

# Continuous Gas Analyzers

## AO2000 Series

### Data Sheet

10/24-1.10 EN May 2005



- One central unit and various analyzer modules
  - with common controls
  - with a common connection technology
  - in a common system housing
- Different analyzer modules 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 input/output modules and boards
- Optional integrated pneumatics module
- Available for 19-inch rack or wall mounting
- Modular design for ease of service
- Self-monitoring function indicates when maintenance is required



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## Modular Analyzer Product Line

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### Overview

The 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
- Power Supply
- Housing with Display and Control Unit
- System Bus

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

An AO2000 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

This is the smallest possible AO2000 configuration.

An AO2000 Multiple Analyzer System (see example 2 on page 5) usually consists of:

- Four analyzer modules handling up to six sample components
- Three pneumatics modules
- 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”.

# Modular Analyzer Product Line

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## Analyzer Modules

Analyzer modules:

- Uras14 Infrared Analyzer Module
- Limas11 Process Photometer Analyzer Module
- Magnos106 Oxygen Analyzer Module
- Magnos17 Oxygen Analyzer Module
- ZO23 Trace Oxygen Analyzer Module
- Caldos15 Thermal Conductivity Analyzer Module
- Caldos17 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 electrochemical oxygen sensor available as an option is installed in the pneumatics module (see below). The oxygen sensor is always associated with an analyzer module and is controlled and monitored by the latter's sensor electronics components.

## Pneumatics Module

The pneumatics module is used to supply gases to the analyzer system. A fully equipped pneumatics module contains the following elements:

- One gas supply pump
- One or three solenoids to control test gas supply
- One or two disposable elements for fine filtration
- One or two flow monitors

A pneumatics module is always associated with an analyzer module. It is installed in the same housing as the analyzer module and is controlled and monitored by the latter's sensor electronics components.

## 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 AO2000 units (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

## Power Supply

A 115-VAC or 230-VAC power supply is required to power an analyzer unit. The analyzer modules are supplied with 24-VDC from an integral power supply or an external unit.

## Housing

The housing is available as a 19-inch (AO2020) or wall-mount (AO2040) unit with IP 20 or IP 54 protection. Special housing versions are available for use in explosion-risk zones. IP-54 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 AO2000 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 AO2000 analyzer system 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 AO2000 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.

# Configuration of Analyzer Units and Multiple Analyzer Systems

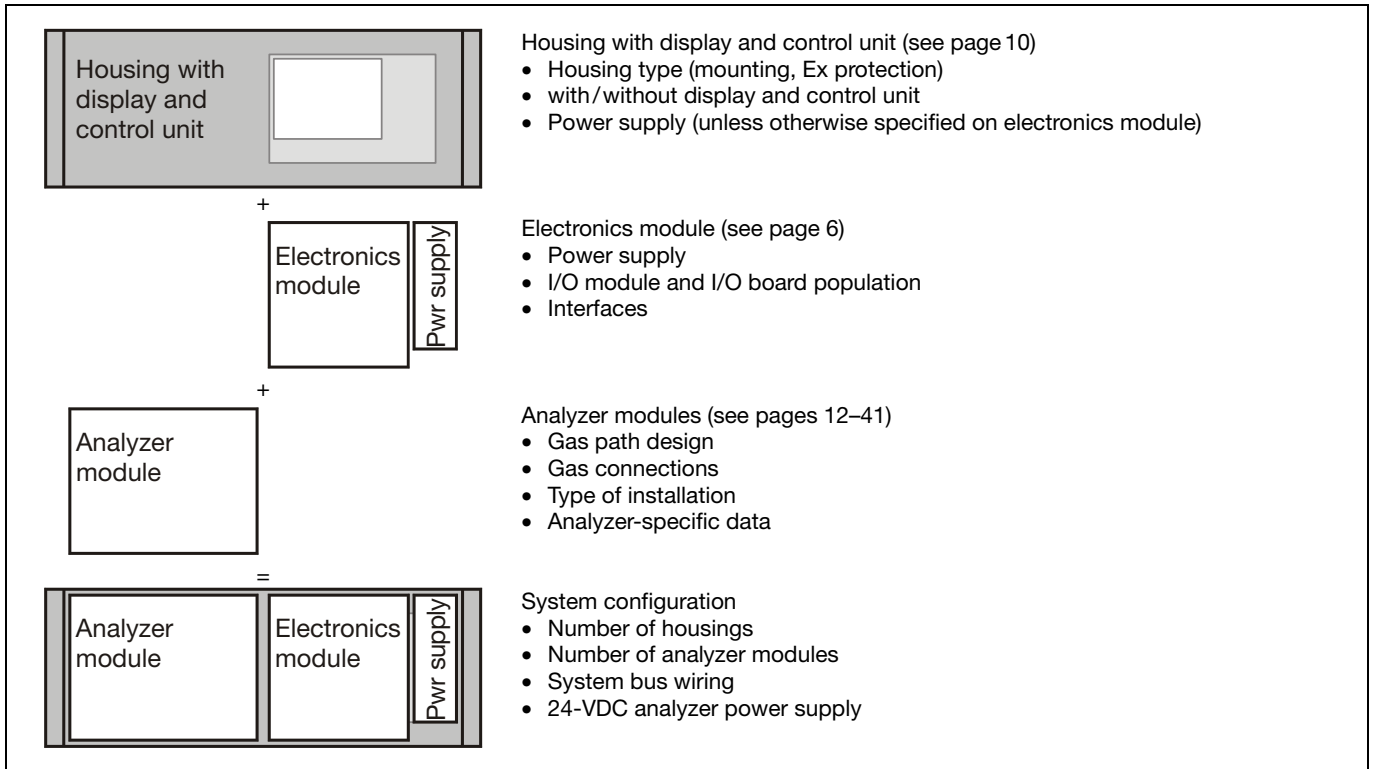
This data sheet contains specifications for all modules and components in the AO2000 modular product line.

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.

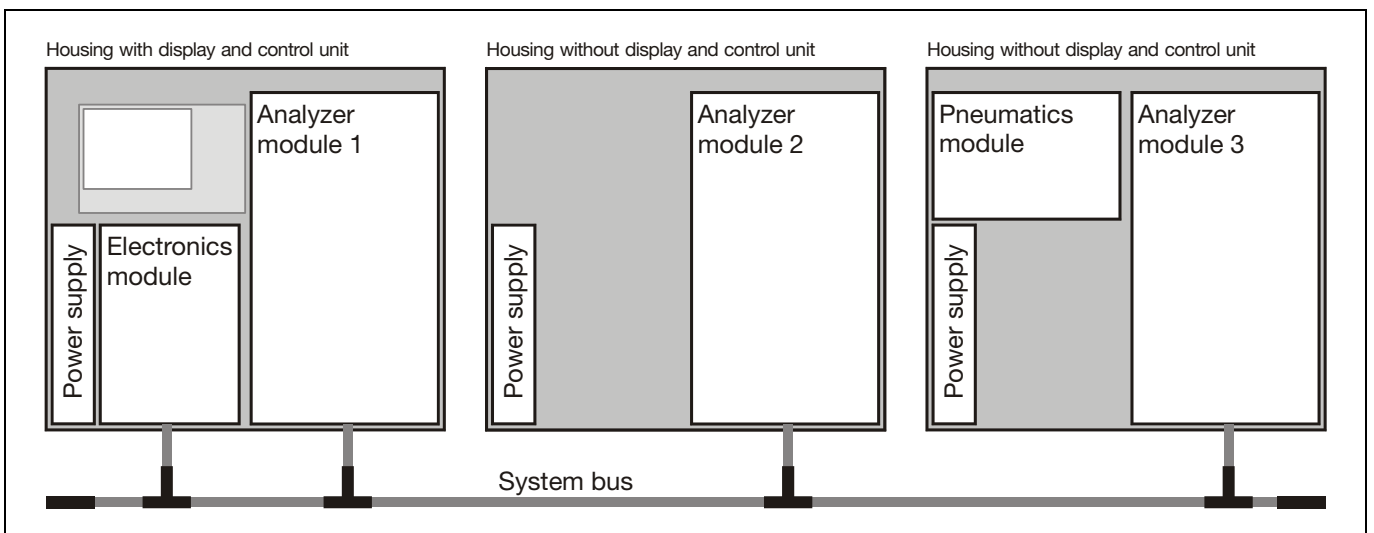
Example 1 shows the modules and components that normally make up an analyzer unit as well as the possibilities for configuring an analyzer unit.

