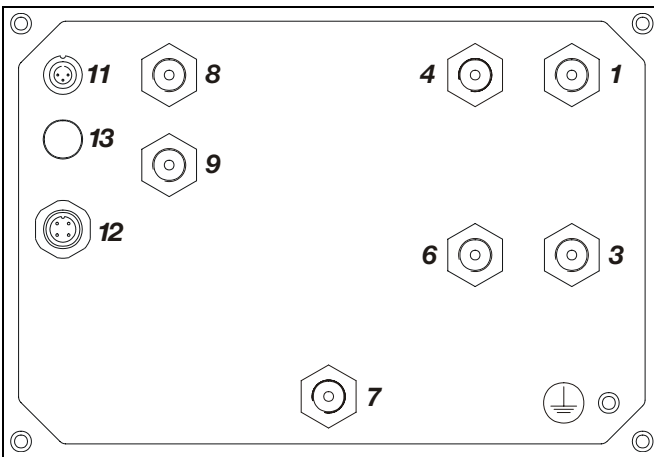
- 1 Pressure Sensor for External Pressure Measurement ¹⁾
- 2 –
- 3 Sample Gas Inlet Gas Path 1
- 4 Sample Gas Outlet Gas Path 1
- 5 Purge Gas Inlet Housing ¹⁾
- 6 Purge Gas Outlet Housing ¹⁾ (also with Flow Sensor)
- 7 Sample Gas Inlet Gas Path 2 ¹⁾
- 8 Sample Gas Outlet Gas Path 2 ¹⁾
- 9 Reference Gas Inlet Gas Path 1 ¹⁾
- 10 Reference Gas Outlet Gas Path 1 ¹⁾

Pneumatics Module ¹⁾:

- 11 Sample Gas Inlet Gas Path 1
- 12 End Point Gas Inlet (with 3 solenoids)
or Sample Gas Inlet Gas Path 2 (only with Flow Sensor)
- 13 Test Gas/Zero-Point Gas Inlet (with 1 or 3 solenoids) or
Sample Gas Outlet Gas Path 2 (only with Flow Sensor) >> 7
- 14 Sample Gas Outlet Gas Path 1 – Connect with Inlet 3

1) Option

Limas11 (Standard Cell, Quartz Cell with FPM Hoses)



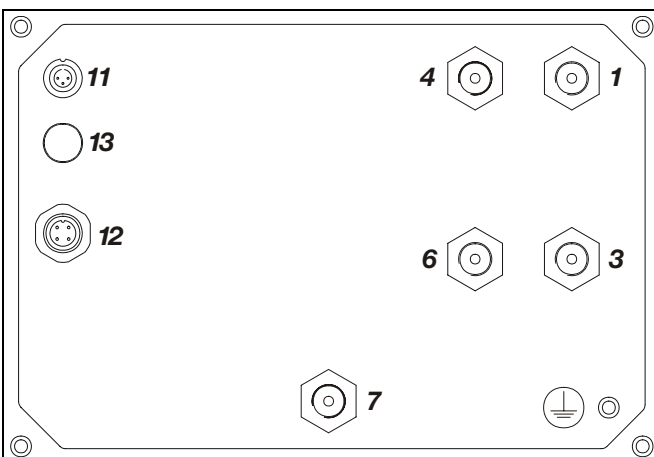
- 1 Sample Gas Inlet
- 3 Purge Gas Inlet Housing
- 4 Sample Gas Outlet
- 6 Purge Gas Outlet Housing
- 7 Pressure Sensor ¹⁾
- 8 End-Point Gas Inlet (with 3 solenoids) ¹⁾
- 9 Zero-Point Gas Inlet (with 1 or 3 solenoids) ¹⁾

Electrical Connections:

- 11 System Bus
- 12 24 VDC Power Supply
- 13 Service Interface

1) Option

Limas11 (Quartz Cell with PFA Tubes)



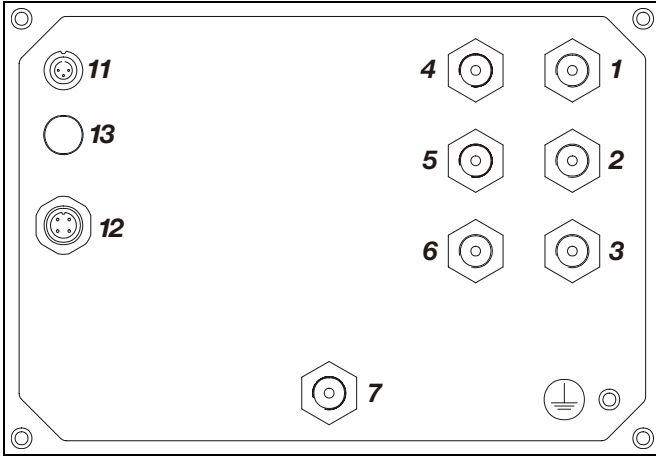
- 1 Sample Gas Inlet
- 3 Purge Gas Inlet Housing
- 4 Sample Gas Outlet
- 6 Purge Gas Outlet Housing
- 7 Pressure Sensor

Electrical Connections:

- 11 System Bus
- 12 24 VDC Power Supply
- 13 Service Interface

Gas Connections Limas11, Limas11 HW, Magnos206

Limas11 (Safety Cell)

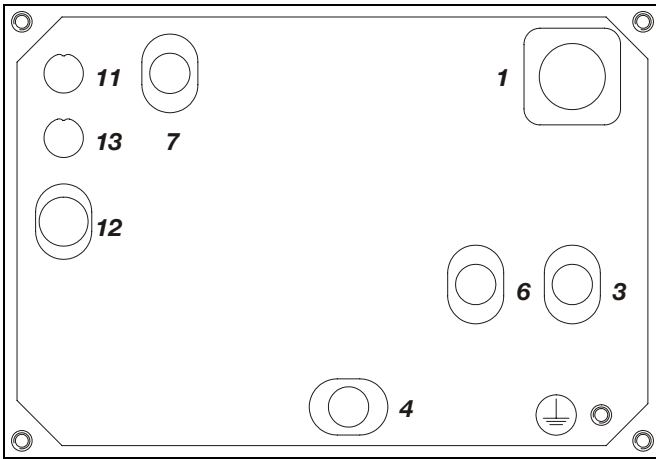


- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Housing
- 4 Purge Gas Inlet Sample Cell
- 5 Purge Gas Outlet Sample Cell
- 6 Purge Gas Outlet Housing
- 7 Pressure Sensor

Electrical Connections:

- 11 System Bus
- 12 24 VDC Power Supply
- 13 Service Interface

Limas11 HW

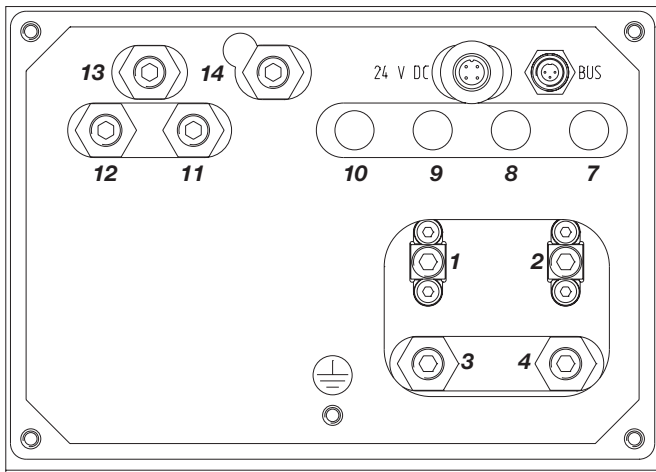


- 1 Sample Gas Inlet
- 3 Purge Gas Inlet Housing
- 4 Sample Gas Outlet
- 6 Purge Gas Outlet Housing
- 7 Pressure Sensor

Electrical Connections:

- 11 System Bus
- 12 24 VDC Power Supply
- 13 Service Interface

Magnos206



- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Analyzer²⁾
- 4 Purge Gas Outlet Analyzer²⁾
- 7 Purge Gas Inlet Housing¹⁾
- 8 Purge Gas Outlet Housing¹⁾ (also with Flow Sensor)
- 9 Pressure Sensor 1¹⁾
- 10 Pressure Sensor 2¹⁾

Pneumatics Module¹⁾:

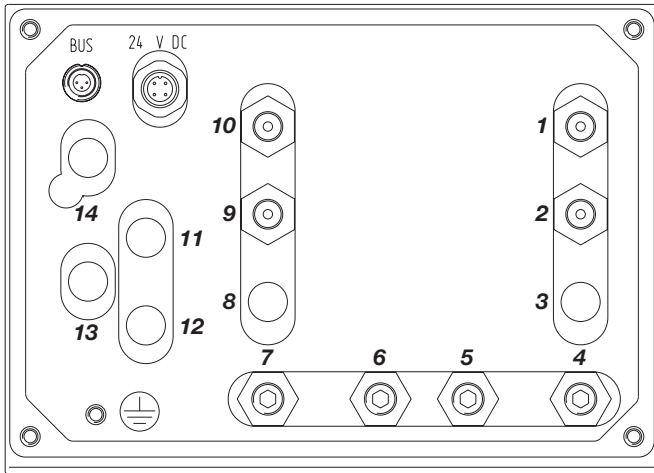
- 11 Sample Gas Inlet
- 12 End Point Gas Inlet (with 3 solenoids)
- 13 Test Gas/Zero-Point Gas Inlet (with 1 or 3 solenoids)
- 14 Sample Gas Outlet – Connect with Inlet 1

1) Option

2) not in version with performance test for emission monitoring

Gas Connections Magnos27, Z023

Magnos27



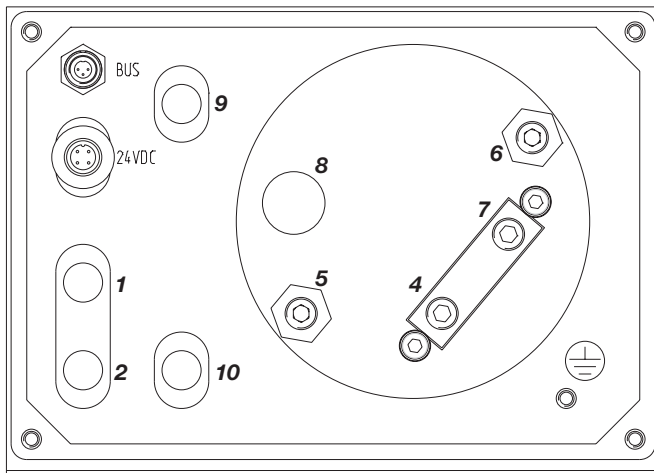
- 1 Purge Gas Inlet Housing ¹⁾
- 2 Purge Gas Outlet Housing ¹⁾ (also with Flow Sensor)
- 3 -
- 4 Sample Gas Inlet
- 5 Purge Gas Inlet Analyzer
- 6 Purge Gas Outlet Analyzer
- 7 Sample Gas Outlet
- 8 -
- 9 Pressure Sensor 1 ¹⁾
- 10 Pressure Sensor 2 ¹⁾

Pneumatics Module ¹⁾:

- 11 Sample Gas Inlet
- 12 End Point Gas Inlet (with 3 solenoids)
- 13 Test Gas/Zero-Point Gas Inlet (with 1 or 3 solenoids)
- 14 Sample Gas Outlet – Connect with Inlet 4

1) Option

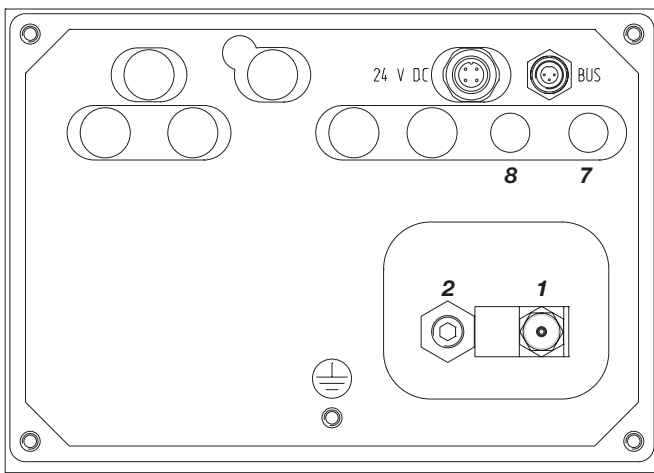
Magnos27 (Sample Cell Direct Connection, only in Wall-Mount Housing)



- 1 Purge Gas Inlet Housing ¹⁾
- 2 Purge Gas Outlet Housing ¹⁾ (also with Flow Sensor)
- 4 Sample Gas Inlet
- 5 Purge Gas Inlet Analyzer
- 6 Purge Gas Outlet Analyzer
- 7 Sample Gas Outlet
- 8 -
- 9 Pressure Sensor 1 ¹⁾
- 10 Pressure Sensor 2 ¹⁾

1) Option

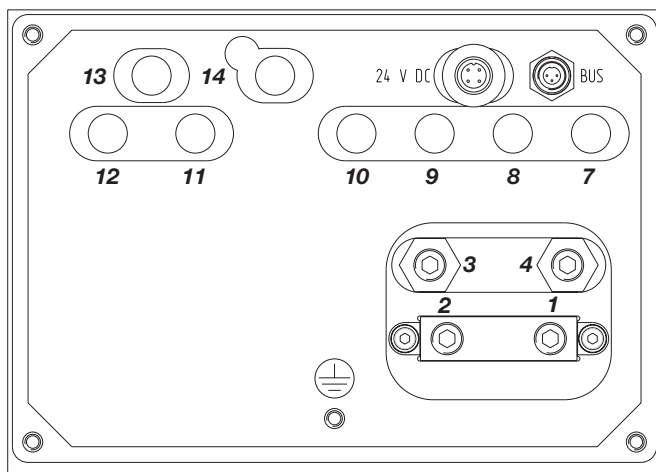
Z023



- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 7 Purge Gas Inlet Housing (only for IP54 Version)
- 8 Purge Gas Outlet Housing (only for IP54 Version)

Gas Connections Caldos25, Caldos27, MultiFID14

Caldos25, Caldos27



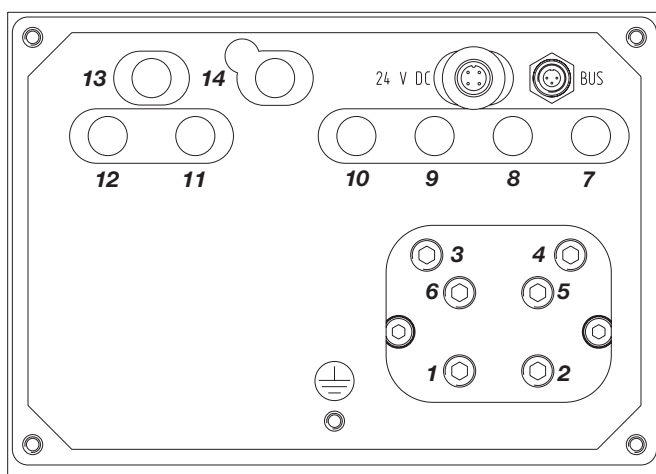
- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Analyzer
- 4 Purge Gas Outlet Analyzer
- 7 Purge Gas Inlet Housing ¹⁾
- 8 Purge Gas Outlet Housing ¹⁾ (also with Flow Sensor)
- 9 Pressure Sensor 1 ¹⁾
- 10 Pressure Sensor 2 ¹⁾

Pneumatics Module ¹⁾:

- 11 Sample Gas Inlet
- 12 End Point Gas Inlet (with 3 solenoids)
- 13 Test Gas/Zero-Point Gas Inlet (with 1 or 3 solenoids)
- 14 Sample Gas Outlet – Connect with Inlet 1

1) Option

Caldos25 (Corrosive Sample Gas or Flowing Reference Gas)



- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Analyzer
- 4 Purge Gas Outlet Analyzer
- 5 Reference Gas Inlet ²⁾
- 6 Reference Gas Outlet ²⁾
- 7 Purge Gas Inlet Housing ¹⁾
- 8 Purge Gas Outlet Housing ¹⁾ (also with Flow Sensor)
- 9 Pressure Sensor 1 ¹⁾
- 10 Pressure Sensor 2 ¹⁾

Pneumatics Module ¹⁾²⁾:

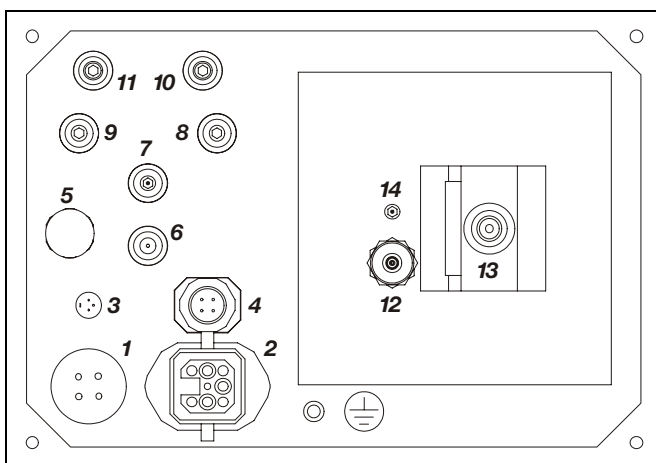
- 11 Sample Gas Inlet
- 12 End Point Gas Inlet (with 3 solenoids)
- 13 Test Gas/Zero-Point Gas Inlet (with 1 or 3 solenoids)
- 14 Sample Gas Outlet – Connect with Inlet 1

1) Option

2) Not in version for corrosive sample gas

Caution! Gas ports 1 to 6 are made of PVC-C.
Do not use metal adapters!