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)



# 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 7 to 9 for technical data of the I/O modules and I/O boards

## Interfaces

### Ethernet

To connect AO2000 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 AO2000 functional  
units  
Electrical connections: 3-pin female plug

## Power Supply

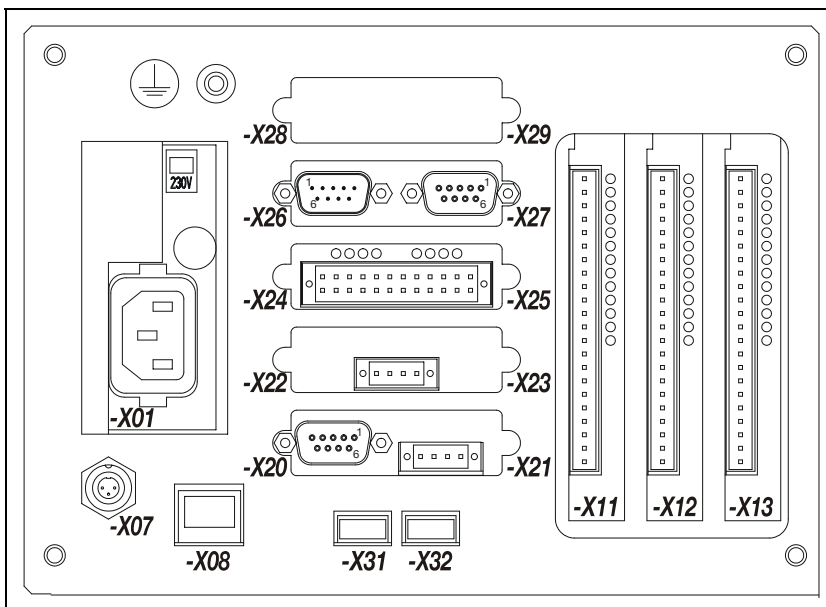
### Input Voltage

24 VDC  $\pm$  5 % from the built-in power supply (see page 10)

### 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 mm<sup>2</sup> (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 mm<sup>2</sup>, i.e. the maximum stranded conductor section is 0.5 mm<sup>2</sup>. The Weidmüller PZ 6/5 crimping tool must be used for crimping the ferrules.

- X01** 115 VAC or 230 VAC Power Supply
- X07** System Bus Connection
- X08** Ethernet-10/100BASE-T Interface
- X11 to -X13** I/O Boards, Options:
  - Analog I/O Board
  - Digital I/O Board
  - 8-Way Analog Output Board
  - Ethernet 10/100BASE-T Board
- X20 to -X29** I/O Modules, Options:
  - Profibus Module
  - RS232/RS485 Module
  - Analog Output Module
  - Digital I/O Module
- X31 to -X32** not used

# 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

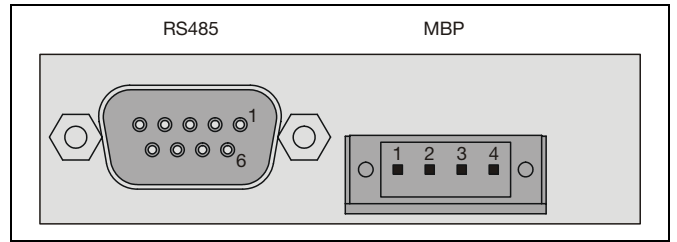
Design: 9-pin Sub-D female connector

#### 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 mm<sup>2</sup> (17 AWG). Observe the information regarding conductor section (see page 6).

### Connection Diagram



## RS232/RS485 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

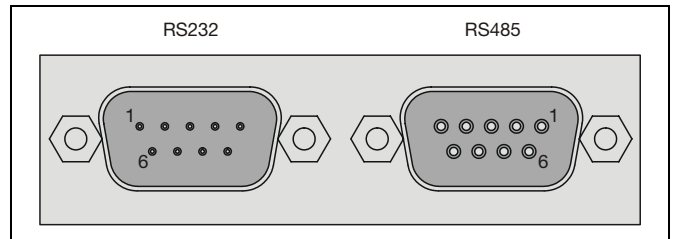
#### Design:

9-pin Sub-D male connector

#### Design:

9-pin Sub-D female connector

### Connection Diagram



## Analog Output Module

### 2 Analog Outputs (AO1, AO2)

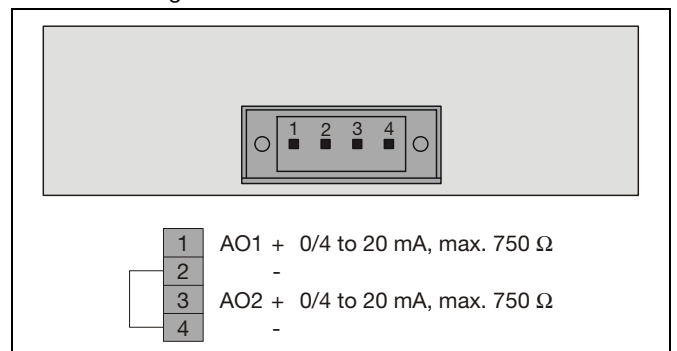
0/4–20 mA (configurable, factory-set to 4–20 mA), common negative pole, galvanically isolated from ground, freely connectable to ground, max. gain relative to protective ground potential 50 V, max. working resistance 750 Ω. The output signal cannot be lower than 0 mA.

### Electrical Connections

4-pin terminal strip for braided or solid conductors with a maximum section of 1 mm<sup>2</sup> (17 AWG). Observe the information regarding conductor section (see page 6).

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. 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 mm<sup>2</sup> (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.

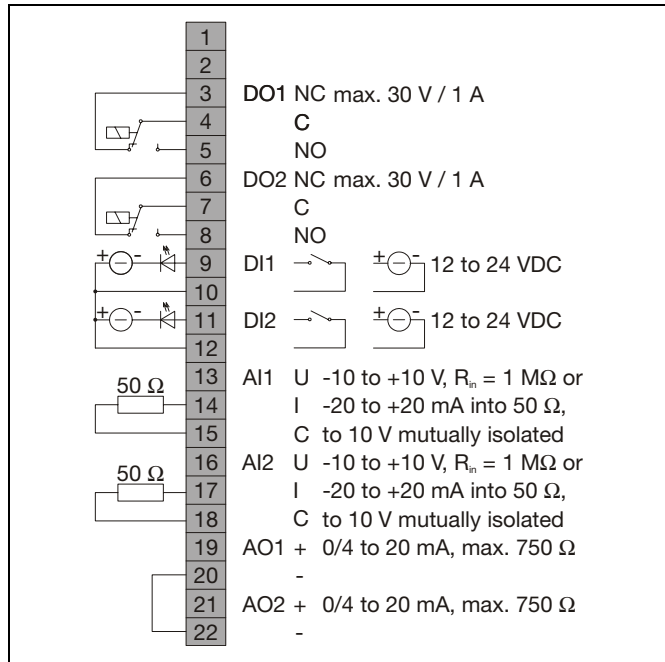
The output signal cannot be lower than 0 mA.

### Electrical Connections

22-pin terminal strip for braided or solid conductors with a maximum section of 1.5 mm<sup>2</sup> (16 AWG)

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

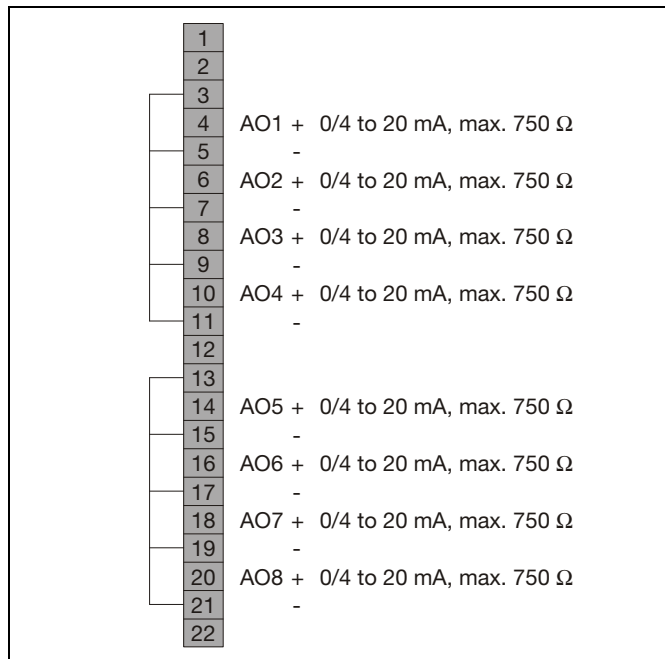
### Connection Diagram



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 mm<sup>2</sup> (17 AWG). Observe the information regarding conductor section (see page 6).

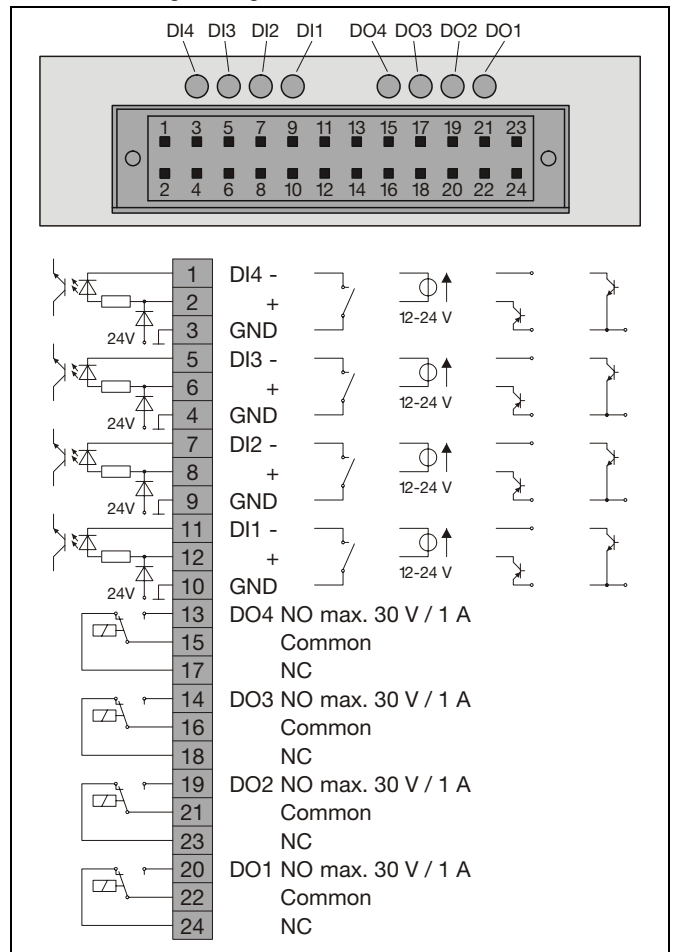
#### Digital I/O Board:

22-pin terminal strip for braided or solid conductors with a maximum section of 1.5 mm<sup>2</sup> (16 AWG)

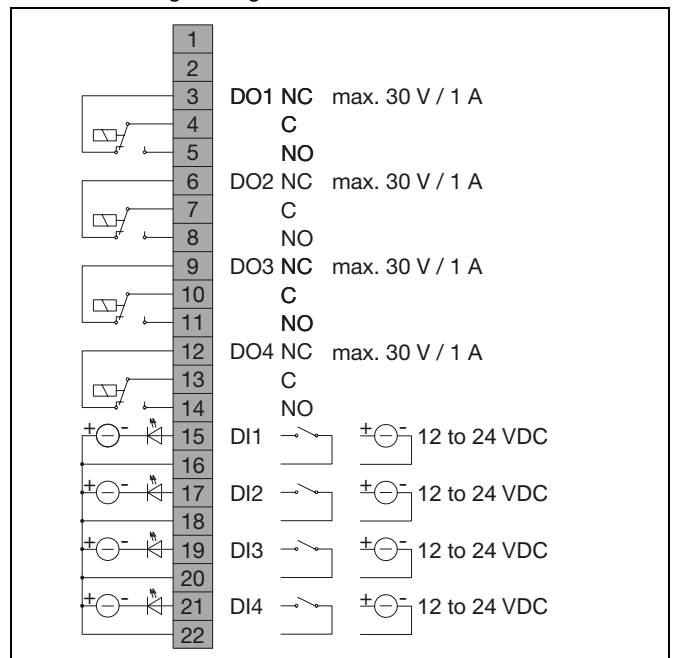
The pin layout in a delivered analyzer unit or multiple analyzer system will be shown in the applicable "Analyzer Data Sheet".

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

### Input Voltage

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. 175 W; see data for individual analyzer modules

### Power Line Protection

G fuse element per EN 60127-2, 4 A rating, slow-blow

### Output Voltage

24 VDC  $\pm$  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 (AO2020) or wall-mount housing (AO2040)

### Housing Protection Type

IP 65 without power supply and without display/control unit  
IP 54 with display/control unit and connection box  
IP 20 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  $p_g = 2\text{--}4$  hPa

### Dimensions

See dimensional drawings on page 11

### 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/m<sup>3</sup> or g/m<sup>3</sup>, 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 115/230 VAC: III/2  
AO2040-CU Ex power supply 115/230 VAC: II/2  
Analyzer module power supply 24 VDC: II/2  
Signal inputs and outputs: 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

## Electromagnetic Compatibility

### Noise Immunity

Tested to EN 61326-1:1997, EN 61326/A1:1998 and EN 61326/A2:2001. Inspection severity: Industrial area, fulfillers at least the rating "continuously monitored operation" to Table 2 of EN 61326-1

### Emitted Interference

Tested to EN 61326-1:1997, EN 61326/A1:1998, EN 61326/A2:2001, EN 61000-3-2:1998 + A14:2000 and EN 61000-3-3:1995. Limit value class B for interference-field strength and interference voltage is met.

## Mechanical Stress

In its original packaging, the analyzer unit or multiple analyzer system will withstand normal shipping conditions, e.g. as found in rail transport.

## Installation Site Requirements

### Vibration

Analyzer unit only: See individual analyzer module data  
Analyzer unit installed in cabinet (analyzer system): Max. acceleration 0.01 ms<sup>-2</sup> 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

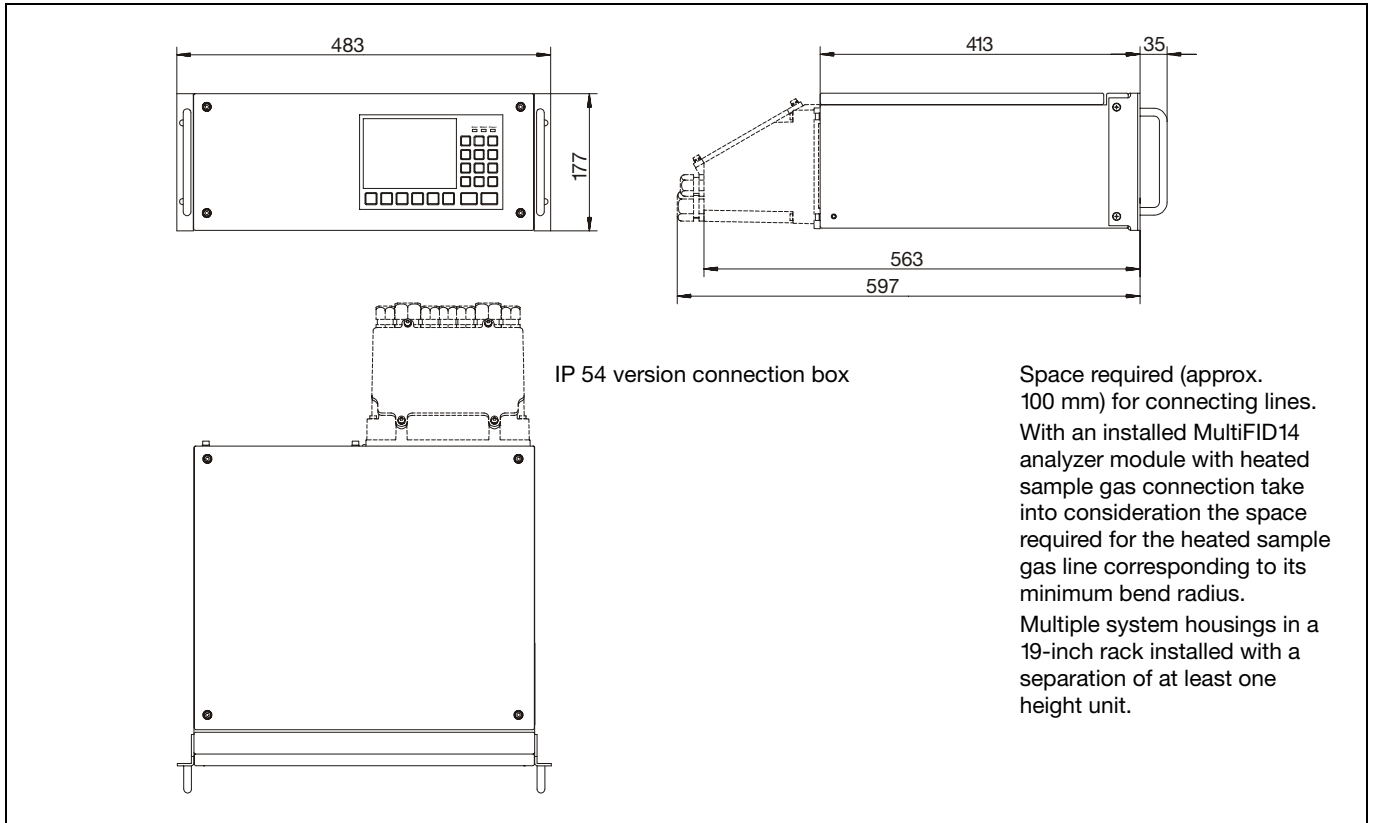
3K3 for IP 20 housing (non-condensing),  
3K4 for IP 54 housing (condensing) per EN 60721-3-3