MultiFID14, MultiFID14 NMHC



- 1 115 or 230 VAC Power Supply for Detector and Heated Sample Gas Connection
- 2 Electrical Connection to Heated Sample Gas Connection
- 3 System Bus
- 4 24 VDC Power Supply
- 5 Pressure Compensation Opening with Protection Filter
- 6 Instrument Air Inlet
- 7 Test Gas Outlet
- 8 End-Point Gas Inlet
- 9 Zero-Point Gas Inlet
- 10 Combustion Gas Inlet
- 11 Combustion Air Inlet
- 12 Exhaust Outlet
- 13 Sample Gas Inlet
- 14 Bypass Nozzle

Note: In the MultiFID14 NMHC, the connection arrangement differs slightly from this drawing.

Explosion Protected Model in Category 3G

Version for Measurement of Flammable and Non-flammable Gases (“Safety Concept”)

The “Safety Concept” gas analyzers include:



- Limas11 and Uras26 in the version with safety cell and purged sample cell windows
- Caldos25, Caldos27 and Magnos206 in the version with direct sample cell connection and purged thermostat housing.

Monitoring of the purge gas flow rate is a feature of the “Safety Concept”. It is fully integrated into the gas analyzer, together with the controls and signal processing.

The version complies with the Directive 94/9/EC (ATEX Directive). There are the following explosion protection measures in the gas analyzer:

- Non-arcing assemblies and components/Non-hot components/Sealed (arcing) devices per EN 50021 (for Limas11) or EN 60079-15 and
- Simplified positive pressure containment per IEC 60079-2.

Designation

-  II 3G Ex nA py II T4
-  II 3G EEx nAP T4/T6 for Limas11

Compliance Certification

- BVS 07 ATEX E 013 X
- BVS 03 E 267 X for Limas11

Housing Protection Type

IP54

Sample Gas Inlet Conditions

Sample Gas

Flammable and non-flammable gases and vapors

- under atmospheric conditions ($p_{abs} \leq 1.1$ bar, oxygen content ≤ 21 Vol.-%),
- Temperature Class T4, for Limas11: T6,
- not potentially explosive under normal conditions,
- if potentially explosive in the event of a fault, then only seldom and briefly (in accordance with Zone 2),
- (only for Limas11:) occasionally potentially explosive under normal conditions (in accordance with Zone 1), Temperature Class T4.

If the sample gas is a mixture only of oxygen and flammable gases and vapors, it must not be explosive under any conditions. As a rule this can be achieved by limiting the oxygen content to a maximum of 2 Vol.-%.

Flammable gases and vapors that are explosive under the conditions encountered in analysis even when oxygen is excluded should be present in the mixture only in concentrations that are not critical to safety.

Pressure

At sample gas inlet: positive pressure $p_e \leq 3$ hPa,
at sample gas outlet: atmospheric

Flow Rate

Max. 40 l/h

Inert Gas Curtain/Purge Gas/ (Simplified) Pressurized Enclosure

Purge Gas

Inert gas (N₂)

Pressure

Positive operating pressure $p_e \geq$ sample gas pressure + 0.5 hPa

Flow Rate

During operation: 15 to 20 l/h, during initial purge: 15 to 50 l/h

Initial Purge

Manually controlled, initial purge duration:

Limas11, Uras26: 1.6 minutes at min. 15 l/h

Caldos25, Caldos27, Magnos206: 18 minutes at min. 15 l/h or 6 minutes at min. 50 l/h

Alarm

When flow rate drops below a minimum value of 15 l/h

(corresponds to approx. 7 hPa) and when flow rate exceeds a maximum value of 50 l/h (corresponds to approx. 60 hPa)

Version for Measurement of Non-flammable Gases


The analyzer modules are suitable for measuring non-flammable gases. The analyzer modules are mounted in the central unit housing or in a separate housing (either wall-mount or 19-inch rack unit).

The version complies with the Directive 94/9/EC (ATEX Directive). There are the following explosion protection measures in the gas analyzer:

- Non-arcing assemblies and components/Non-hot components/Sealed (arcing) devices per EN 50021/EN 60079-15

In undisturbed operation there cannot be any sparking, arcing or impermissible temperatures inside the device. During operation, all unused gas ports should be plugged.

Designation

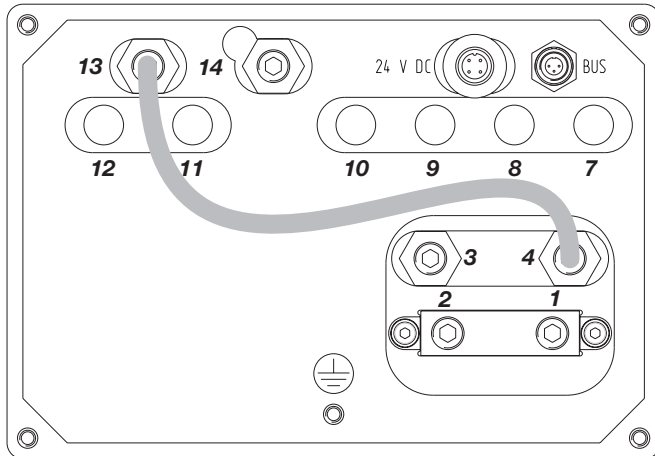
 II 3G EEx nAC IIC T4 X

Housing Protection Type

IP54

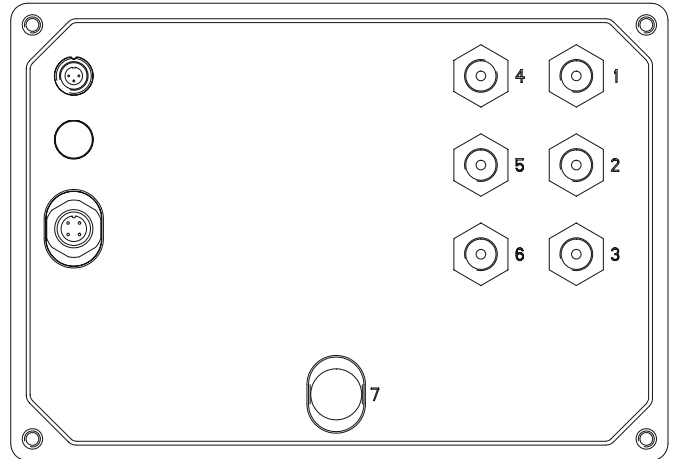
Explosion Protected Model in Category 3G

Gas Connections Caldos25, Caldos27 „Safety Concept“



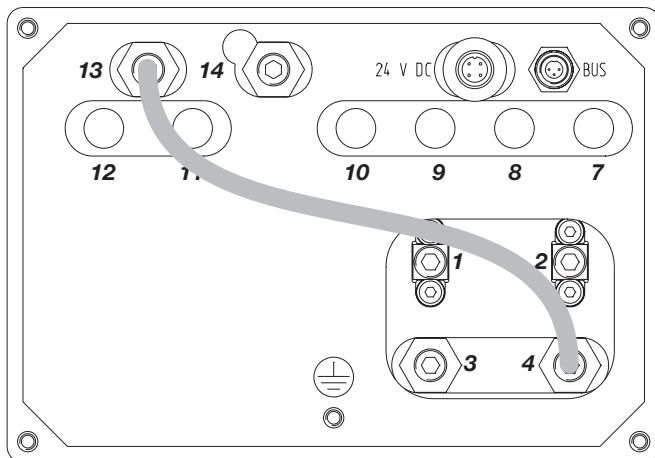
- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Thermostat Chamber „Analyzer Purge In“
- 4 Purge Gas Outlet Thermostat Chamber (rigid tubed with 13)
- 7 Purge Gas Inlet Housing
- 8 Purge Gas Outlet Housing
- 9 Pressure Sensor 1
- 10 Pressure Sensor 2
- 11 not used, sealed
- 12 not used, sealed
- 13 Purge Gas Inlet Flow Rate Monitor (rigid tubed with 4)
- 14 Purge Gas Outlet Flow Rate Monitor „Analyzer Purge Out“

Gas Connections Limas11 „Safety Concept“



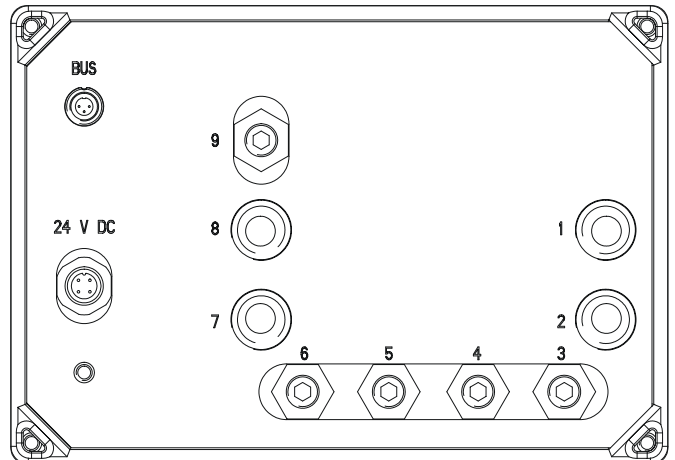
- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Housing
- 4 Purge Gas Inlet Sample Cell Windows „Analyzer Purge In“
- 5 Purge Gas Outlet Flow Rate Monitor „Analyzer Purge Out“
- 6 Purge Gas Outlet Housing
- 7 Pressure Sensor (Option)

Gas Connections Magnos206 „Safety Concept“



- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 Purge Gas Inlet Thermostat Chamber „Analyzer Purge In“
- 4 Purge Gas Outlet Thermostat Chamber (rigid tubed with 13)
- 7 Purge Gas Inlet Housing
- 8 Purge Gas Outlet Housing
- 9 Pressure Sensor 1
- 10 Pressure Sensor 2
- 11 not used, sealed
- 12 not used, sealed
- 13 Purge Gas Inlet Flow Rate Monitor (rigid tubed with 4)
- 14 Purge Gas Outlet Flow Rate Monitor „Analyzer Purge Out“

Gas Connections Uras26 „Safety Concept“



- 1 Sample Gas Inlet Gas Path 1
- 2 Sample Gas Outlet Gas Path 1
- 3 Purge Gas Inlet Sample Cell Windows „Analyzer Purge In“
- 4 Purge Gas Inlet Housing
- 5 Purge Gas Outlet Housing
- 6 Purge Gas Outlet Flow Rate Monitor „Analyzer Purge Out“
- 7 Sample Gas Outlet Gas Path 2
- 8 Sample Gas Inlet Gas Path 2
- 9 Pressure Sensor (Option)

Electronics Module

Processing of Measured Values and Signals

Processor system with buffered real-time clock and non-volatile memory for firmware and device data.

Software updates can be obtained via the Ethernet interface.

I/O Modules and I/O Boards

5 slots for I/O modules, 3 slots for I/O boards

See pages 41 to 43 for technical data of the I/O modules and I/O boards

Interfaces

Ethernet

To connect the gas analyzer to Ethernet networks

TCP/IP protocol via 10/100BASE-T interface

Optional: board with 2nd 10/100BASE-T interface for redundant networks

Electrical connections: 8-pin RJ45 plug

System Bus

Internal bus for communication between the gas analyzer's functional units

Electrical connections: 3-pin female plug

Power Supply

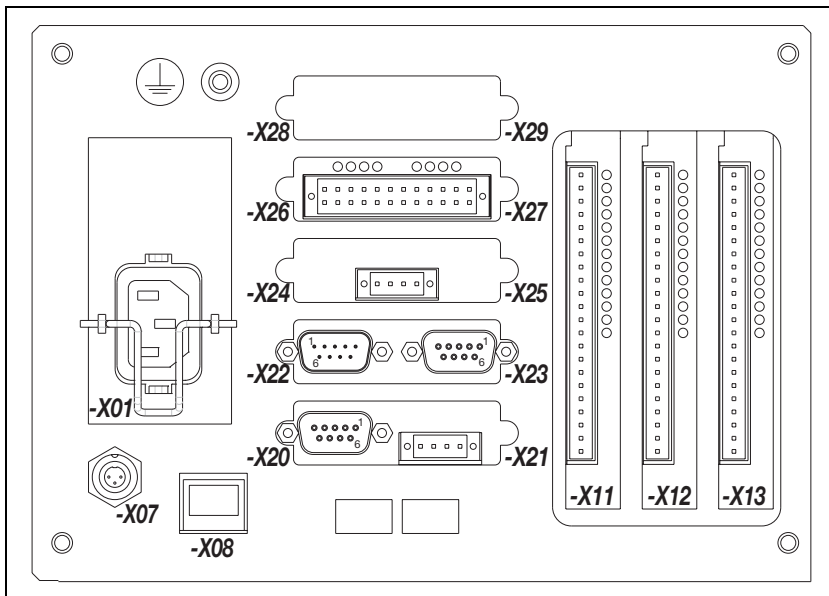
Input Voltage

24 VDC \pm 5 % from the built-in power supply (see page 44)

Power Consumption

approx. 15 W without I/O modules and I/O boards

Connection Drawing



Notes Regarding Conductor Section for 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.

- X01** Power Supply
 - X07** System Bus Connection
 - X08** Ethernet 10/100BASE-T Interface
 - X11** I/O Boards (3 slots), Options:
 - to
 - Analog I/O Board
 - X13**
 - Digital I/O Board
 - 8-Way Analog Output Board
 - Ethernet 10/100BASE-T Board
 - X20** I/O Modules (5 slots), Options:
 - to
 - Profibus Module
 - X29**
 - Modbus Module
 - Analog Output Module
 - Digital I/O Module
- Note:** The connection drawing shows an example for the I/O boards and I/O modules equipment.

I/O Modules and I/O Boards

Profibus Module

Application

Integration of AO2000 into Profibus networks for transfer of measured values and status signals as well as analog inputs, digital inputs and digital outputs

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

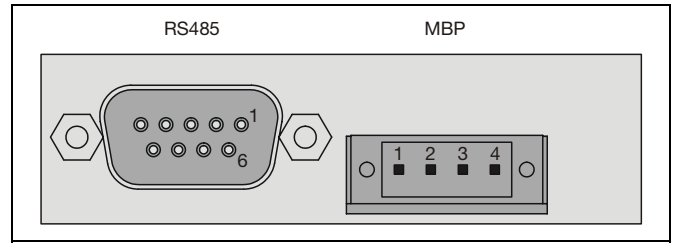
Design: 9-pin Sub-D female connector

MBP Interface (non-intrinsically safe):

- 1 +
- 3 -
- 4 GND

Design: 4-pin terminal strip for braided or solid conductors with a maximum section of 1 mm² (17 AWG). Observe the information regarding conductor section (see page 40).

Connection Diagram



Modbus Module

Application

Transfers measured values and status signals as well as analog inputs, digital inputs and digital outputs to host systems, e.g. to standard Windows applications via M-DDE Server; Modbus slave protocol in RTU (remote terminal unit) mode or via RS485 or RS232 interface (configurable).