### Mounting

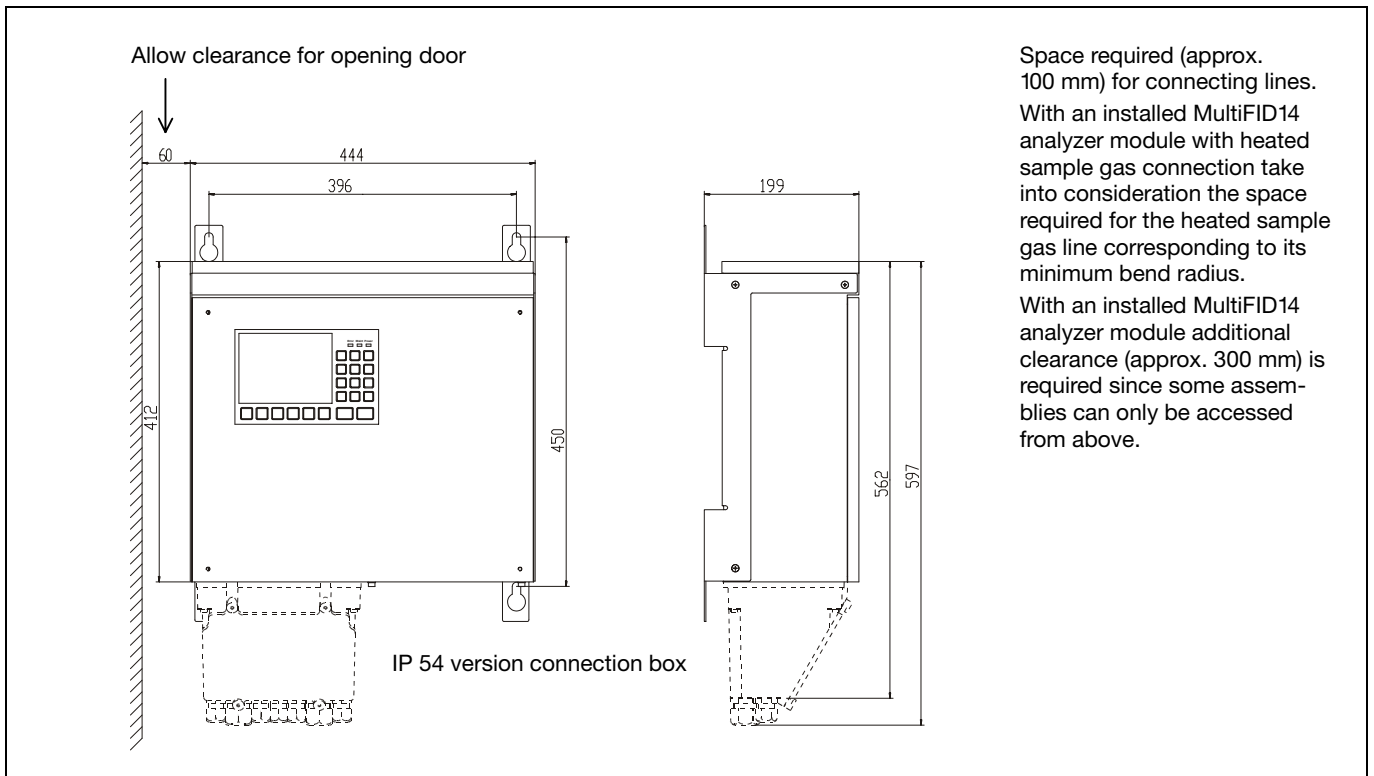
Multiple system housings in a 19-inch rack must be installed with a separation of at least one height unit between housings.

# Dimensional Drawings

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



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



# Infrared Analyzer Module Uras14

## 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 Uras14 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 <sup>1)</sup>
CO	0– 100 ppm	0– 10 ppm	0– 50 ppm <sup>2)</sup>	A
CO <sub>2</sub>	0– 100 ppm	0– 5 ppm	0– 25 ppm <sup>2)</sup>	A
NO	0– 200 ppm	0– 150 ppm	0– 150 ppm <sup>2)</sup>	A
SO <sub>2</sub>	0– 100 ppm	0– 25 ppm	0– 25 ppm <sup>2)</sup>	A
N <sub>2</sub> O	0– 100 ppm	0– 20 ppm	0– 50 ppm <sup>2)</sup>	A
NH <sub>3</sub>	0– 500 ppm	0– 30 ppm	–	B
CH <sub>4</sub>	0– 100 ppm	0– 50 ppm	0– 50 ppm <sup>2)</sup>	A
C <sub>2</sub> H <sub>2</sub>	0– 200 ppm	0– 100 ppm	0– 100 ppm	B
C <sub>2</sub> H <sub>4</sub>	0– 500 ppm	0– 300 ppm	0– 300 ppm	B
C <sub>2</sub> H <sub>6</sub>	0– 100 ppm	0– 50 ppm	0– 50 ppm <sup>2)</sup>	B
C <sub>3</sub> H <sub>6</sub>	0– 250 ppm	0– 100 ppm	0– 100 ppm <sup>2)</sup>	B
C <sub>3</sub> H <sub>8</sub>	0– 100 ppm	0– 50 ppm	0– 50 ppm <sup>2)</sup>	B
C <sub>4</sub> H <sub>10</sub>	0– 100 ppm	0– 50 ppm	0– 50 ppm <sup>2)</sup>	B
C <sub>6</sub> H <sub>14</sub>	0– 500 ppm	0– 100 ppm	0– 100 ppm <sup>2)</sup>	B
R 134a	0– 100 ppm	0– 50 ppm	0– 50 ppm <sup>2)</sup>	B
SF <sub>6</sub>	0–2000 ppm	0–1900 ppm	0–2000 ppm	B
H <sub>2</sub> 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  $\sigma$ )

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

Detection Limit (4  $\sigma$ )

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

## 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. N<sub>2</sub>, 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 N<sub>2</sub>.

## 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 Uras14.

# Infrared Analyzer Module Uras14

## 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:  $\text{CaF}_2$ , Option:  $\text{BaF}_2$ ;  
Connectors: Rust- and acid-resistant steel 1.4571

### Gas Lines and Connectors

Viton 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 42 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 ( $\text{Cl}_2$ ) and hydrogen chloride ( $\text{HCl}$ ), as well as gases or aerosols containing chlorine must be cooled or undergo prior absorption. Provide for housing purge.

Viton hoses should not be used if the sample gas contains  $\text{NH}_3$ . In this case the gas module cannot be connected to the analyzer module.

### Flammable Gases

The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ( $p_{\text{abs}} \leq 1.1\text{ bar}$ , 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  $p_e = 500\text{ hPa}$ . Stainless steel tubes and housing purge with  $\text{N}_2$  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.

### $\text{O}_2$ Concentration

If an Ex model analyzer module is installed in Zone 1, the sample gas  $\text{O}_2$  concentration must not exceed 21 Vol.-% (see also page 44).

### Purge Gas

The purge gas should not contain any sample gas components.