Electrical Connections

RS232 Interface:

- 2 RxD
- 3 TxD
- 5 GND

RS485 Interface:

- 2 RTxD-
- 3 RTxD+
- 5 GND

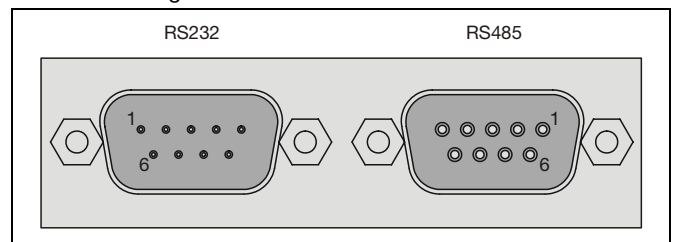
Design:

9-pin Sub-D male connector

Design:

9-pin Sub-D female connector

Connection Diagram



Analog Output Module

2 Analog Outputs (AO1, AO2)

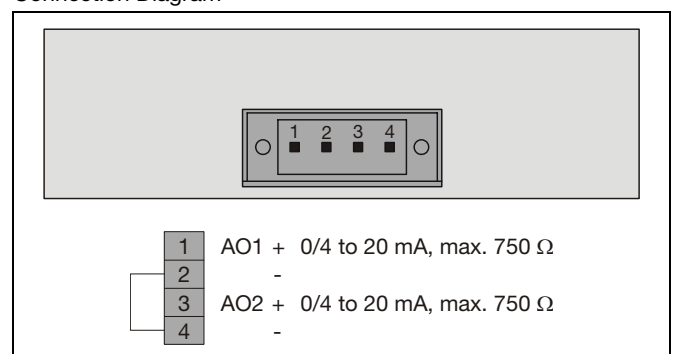
0/4–20 mA (configurable, factory-set to 4–20 mA), common negative pole, galvanically isolated from ground, freely connectable to ground, max. gain relative to protective ground potential 50 V, max. working resistance 750 Ω. Resolution 16 bit. The output signal cannot be lower than 0 mA.

Electrical Connections

4-pin terminal strip for braided or solid conductors with a maximum section of 1 mm² (17 AWG). Observe the information regarding conductor section (see page 40).

The pin layout in a delivered analyzer unit or multiple analyzer system will be shown in the applicable "Analyzer Data Sheet".

Connection Diagram



I/O Modules and I/O Boards

Analog I/O Board

2 Digital Outputs (DO1, DO2)

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

2 Digital Inputs (DI1, DI2)

Optocouplers with internal 24 VDC power supply, switchable with floating contacts; alternative: switchable with external voltage 12–24 VDC, common negative pole

2 Analog Inputs (AI1, AO2)

–20 to +20 mA into 50 Ω or –10 to +10 V, input resistance $R_{in} = 1\text{ M}\Omega$, mutually isolated to 10 V

2 Analog Outputs (AO1, AO2)

0/4–20 mA (configurable, factory-set to 4–20 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.

Standard Function Block Applications

Analog 1:		Analog 2:	
DO1	Limit Value	DO1	Limit Value
DO2	Limit Value	DO2	Limit Value
DI1	Calibration Cells In/Out	DI1	Pump On/Off
DI2	Hold Current Output	DI2	External Failure
AI1	External Measured Value	AI1	External Meas. Value
AI2	External Measured Value	AI2	External Meas. Value
AO1	Measured Value	AO1	Measured Value
AO2	Measured Value	AO2	Measured Value

Electrical Connections

22-pin terminal strip for braided or solid conductors with a maximum section of 1.5 mm² (16 AWG)

8-Way Analog Output Board

8 Analog Outputs (AO1 to AO8)

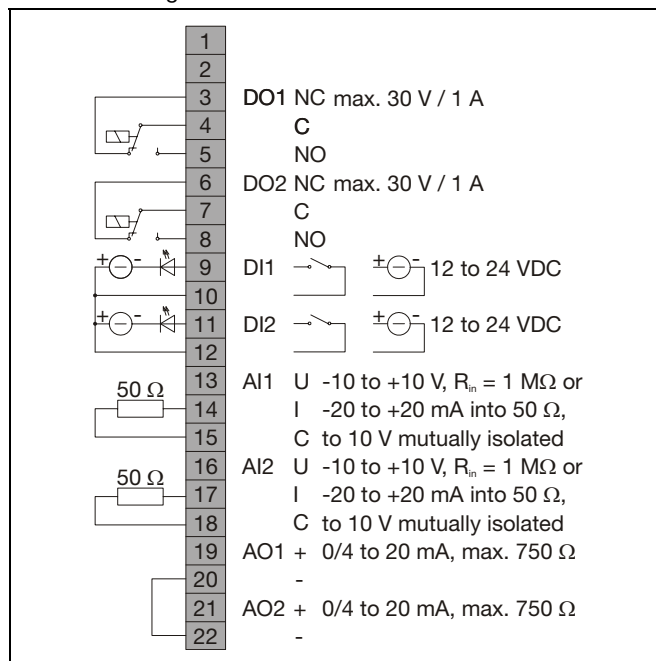
0/4–20 mA (configurable, factory-set to 4–20 mA), 2 groups of 4 analog outputs each with a common negative pole, galvanically isolated from ground, freely connectable to ground, max. gain relative to protective ground potential 50 V, max. working resistance 750 Ω. Resolution 16 bit. The output signal cannot be lower than 0 mA.

Electrical Connections

22-pin terminal strip for braided or solid conductors with a maximum section of 1.5 mm² (16 AWG)

The pin layout in a delivered analyzer unit or multiple analyzer system will be shown in the applicable “Analyzer Data Sheet”.

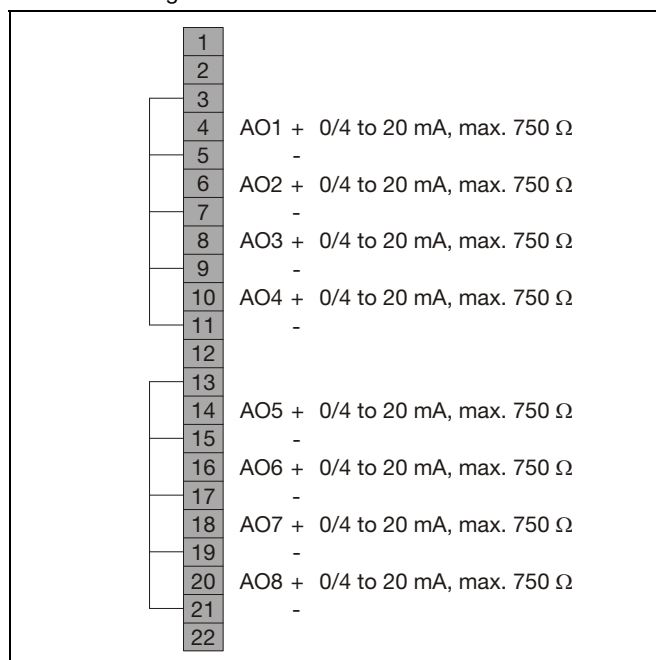
Connection Diagram



The pin layout in a delivered analyzer unit or multiple analyzer system will be shown in the applicable “Analyzer Data Sheet”.

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

Connection Diagram



I/O Modules and I/O Boards

Digital I/O Module and Digital I/O Board

4 Digital Inputs (DI1 to DI4)

Optocouplers with internal 24 VDC power supply. Control with floating contacts, with external voltage 12–24 VDC or (for Digital I/O Module only) with open collector drivers PNP or NPN.

4 Digital Outputs (DO1 to DO4)

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

Standard Function Block Applications

Status Signals/Externally Controlled Calibration:

- DO1 Failure/Collective Status
- DO2 Maintenance Mode/Limit Value
- DO3 Maintenance Request/Limit Value
- DO4 External Solenoid Valve
- DI1 Start Automatic Calibration
- DI2 Inhibit Automatic Calibration
- DI3 Adjust Zero-Point
- DI4 Adjust End-Point

Measurement Range Control:

- DO1 Measurement Range Feedback
- DO2 Measurement Range Feedback
- DO3 Measurement Range Feedback
- DO4 Measurement Range Feedback
- DI1 Measurement Range Switchover
- DI2 Measurement Range Switchover
- DI3 Measurement Range Switchover
- DI4 Measurement Range Switchover

Limit Values:

- DO1 Limit Value
- DO2 Limit Value
- DO3 Limit Value
- DO4 Limit Value
- DI1 Calibration Cells In/Out
- DI2 Hold Current Output
- DI3 Pump On/Off
- DI4 External Failure

Calibration Control:

- DO1 External Solenoid Valve Sample Gas
- DO2 External Solenoid Valve Zero Gas
- DO3 External Solenoid Valve Span Gas
- DO4 External Pump On/Off
- DI1 Pump On/Off
- DI2 External Failure
- DI3 External Failure
- DI4 External Failure

Electrical Connections

Digital I/O Module:

2x12-pin terminal strip for braided or solid conductors with a maximum section of 1 mm² (17 AWG). Observe the information regarding conductor section (see page 40).

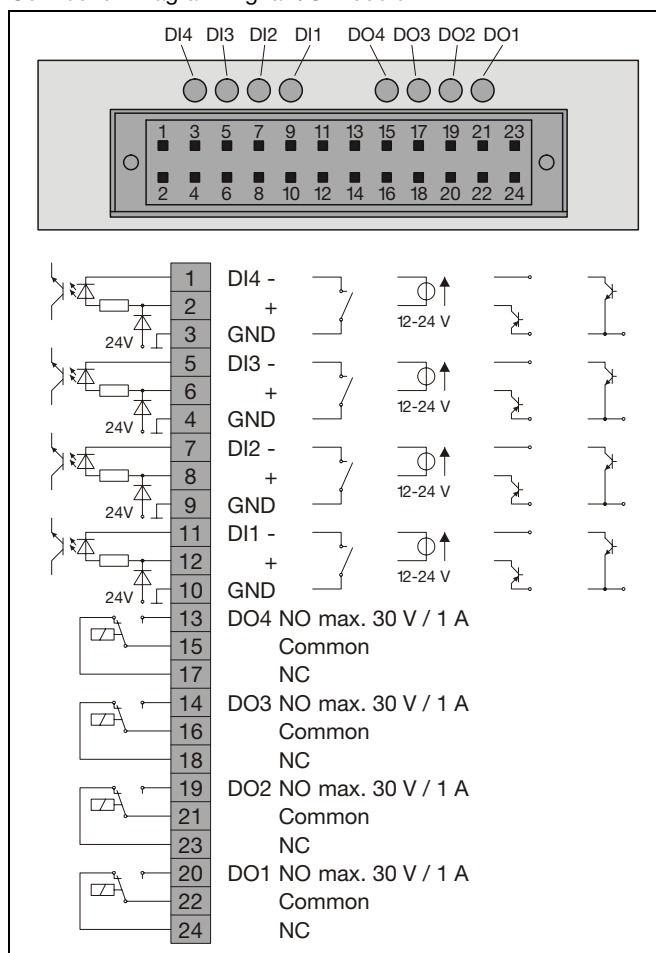
Digital I/O Board:

22-pin terminal strip for braided or solid conductors with a maximum section of 1.5 mm² (16 AWG)

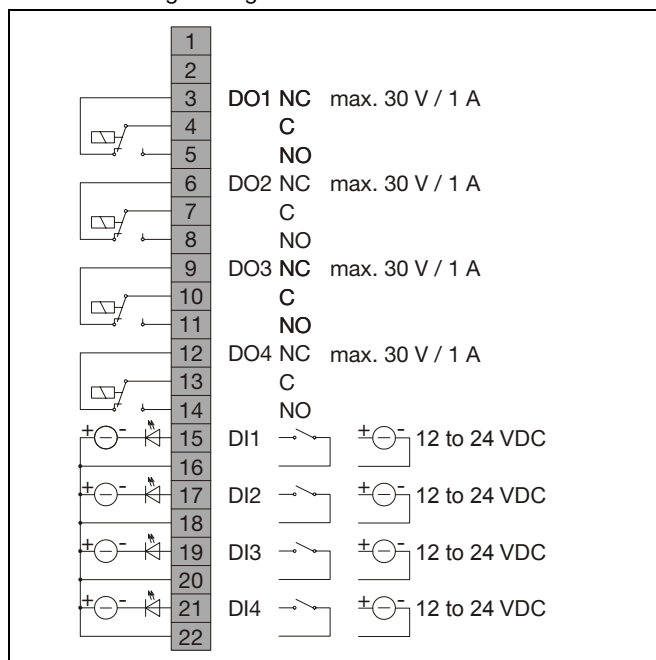
The pin layout in a delivered analyzer unit or multiple analyzer system will be shown in the applicable "Analyzer Data Sheet".

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

Connection Diagram Digital I/O Module



Connection Diagram Digital I/O Board



Power Supply and Housing

Power Supply

	Standard Power Supply Unit	Power Supply Unit for Limas11, MultiFID14
Input Voltage	100–240 V AC, –15 %, +10 %, max. 2.2 A, 50–60 Hz ± 3 Hz	85–115–140 V AC, max. 2.5 A or 185–230–250 V AC, max. 1.25 A; 47–63 Hz
Power Consumption	max. 187 W	max. 175 W
Power Line Protection	–	G fuse element per EN 60127-2, 4 A rating, slow-blow
Output Voltage	24 V DC ± 5 % to supply the electronics module and one analyzer module installed in the central unit or (optionally) one external analyzer module	
Connection	3-pin plug per EN 60320/C14 (Connecting cable supplied)	

Housing

Versions

- 19-inch housing (Model AO2020) or Wall-mount housing (Model AO2040)

Housing Protection Type

- IP65 without power supply and without display/control unit
- IP54 with display/control unit and connection box
- IP20 without connection box per EN 60529

Housing Purge

- Possible with IP-54 version with connection box
- Purge version can be fitted with screwed cable glands (per EN) or with conduit connections (per CSA)
- Purge gas flow during operation max. 20 l/h (MultiFID14: approx. 300 l/h), purge gas pressure $p_e = 2\text{--}4$ hPa

Dimensions

- See dimensional drawings on page 45

Weight

- Analyzer unit with one analyzer module: 18–23 kg

Housing Materials

- Housing: stainless steel 1.4016, module rear panel: aluminum, keypad sheet: Polyester

Housing Color

- Light gray (RAL 7035), basalt gray (RAL 7012)

Display/Control Unit

Display

- Backlit graphics display, 320 x 240-pixel resolution

Measured Value Display

- Digits with unit and bar graph; simultaneous display of up to 6 measured values, configurable

Units of Measure

- Selectable in physical units, e.g. ppm, Vol.-%, mg/m³ or g/m³, as well as in % of span or mA

Digital Value Resolution

- Better than 0.2 % of span

Status Indication

- Green LED: Power supply on
- Yellow LED: Maintenance request
- Red LED: Failure

Status Messages

- Plain text

Operation

- Panel with six softkeys, two cancel keys and 10-digit keypad; menu-driven interface

Electrical Safety

Tested per EN 61010-1:2001

Protection Class

- Central unit with electronics module (power supply): I
- Analyzer module without electronics module (power supply): III

Overload Category/Pollution Level

- Electronics module power supply: III/2
- Analyzer module power supply: II/2
- Signal inputs and outputs: II/2

Safe Isolation

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

Electromagnetic Compatibility

Noise Immunity

- Tested to EN 61326:1997 + A1:1998 + A2:2001 + A3:2003.
- Inspection severity: Industrial area, fulfills at least the rating “continuously monitored operation” to Table 2 of EN 61326.

Emitted Interference

- Tested to EN 61326:1997 + A1:1998 + A2:2001 + A3:2003, EN 61000-3-2:2000 and EN 61000-3-3:1995 + A1:2001.
- Limit value class B for interference field strength and interference voltage is met.

Mechanical Stress

- In its original packaging, the gas analyzer will withstand normal shipping conditions, e.g. as found in rail transport.

Installation Site Requirements

- The gas analyzer is intended for indoor installation only.

Vibration

- Analyzer unit only: See individual analyzer module data
- Analyzer unit installed in cabinet (analyzer system): Max. acceleration 0.01 ms⁻² in a frequency range of 0.1–200 Hz.
- Compliance with the metrological data can only be assured if data on vibration amplitude and frequency range at the installation site are available and suitable means are employed to decouple the analyzer.