## Power Supply

### Input Voltage

$24\text{ VDC} \pm 5\%$  from the built-in power supply or an external unit

### Power Consumption

Approx. 75 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  $\lambda = 2.5\text{--}10\text{ }\mu\text{m}$  (Limas11 IR)

Photometer to measure from 1 to 5 components (including the optionally integrated 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 16)

## 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 <sup>1)</sup>
Limas11 UV:			
NO <sup>2)</sup>	0– 50 ppm	0– 10 ppm	A
SO <sub>2</sub>	0– 70 ppm	0– 25 ppm	A
NO <sub>2</sub>	0– 250 ppm	0– 125 ppm	B
H <sub>2</sub> S	0– 50 ppm	0– 25 ppm	B
Cl <sub>2</sub>	0– 250 ppm	0– 100 ppm	D
CS <sub>2</sub>	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 <sub>2</sub>	0– 300 ppm	0– 150 ppm	A
HCl	0–5000 ppm	0–2500 ppm	D
CH <sub>4</sub>	0–2000 ppm	0–1000 ppm	A
C <sub>2</sub> H <sub>2</sub>	0–2500 ppm	0–1250 ppm	B
C <sub>2</sub> H <sub>4</sub>	0–3000 ppm	0–1500 ppm	B
C <sub>2</sub> H <sub>6</sub>	0– 500 ppm	0– 250 ppm	B
C <sub>3</sub> H <sub>6</sub>	0–1000 ppm	0– 500 ppm	B
C <sub>3</sub> H <sub>8</sub>	0– 300 ppm	0– 150 ppm	B
C <sub>4</sub> H <sub>10</sub>	0– 500 ppm	0– 250 ppm	B

1) See price information

2) The UV-RAS method (ultra-violet resonant absorption spectroscopy) 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 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, for NO ≤ 1 % of span per day (Recommendation: daily automatic zero-point calibration)

Sensitivity Drift

≤ 1 % of measured value per week

Output Fluctuation (2  $\sigma$ )

Limas11UV: ≤ 0.5 % of span at electronic T90 time = 10 sec;

Limas11IR: ≤ 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  $\sigma$ )

≤ 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. N<sub>2</sub>, 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 N<sub>2</sub>.

# Process Photometer Analyzer Module Limas11

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## 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 16, section “Sample Cells”

## Gas Connections

see page 16, section “Sample Cells”;

see page 17 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 16, 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 16, section “Sample Cells”

### Purge Gas

see page 16, section “Sample Cells”

## Power Supply

### Input Voltage

24 VDC  $\pm 5\%$  from the built-in power supply or an external unit

### Power Consumption

Approx. 80 W at +5 °C, 35 W at +45 °C

## Installation Site Requirements

### Vibration

max.  $\pm 0.04$  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 or I/O boards are installed in the electronics module;  
Storage and transport: –25 to +65 °C

## Note

The Limas11 IR analyzer module is available only with IP 54 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 <sub>2</sub> window: 200 to 10000 nm SiO <sub>2</sub> window: 200 to 4000 nm
Resistance <sup>1)</sup>			
Suitable for measurement of ...	Non-corrosive gases	Corrosive gases, e.g. wet Cl <sub>2</sub> , wet HCl, H <sub>2</sub> SO <sub>4</sub> , SO <sub>3</sub> , ozone	Corrosive gases, e.g. dry HCl, dry COCl <sub>2</sub> (< 50 ppm H <sub>2</sub> O)
Not suitable for measurement of ...	Highly corrosive gases, e.g. gases containing chlorine, H <sub>2</sub> SO <sub>4</sub> , SO <sub>3</sub> , fluorine compounds	Fluorine compounds	Wet gases containing chlorine, H <sub>2</sub> SO <sub>4</sub> , SO <sub>3</sub> , fluorine compounds
Safety Principle			
Toxic Gases	Housing purge (≤ 20 l/h) with sample component-free air or with N <sub>2</sub>	Housing purge (≤ 20 l/h) with sample component-free air or with N <sub>2</sub>	Cell purge <sup>2)</sup> with N <sub>2</sub> 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 <sub>2</sub>	Housing purge (≤ 20 l/h) with sample component-free air or with N <sub>2</sub>	Cell purge <sup>2)</sup> with N <sub>2</sub> or with sample component-free air with excess pressure <sup>3)</sup> and flow monitoring
Flammable Gases <sup>4)</sup>	Stainless steel gas lines, housing purge (≤ 20 l/h) with N <sub>2</sub>	Housing purge (≤ 20 l/h) with N <sub>2</sub>	Cell purge <sup>2)</sup> with N <sub>2</sub>
Category 3G Flammable Gases	–	–	Cell purge <sup>2)</sup> with N <sub>2</sub> with excess pressure <sup>3)</sup> and flow monitoring
Seal Integrity	< 1 x 10 <sup>-3</sup> hPa l/s	< 1 x 10 <sup>-6</sup> hPa l/s	< 1 x 10 <sup>-6</sup> hPa l/s
Pressure Rating			
Continuous	p <sub>e</sub> < 500 hPa	p <sub>e</sub> < 500 hPa	p <sub>e</sub> < 500 hPa
Spike	–	p <sub>abs</sub> < 300 kPa	p <sub>abs</sub> < 500 kPa
Sample Cell Material			
Cell Tube	Aluminum	Silica glass (SiO <sub>2</sub> )	Stainless steel 1.4571
Window	CaF <sub>2</sub> , adhesive fastening	Silica glass (SiO <sub>2</sub> )	CaF <sub>2</sub> or SiO <sub>2</sub> , threaded fastening
Seal	–	FFKM75 (Kalrez®)	FFKM70 (Kalrez®)
Connectors	Stainless steel 1.4571	PFA	Stainless steel 1.4571
Gas Line Materials	Viton 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	Tubes 6/4 mm	Pipes with 4-mm OD

1) see page 15 "Gas Inlet Conditions"

2) purge curtain, optional

3) p<sub>e</sub> = 7 to 20 hPa, 15 to 20 l/h

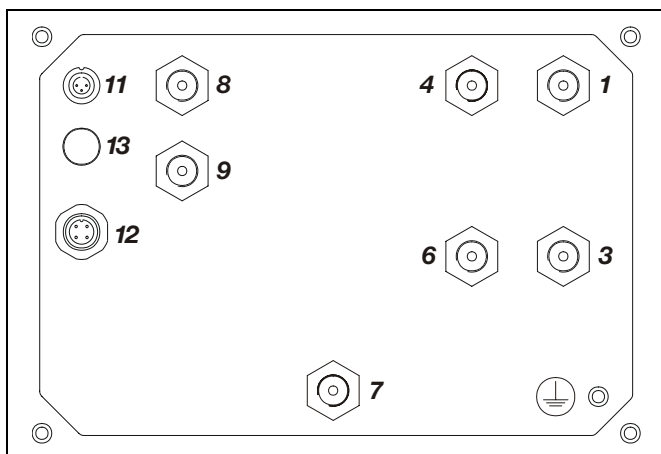
4) The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions (p<sub>abs</sub> ≤ 1.1 bar, oxygen content ≤ 21 Vol.-%). Temperature Class: T4. The sample gas must not be explosive under normal conditions. If the sample gas is explosive in the event of a sample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



# Process Photometer Analyzer Module Limas11

## Connection Drawings

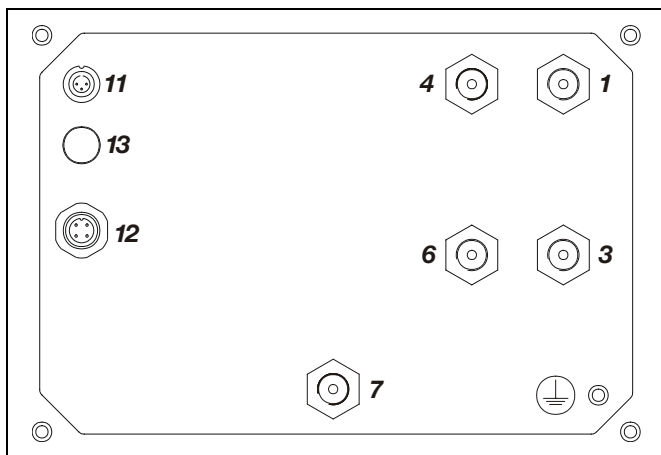
### Standard Cell, Quartz Cell with FPM Hoses



- 1** Sample Gas Inlet
- 3** Housing Purge Gas Inlet
- 4** Sample Gas Outlet
- 6** Housing Purge Gas Outlet
- 7** Pressure Sensor <sup>1)</sup>
- 8** End-Point Gas Inlet (with pneumatics module with 3 solenoids) <sup>1)</sup>
- 9** Zero-Point Gas Inlet (with pneumatics module with 1 or 3 solenoids) <sup>1)</sup>
- 11** System Bus
- 12** 24 VDC Power Supply
- 13** Service Interface

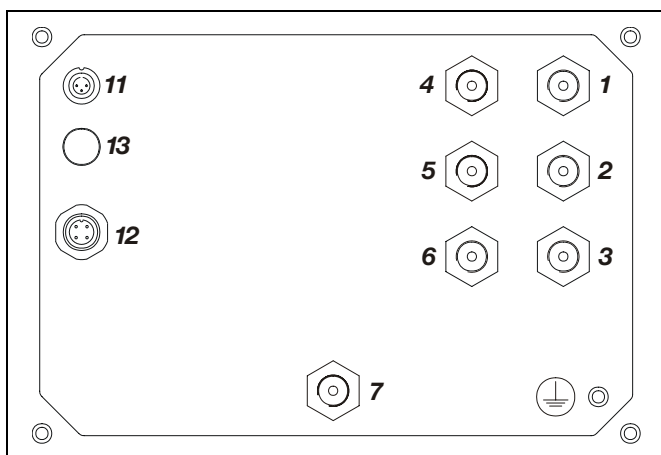
1) Option

### Quartz Cell with PFA Tubes



- 1** Sample Gas Inlet
- 3** Housing Purge Gas Inlet
- 4** Sample Gas Outlet
- 6** Housing Purge Gas Outlet
- 7** Pressure Sensor
- 11** System Bus
- 12** 24 VDC Power Supply
- 13** Service Interface

### Safety Cell



- 1** Sample Gas Inlet
- 2** Sample Gas Outlet
- 3** Housing Purge Gas Inlet
- 4** Sample Cell Purge Gas Inlet
- 5** Sample Cell Purge Gas Outlet
- 6** Housing Purge Gas Outlet
- 7** Pressure Sensor
- 11** System Bus
- 12** 24 VDC Power Supply
- 13** Service Interface

# 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, NO<sub>2</sub>, NH<sub>3</sub>

Wavelength comparison in ultraviolet spectrum range  $\lambda = 200$  to 600 nm for sample components NO<sub>2</sub>, NH<sub>3</sub> and SO<sub>2</sub>.

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 raw and pure gas measurement in

- Four-stroke gasoline and diesel engines
- Catalysts for nitrogen oxide reduction
- DeNOx SCR catalysts for 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 <sub>2</sub>	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

#### 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 $\sigma$ )

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

#### Detection Limit (4 $\sigma$ )

- ≤ 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 <sub>2</sub>	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

#### 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 $\sigma$ )

- NO ≤ 50 ppb,
- NO<sub>2</sub> ≤ 60 ppb
- at electronic T90 time = 15 sec

#### Detection Limit (4 $\sigma$ )

- NO ≤ 100 ppb or ≤ 1% of span,
- NO<sub>2</sub> ≤ 120 ppb or ≤ 1% of span
- at electronic T90 time = 15 sec

### DeNOx SCR Catalysts for Freight Vehicle Diesel Engines

Sample Component	Smallest Range	Largest Range
NO	0 to 100 ppm	0 to 1000 ppm
NO <sub>2</sub>	0 to 100 ppm	0 to 500 ppm
NH <sub>3</sub>	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 $\sigma$ )

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

#### Detection Limit (4 $\sigma$ )

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

# Process Photometer Analyzer Module Limas11 HW

## Flue Gas Scrubbing Systems in Gas Turbines and Gas-fired Burners

Sample Component	Smallest Range (Pure Gas)	Largest Range (Raw Gas)
NO	0 to 25 ppm	0 to 500 ppm
NO <sub>2</sub>	0 to 40 ppm	0 to 500 ppm
NH <sub>3</sub>	0 to 25 ppm	0 to 500 ppm
SO <sub>2</sub>	0 to 25 ppm	0 to 50 ppm

Linearity Deviation  
≤ 1% of span

Repeatability  
≤ 0.25 % of span

Zero Drift  
≤ 2 % 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  $\sigma$ )  
≤ 0.25 % of span at electronic T90 time = 30 sec

Detection Limit (4  $\sigma$ )  
≤ 0.5 % of span at electronic T90 time = 30 sec

## 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.

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. N<sub>2</sub>, or with ambient air that is free of the sample component

End-Point Calibration  
With gas-filled calibration cells (optional) or manually 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 N<sub>2</sub>.

## 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 Limas11HW.

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 automatic 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<sub>abs</sub> = 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  
T<sub>90</sub> ≤ 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 (SiO<sub>2</sub>); Connectors: PTFE

Gas Lines and Connectors  
PTFE tubes

# Process Photometer Analyzer Module Limas11 HW

## Housing Purge

Purge Gas  
Sample component-free air or N<sub>2</sub>

Purge Gas Flow Rate  
≤ 10 l/h

## Gas Connections

Layout and Design  
6/4 mm PTFE tubes on back of the analyzer module (see 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,  
SO<sub>2</sub> concentration < 25 ppm, H<sub>2</sub>O < 20 Vol.-%,  
filtered with pore width ≤ 0.5 μm

Temperature  
Sample gas dew point ≤ 65 °C

Inlet Pressure  
p<sub>e</sub> = 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

## Power Supply

Input Voltage  
24 VDC ± 5 % from the built-in power supply or an external unit

Power Consumption  
Approx. 80 W at +5 °C, 35 W at +45 °C

## Installation Site Requirements

Vibration  
max. ±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

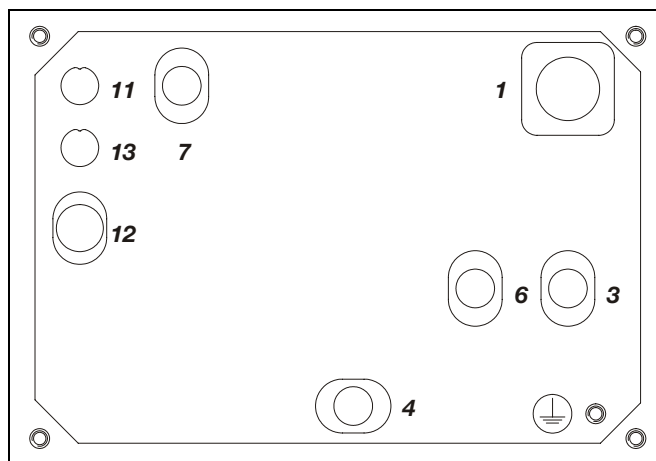
The analyzer module can only be mounted in the 19-inch housing.

SO<sub>2</sub> influences the NH<sub>3</sub> reading. If the sample gas mixture contains SO<sub>2</sub>, 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 "Sample Conditioning System Requirements" have to be considered (see page 21).

## Connection Drawing



- 1 Sample Gas Inlet
- 3 Housing Purge Gas Inlet
- 4 Sample Gas Outlet
- 6 Housing Purge Gas Outlet
- 7 Pressure Sensor
- 11 System Bus
- 12 24 VDC Power Supply
- 13 Service Interface

# Process Photometer Analyzer Module Limas11 HW

## Sample Conditioning System Requirements

### Sample Gas Feed-In

The application requires the sample gas feed-in to the gas analyzer at a temperature of approx. 150 °C. It is imperative to eliminate condensate formation since NH<sub>3</sub> and NO<sub>2</sub> are easy soluble in water.

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

### Sample Gas Filter

For NO and NO<sub>2</sub> measurement: Sintered metal;  
For NH<sub>3</sub> measurement: Ceramics, pore width ≤ 0.5 μm

### Materials in Contact with the Sample Medium

PTFE, PVDF or Silicosteel

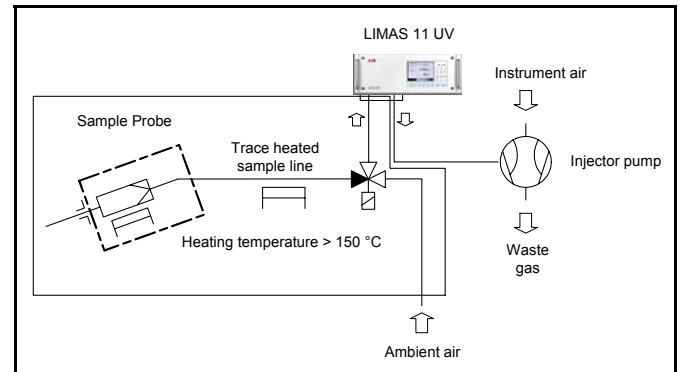
### Exhaust Gas Conditions

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

### Installation Note

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

## ABB Analytical Sample Conditioning System (Example)



The sample gas is fed-in to the gas analyzer through a short heated sample gas line. When the temperature reaches the set point the sample gas is routed via a heated solenoid valve into the gas analyzer. An injector pump downstream the sample gas outlet of the gas analyzer is used to feed the sample gas. As an alternative a pressure pump can be used at an operating temperature of approx. 150 °C.