Ambient Temperature

- Operation: +5 to +50 °C (additionally, see the data for individual analyzer modules); Storage and transport: –25 to +65 °C

Relative Humidity: < 75 %

Climate Class

- 3K3 for IP20 housing (non-condensing),
- 3K4 for IP54 housing (condensing) per EN 60721-3-3

Installation Location Altitude

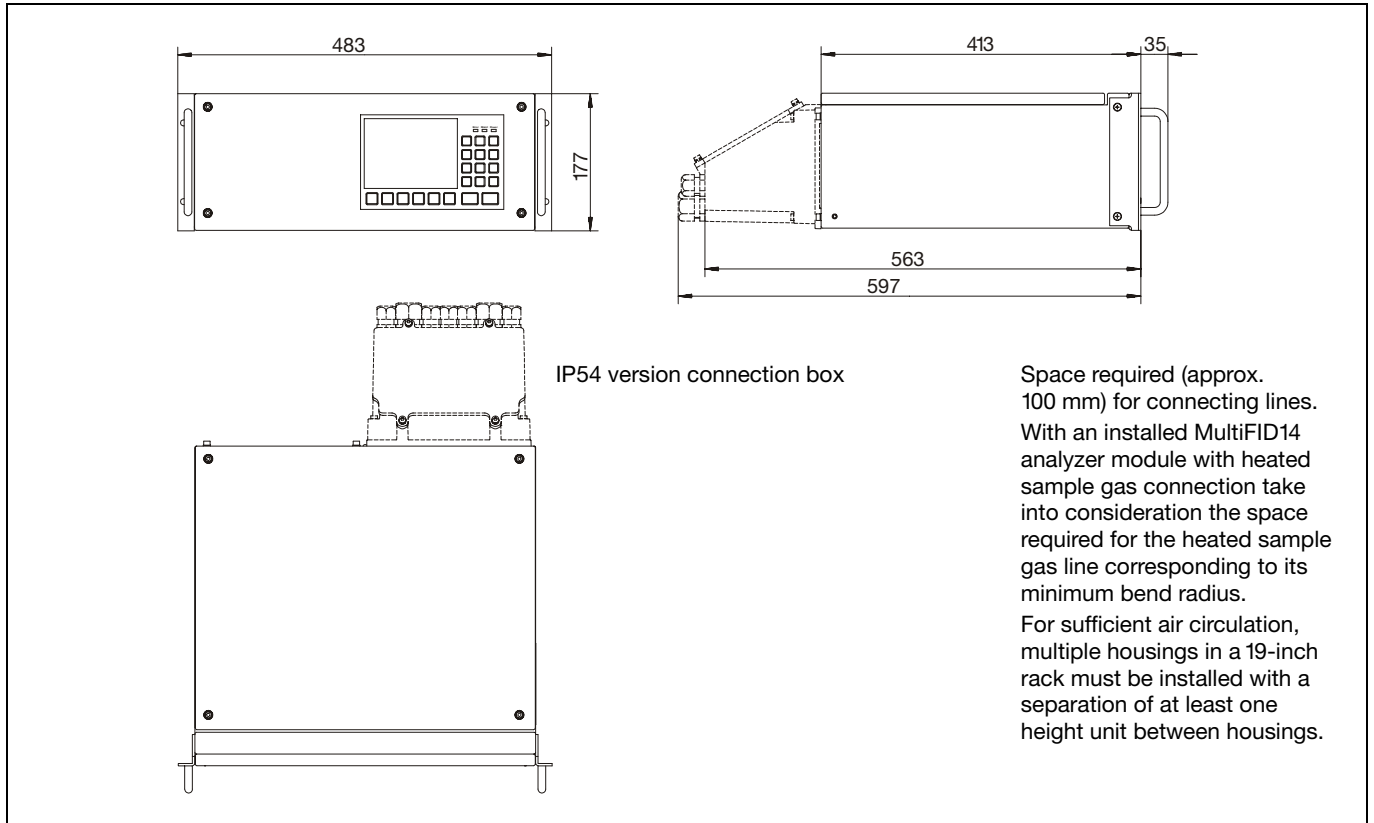
- Max. 2000 m above sea level (over 2000 m on request)

Mounting

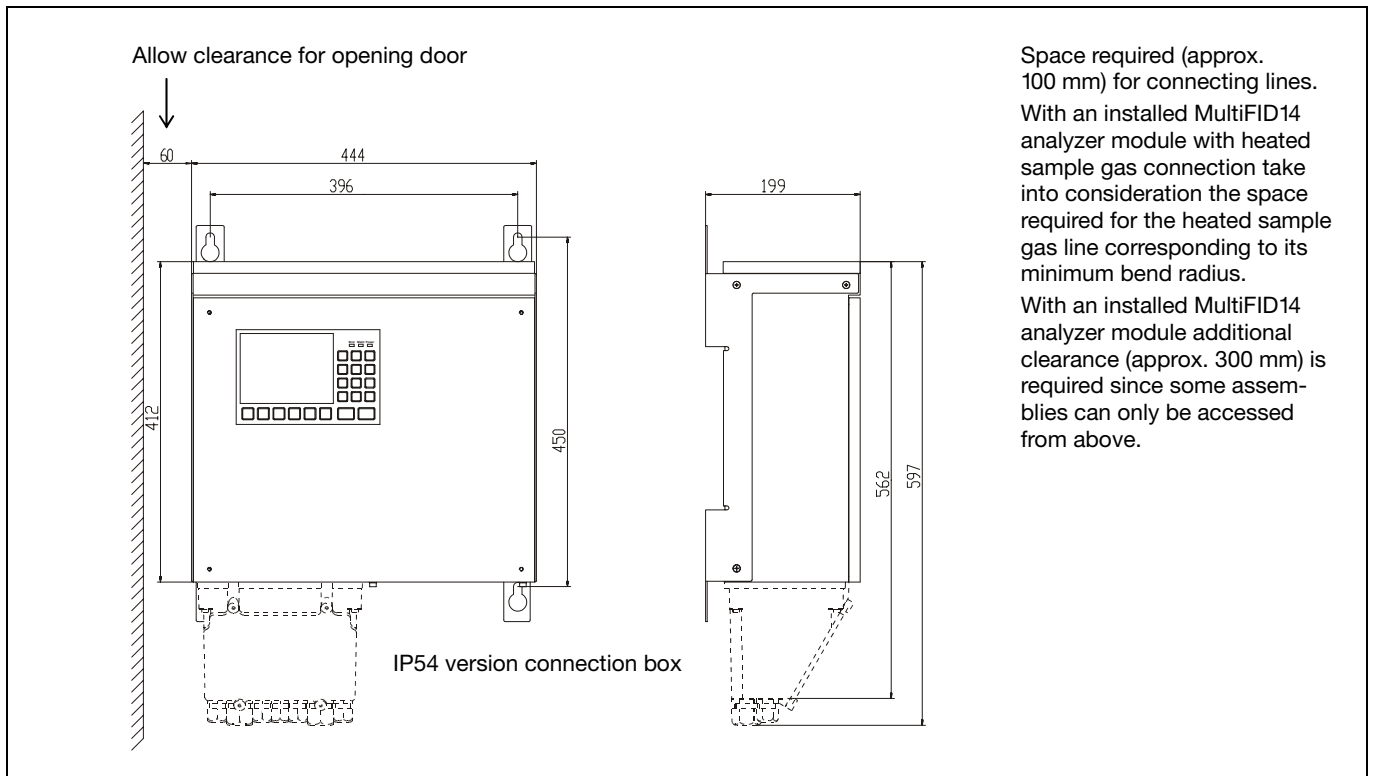
- For sufficient air circulation, multiple housings in a 19-inch rack must be installed with a separation of at least one height unit between housings.

Dimensional Drawings

19-Inch Rack Housing (Model AO2020) (dimensions in mm)



Wall-Mount Housing (Model AO2040) (dimensions in mm)



Certifications

CE Declaration of Conformity

The gas analyzers satisfy the provisions of the following European directives:

73/23/EC (Low Voltage Directive)
89/336/EC (EMC Directive)
94/9/EC (ATEX Directive, explosion protected versions only)

Compliance with the provisions of directive 73/23/EC is evidenced by full compliance with European standard:
EN 61010-1:2001.

Compliance with the provisions of directive 89/336/EC is evidenced by full compliance with European standards:
EN 61326:1997 + A1:1998 + A2:2001 + A3:2003,
EN 61000-3-2:2000 und EN 61000-3-3:1995 + A1:2001

Compliance of the explosion protected version with the provisions of directive 94/9/EC is evidenced by full compliance with the European standards listed in the "Explosion Protection to European Standards" section (see below).