# Oxygen Analyzer Module Magnos106

## Measurement Principle

Paramagnetic behavior of oxygen

Magnetomechanical oxygen analyzer; short 90% response time

## Sample Component and Smallest Measurement Range

Sample Component  
Oxygen (O<sub>2</sub>)

Smallest Measurement Range  
0 to 1 Vol.-% O<sub>2</sub>  
0 to 0.5 Vol.-% O<sub>2</sub> with limited performance data relative to span. The following data are based on a span of 1 Vol.-% O<sub>2</sub>.

## Stability

Linearity Deviation  
≤ 0.5 % of span

Repeatability  
≤ 0.5 % of span (time base for gas exchange ≥ 7 minutes)

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

Sensitivity Drift  
≤ 0.1 Vol.-% O<sub>2</sub> 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)  
≤ 0.5 % of smallest measurement range span at electronic  
T90 time (static/dynamic) = 3/0 sec

Detection Limit (4 σ)  
≤ 1% of smallest measurement range span 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.-% O<sub>2</sub> or per order.

Largest Measurement Range  
0–100 Vol.-% O<sub>2</sub>  
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.-% O<sub>2</sub>;  
Highly suppressed measurement ranges (≥95–100 Vol.-% O<sub>2</sub>) 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.-% O<sub>2</sub> to 0 to 25 Vol.-% O<sub>2</sub>  
Zero-point calibration with any oxygen concentration, e.g. with nitrogen (N<sub>2</sub>) or ambient air, processed through a cooler or H<sub>2</sub>O absorber; sensitivity deviation ≤ 0.05 Vol.-% O<sub>2</sub> per year.  
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.-% O<sub>2</sub>) 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 if the suppression ratio is ≤ 1:5. The O<sub>2</sub> concentration of the test gas must lie within the measurement range.

## Influence Effects

Flow Effect  
≤ 0.1 Vol.-% O<sub>2</sub> in permissible range

Associated Gas Effect  
The effect of associated gases as a shift of the zero-point – expressed in Vol.-% O<sub>2</sub> – can be estimated using the approximate values in the following table:

Associated Gas Concentration 100 Vol.-%		Zero-Point Shift in Vol.-% O <sub>2</sub>
Hydrogen	H <sub>2</sub>	+0.28
Hydrogen Sulfide	H <sub>2</sub> S	-0.45
Argon	Ar	-0.26
Helium	He	+0.30
Neon	Ne	+0.13
Nitrogen	N <sub>2</sub>	0
Nitrogen Oxide	NO	+43
Nitrogen Dioxide	NO <sub>2</sub>	+28
Nitrous Oxide	N <sub>2</sub> O	-0.20
Carbon Monoxide	CO	-0.01
Carbon Dioxide	CO <sub>2</sub>	-0.32
Carbon Oxysulfide	COS	-0.90
Ethane	C <sub>2</sub> H <sub>6</sub>	-0.46
Ethylene	C <sub>2</sub> H <sub>4</sub>	-0.29
Methane	CH <sub>4</sub>	-0.24
Propane	C <sub>3</sub> H <sub>8</sub>	-0.98
Propylene	C <sub>3</sub> H <sub>6</sub>	-0.55
Trichloroethane	C <sub>2</sub> HCl <sub>3</sub>	-2.17
Vinyl Chloride	CH <sub>2</sub> CHCl	-0.75

For further associated gases refer to EN 61207-3

# Oxygen Analyzer Module Magnos106

## Temperature Effect

- Ambient temperature in permissible range
    - At zero-point:  $\leq 0.02$  Vol.-% O<sub>2</sub> per 10 °C
    - On sensitivity:  $\leq 0.1\%$  of measured value per 10 °C
- Thermostat temperature = 64 °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):  
 $\leq 0.01\%$  of measured value per 1% pressure change or  
 $\leq 0.002$  Vol.-% O<sub>2</sub> per 1% pressure change, whichever is greater
- Pressure sensor working range:  $p_{\text{abs}} = 600\text{--}1250$  hPa

## Power Supply Effect

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

## Position Effect

Zero-point shift  $\leq 0.05$  Vol.-% O<sub>2</sub> 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

Depending on sample gas flow and sample cell connection (see “Gas Connections”);  
 $T_{90} \leq 3.5$  to 10 sec at a sample gas flow of 60 l/h and electronic T90 time (static/dynamic) = 3/0 sec, gas change from N<sub>2</sub> to air (applies to an analyzer unit with 1 analyzer module)

## Materials in Contact with the Sample Medium

### Sample Cell

Rust- and acid-resistant steel 1.4305, glass, platinum, rhodium, epoxy resin;  
FPM (Viton) seals, optional: FFKM75 (Chemraz™)

### Gas Lines and Connectors

Rust- and acid-resistant steel 1.4305

### Pressure Sensor

Silicon gel, plastics, FPM (Viton)

## 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 43 for connection drawings

### Sample Cell Connection

The sample cell can be connected to the gas ports directly (with or without a flame trap) or by means of Viton hoses.  
Direct sample cell connection e.g. in case of corrosive sample gases, 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

20–60 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<sub>2</sub>, HCl, HF or other corrosive components.  
Viton hoses and seals should not be used if the sample gas contains NH<sub>3</sub>. In this case the gas module cannot be connected to the analyzer module.

### Flammable Gases

The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ( $p_{\text{abs}} \leq 1.1$  bar, oxygen content  $\leq 21$  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  $p_e = 1000$  hPa. Stainless steel tubes and housing purge with N<sub>2</sub> 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.

## Power Supply

### Input Voltage

24 VDC  $\pm 5\%$  from the built-in power supply or an external unit

### Power Consumption

Approx. 55 W

## Installation Site Requirements

### Vibration

max.  $\pm 0.04$  mm at 5 to 20 Hz

### Ambient Temperature

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

# Oxygen Analyzer Module Magnos17

---

## Measurement Principle

Paramagnetic behavior of oxygen

Heavy-duty thermomagnetic oxygen analyzer

## Sample Component and Smallest Measurement Range

Sample Component

Oxygen (O<sub>2</sub>) in flue gas or in nitrogen (N<sub>2</sub>)

Smallest Measurement Range

0–3 Vol.-% O<sub>2</sub>

## 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.-% O<sub>2</sub>

Measurement ranges within ignition limits cannot be provided.

Measurement Range Switching Ratio

≤ 1:33 1/3

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

Magnos17 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 = 61 °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 Magnos17

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## Dynamic Response

Warm-Up Time  
2–4 hours

90% Response Time  
 $T_{90}$  = 10–22 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, Viton, FFKM75 seals (Chemraz™)

## 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 43 for connection drawings

Sample Cell Connection  
The sample cell can be connected to the gas ports directly or by means of Viton 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  
 $p_e$  = 2–100 hPa  
Lower pressures require a sample gas pump and higher pressures require a pressure reducer.

Outlet Pressure  
Atmospheric pressure

Flow Rate  
normal 20–60 l/h, max. 90 l/h

Flammable Gases  
Measurement of flammable gases is not possible.

## Power Supply

Input Voltage  
24 VDC  $\pm$  5 % from the built-in power supply or an external unit

Power Consumption  
Approx. 35 W

## Installation Site Requirements

Vibration  
max.  $\pm$ 0.04 mm at 5 to 60 Hz

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

Operating Altitude  
Above 2000 m as an option

## 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 (N<sub>2</sub>, Ar). The measuring cell is catalytically inactivated to the extent that flammable carrier components in stoichiometric concentrations only negligibly reduce the oxygen value.