Approval for USA and Canada – CSA

AO2000 with housing, electronics module, pneumatics module and Uras26, Limas11IR, Limas11UV, Limas11HW, Magnos206, Magnos27, Caldos25, Caldos27 and LS25 analyzer modules is certified to

Class 2258 02 Process Control Equipment and
Class 2258 82 Process Control Equipment – Certified to U.S. Standards

AO2000 with housing, electronics module, pneumatics module and ZO23, MultiFID14 and MultiFID14 NMHC analyzer modules is certified to

Class 2252 01 Process Control Equipment and
Class 2252 81 Process Control Equipment – Certified to U.S. Standards


Certificate No. 1105720 (LR 95368)

Explosion Protection

Explosion Protection to European Standards



The LS25 analyzer module in Category 2GD satisfies the following European standards:

EN 50014:1997 + A1 – A2	General requirements
EN 50016:2002	Pressurized apparatus "p"
EN 50281-1-1:1998	Electrical apparatus for use in the presence of combustible dust


The designation is  II 2GD T64°C EEx p II T5 T_{amb}: 55°C
EC-Type Examination Certificate No. Nemko 04 ATEX 1436 X

AO2000 in Category 3G (flammable and non-flammable sample gas) satisfies the following European standards:

EN 50021:1999/EN 60079-15:2005 Ignition prevention type "n"
IEC 60079-2 Pressurized apparatus "p"

The designation is  II 3G Ex nA py II T4
EC-Type Examination Certificate No. BVS 07 ATEX E 013 X
for Limas11: The designation is  II 3G EEx nAP T4/T6
EC-Type Examination Certificate No. BVS 03 E 267 X

AO2000 in Category 3G (non-flammable sample gas) satisfies the following European standards:

EN 50021:1999/EN 60079-15:2005 Ignition prevention type "n"
The designation is  II 3G EEx nAC IIC T4 X.

Explosion Protection to U.S. and Canadian Standards

AO2000 with housing, electronics module, pneumatics module and Uras26, Limas11IR, Limas11UV, Limas11HW, Magnos206, Magnos27, Caldos25, Caldos27 und LS25 analyzer modules is certified to

Class 2258 02 Process Control Equipment – For Hazardous Locations and

Class 2258 82 Process Control Equipment – For Hazardous Locations – Certified to U.S. Standards

for use in Class 1, Div. 2, Groups A, B, C, and D, Temperature Code T4, max. ambient temperature +50 °C (+55 °C for LS25) explosion hazard areas.

Housing versions not equipped with conduit entries must be installed in a suitable enclosure, cabinet or rack with provision for connection of Division 2 wiring methods, acceptable to the local inspection authority having jurisdiction.

Certificate No. 1105720 (LR 95368)

Sample Components and Analyzer Modules

The following table lists the sample components that can be measured with the AO2000 Series gas analyzers (other sample components available on request).

In each case, the smallest measurement range and the appropriate analyzer module are given. Please see the specifications of the individual analyzer modules.

Sample Component	Requirements (Examples)	Smallest Meas. Range	Analyzer Module	Data	
Acetylene	C ₂ H ₂	Small meas. ranges, selective measurement	0–100 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–1250 ppm	Limas11 IR	Page 8
Ammonia	NH ₃	Process measurement	0–30 ppm	Uras26	Page 6
		Combustion exhaust gas	0–100 ppm	Limas11 HW	Page 11
Argon	Ar in N ₂	Especially short T ₉₀ time	97.5–100 Vol.-%	Caldos27	Page 22
	Ar in O ₂	Especially short T ₉₀ time	0–2 Vol.-%	Caldos27	Page 22
Butane	C ₄ H ₁₀	Small meas. ranges, selective measurement	0–50 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–250 ppm	Limas11 IR	Page 8
Chlorine	Cl ₂	Corrosive gases	0–100 ppm	Limas11 UV	Page 8
Nitrous Oxide	N ₂ O	Small measurement ranges	0–20 ppm	Uras26	Page 6
Ethane	C ₂ H ₆	Small meas. ranges, selective measurement	0–50 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–250 ppm	Limas11 IR	Page 8
Ethylene	C ₂ H ₄	Small meas. ranges, selective measurement	0–300 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–1500 ppm	Limas11 IR	Page 8
Helium	He in N ₂	Especially short T ₉₀ time	97–100 Vol.-%	Caldos27	Page 22
Hexane	C ₆ H ₁₄	Selective measurement	0–100 ppm	Uras26	Page 6
Refrigerant	R 134a	Small measurement ranges	0–50 ppm	Uras26	Page 6
Carbon Dioxide	CO ₂	Small measurement ranges	0–5 ppm	Uras26	Page 6
		Corrosive/toxic/flammable gases	0–150 ppm	Limas11 IR	Page 8
	CO ₂ in N ₂ or air	Especially short T ₉₀ time	0–3 Vol.-%	Caldos27	Page 22
Carbon Disulfide	CS ₂	Toxic/flammable gases	0–50 ppm	Limas11 UV	Page 8
Carbon Monoxide	CO	Small meas. ranges, emission measurement	0–10 ppm	Uras26	Page 6
		Toxic/flammable gases, process measurement	0–500 ppm	Limas11 IR	Page 8
Carbon Oxide Sulfide	COS	Toxic/flammable gases	0–250 ppm	Limas11 UV	Page 8
Hydrocarbons	Total	Fast hot measurement	0–5 mg C/m ³	MultiFID14	Page 24
	C _n H _m – CH ₄	Non-methane measurement	0–5 mg C/m ³	MultiFID14 NMHC	Page 26
Methane	CH ₄	Small meas. ranges, selective measurement	0–50 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–1000 ppm	Limas11 IR	Page 8
		CH ₄ in N ₂	Especially short T ₉₀ time	99–100 Vol.-%	Caldos27
	CH ₄ in N ₂ or air	Especially short T ₉₀ time	0–2 Vol.-%	Caldos27	Page 22
Propane	C ₃ H ₈	Small meas. ranges, selective measurement	0–50 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–150 ppm	Limas11 IR	Page 8
Propylene	C ₃ H ₆	Small meas. ranges, selective measurement	0–100 ppm	Uras26	Page 6
		Flammable gases, selective measurement	0–500 ppm	Limas11 IR	Page 8
Hydrochloric Acid	HCl	Corrosive gases	0–2500 ppm	Limas11 IR	Page 8
Oxygen	O ₂	Magnetomechanical measurement principle	0–0.5 Vol.-%	Magnos206	Page 14
		Trace measurement with ZrO ₂ cell	0–1 ppm	ZO23	Page 18
		Electrochemical measurement principle	0–5 Vol.-%	Oxygen sensor	Page 32
	O ₂ in N ₂	Thermomagnetic measurement principle	0–3 Vol.-%	Magnos27	Page 16
	O ₂ in flue gas	Thermomagnetic measurement principle	0–3 Vol.-%	Magnos27	Page 16
Sulfur Dioxide	SO ₂	Emission measurement	0–25 ppm	Uras26	Page 6
		Corrosive gases	0–25 ppm	Limas11 UV	Page 8
		SO ₂ in N ₂ or air	Corrosive gases	0–1.5 Vol.-%	Caldos25
Hydrogen Sulfide	H ₂ S	Exhaust gas, process measurement	0–25 ppm	Limas11 UV	Page 8
Nitrogen Dioxide	NO ₂	Corrosive gases	0–50 ppm	Limas11 UV	Page 8
		Combustion exhaust gas	0–10 ppm	Limas11 HW	Page 11
Nitrogen Monoxide	NO	Emission measurement	0–75 ppm	Uras26	Page 6
		Small measurement ranges	0–10 ppm	Limas11 UV	Page 8
		Combustion exhaust gas	0–10 ppm	Limas11 HW	Page 11
Hydrogen	H ₂ in Ar	Especially short T ₉₀ time	0–0.25 Vol.-%	Caldos27	Page 22
	H ₂ in Cl ₂	Corrosive gases	0–0.5 Vol.-%	Caldos25	Page 20
	H ₂ in stack gas	Especially short T ₉₀ time	0–0.5 Vol.-%	Caldos27	Page 22
	H ₂ in N ₂	Especially short T ₉₀ time	99–100 Vol.-%	Caldos27	Page 22
	H ₂ in N ₂ or air	Corrosive gases	0–0.5 Vol.-%	Caldos25	Page 20
		Especially short T ₉₀ time	0–0.3 Vol.-%	Caldos27	Page 22

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ABB Automation GmbH

Analytical Division

Stierstaedter Strasse 5

60488 Frankfurt am Main

Germany

Phone: +49 69 7930-40

Fax: +49 69 7930-4566

E-Mail: analytical-mkt.deapr@de.abb.com

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