## Sample Component and Measurement Ranges

Sample Component  
Oxygen (O<sub>2</sub>)

Measurement Ranges  
Factory-set: 0 to 1/10/100/1000 ppm O<sub>2</sub>  
The following measurement data refer to a measurement span of 100 ppm O<sub>2</sub> 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 O<sub>2</sub> (whichever is greater)

Zero Drift  
The zero point (reference point) is displayed if ambient air is present on the sample gas side. The value for air of 20.6 % Vol. of O<sub>2</sub> may deviate through aging of the cell.  
< 1 % of the measurement range per week or 250 ppb O<sub>2</sub> (whichever is greater)

Sensitivity Drift  
Depends on possible interfering components (catalyst poisons) in the sample gas and the aging of the cell.  
For pure gas measurements in N<sub>2</sub> and Ar:  
< 1 % of the measurement range per week or 250 ppb O<sub>2</sub> (whichever is greater)

Output Fluctuation (2 σ)  
< ±0.5 % of the measured value or 50 ppb O<sub>2</sub> (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 O<sub>2</sub> in N<sub>2</sub> (or in Ar); O<sub>2</sub> concentration in the measurement range, e.g. 10 ppm O<sub>2</sub>

## 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 O<sub>2</sub> in the permissible range of 5 to 10 l/h (whichever is greater)

Associated Gas Effect  
Inert gases (Ar, N<sub>2</sub>) have no effect. Flammable gases (CO, H<sub>2</sub>, CH<sub>4</sub>) in stoichiometric concentrations to the oxygen content: Conversion of O<sub>2</sub> < 20 % of the stoichiometric conversion. If higher concentrations of flammable gases are present, higher O<sub>2</sub> 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 O<sub>2</sub> 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

## 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<sub>90</sub> < 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

# Trace Oxygen Analyzer Module ZO23

## 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, Viton in the gas outlet;  
Gas connections: stainless steel 1.4401/1.4305

## 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®

### 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 Viton 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  $8 \pm 0.2$  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.

### Pneumatics Module

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

## Power Supply

### Input voltage

24 VDC  $\pm 5\%$  from the built-in power supply or an external unit

### Power consumption

Approx. 12 W in continuous operation, approx. 35 W during start-up for each analyzer module

## Installation Site Requirements

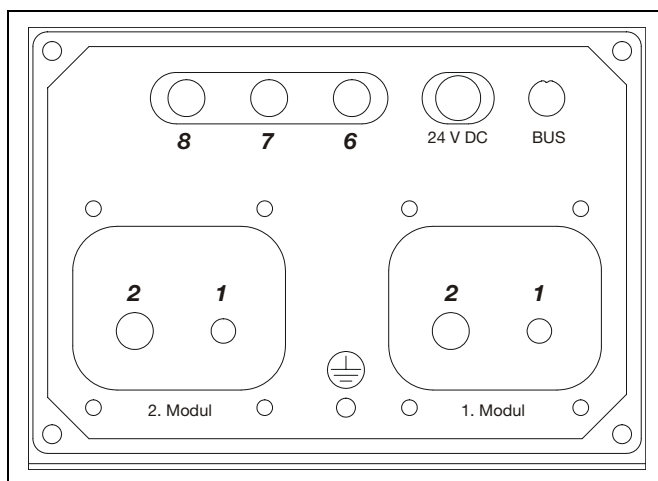
### Vibration

max.  $\pm 0.04$  mm at 5 to 55 Hz, 0.5 g at 55 to 150 Hz

### Ambient Temperature

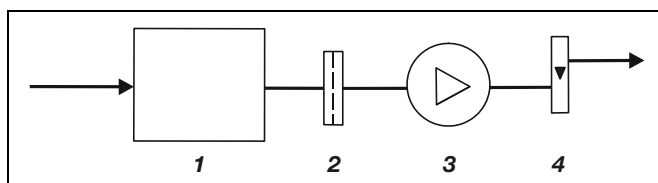
Operation: +5 to +45 °C, when installed in housing with electronics module; Storage and transport: -25 to +65 °C

## Connection Drawing



- 1 Sample gas inlet
- 2 Sample gas outlet
- 6 Purge gas inlet on case (only for IP54 version)
- 7 Purge gas outlet on case (only for IP54 version)
- 8 not assigned

## Pneumatics Diagram



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

# Thermal Conductivity Analyzer Module Caldos15

---

## 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 Caldos15 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 <sub>2</sub> in N <sub>2</sub> or air	0–0.5 Vol.-%	Air (sealed)
SO <sub>2</sub> in N <sub>2</sub> or air	0–1.5 Vol.-%	Air (sealed)
H <sub>2</sub> in Cl <sub>2</sub>	0–0.5 Vol.-%	Flowing (not in Ex version)

## 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  $\sigma$ )  
≤ 0.5 % of smallest measurement range span at electronic  
T90 time = 0 sec

Detection Limit (4  $\sigma$ )  
≤ 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  
Depending on sample cell connection (see “Gas Connections”);  
≤ 1 to 5 % of span at a flow change of  $\pm 10$  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  $\pm$  5 %: ≤ 0.2 % of span

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

# Thermal Conductivity Analyzer Module Caldos15

## Dynamic Response

### Warm-Up Time

2–4 hours, depending on measurement range

### 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, fluor-elastomer (FPM) seals

## Gas Connections

The Caldos15 analyzer module is only available for wall mounting.

### Layout and Design

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

Caution: Do not use metal adapters for flowing reference gases. The sample and reference gas ports are made of PVC-C.

See page 43 for connection drawing

### Sample Cell Connection

Sample cell connected directly to gas ports, i.e. pneumatics module cannot be used; sample gas connection can be fitted with flame barriers (not for flowing reference gas).

## 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

Not possible with Ex version

### 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  $\leq 21$  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  $p_e = 1000$  hPa. Direct sample cell connection 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.

### O<sub>2</sub> Concentration

If an Ex model analyzer module is installed in Zone 1, the sample gas O<sub>2</sub> concentration must not exceed 21 Vol.-% (see also page 44).

## Power Supply

### Input Voltage

24 VDC  $\pm 5\%$  from the built-in power supply or an external unit

### Power Consumption

Approx. 35 W

## Installation Site Requirements

### Vibration

max.  $\pm 0.04$  mm at 5 to 30 Hz

### Ambient Temperature

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

# Thermal Conductivity Analyzer Module Caldos17

## 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 <sup>1)</sup> for Calibration
Ar in O <sub>2</sub>	0 – 20	0 – 2	Air, N <sub>2</sub> , O <sub>2</sub>
H <sub>2</sub> in Ar	0 – 2.5	0 – 0.25	Air, N <sub>2</sub> , Ar
H <sub>2</sub> in N <sub>2</sub> /Air	0 – 3	0 – 0.3	Air, N <sub>2</sub>
H <sub>2</sub> in stack gas	0 – 5	0 – 0.5	Air, N <sub>2</sub>
CH <sub>4</sub> in N <sub>2</sub>	0 – 20	0 – 2	Air, N <sub>2</sub>
CH <sub>4</sub> in Air	0 – 4	0 – 2	Air, N <sub>2</sub>
CO <sub>2</sub> in N <sub>2</sub> /Air	0 – 30	0 – 3	Air, N <sub>2</sub>
Ar in N <sub>2</sub>	75 –100	97.5–100	Air, N <sub>2</sub> , Ar
H <sub>2</sub> in N <sub>2</sub>	90 –100	99 –100	N <sub>2</sub> , H <sub>2</sub>
CH <sub>4</sub> in N <sub>2</sub>	90 –100	99 –100	N <sub>2</sub> , CH <sub>4</sub>
He in N <sub>2</sub>	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 <sub>2</sub> in Air	0–100 Vol.-%
H <sub>2</sub> in CO <sub>2</sub>	100–0 Vol.-%
H <sub>2</sub> 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  $\sigma$ )  
 $\leq 0.5\%$  of smallest measurement range span at electronic  
T<sub>90</sub> time = 0 sec

Detection Limit (4  $\sigma$ )  
 $\leq 1\%$  of smallest measurement range span at electronic  
T<sub>90</sub> 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  $\pm 10$  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 Caldos17

## 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:  $p_{\text{abs}} = 600\text{--}1250$  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 oxo-nitride;  
Sample cell: Stainless steel 1.4305;  
Seal: FFKM75 (Chemraz™)

### Gas Lines and Connectors

Viton, stainless steel

## 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 43 for connection drawings

### Sample Cell Connection

The sample cell can be connected to the gas ports directly (with or without a flame trap) or by means of Viton hoses.  
Direct sample cell connection e.g. in case of corrosive sample gases or when external gas supply is connected.

## 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  $\text{Cl}_2$ , HCl, HF,  $\text{SO}_2$ ,  $\text{NH}_3$ ,  $\text{H}_2\text{S}$  or other corrosive components.  
Viton hoses should not be used if the sample gas contains  $\text{NH}_3$ . In this case the gas module cannot be connected to the analyzer module.

### Flammable Gases

The analyzer module is suitable for measuring flammable gases and vapors under atmospheric conditions ( $p_{\text{abs}} \leq 1.1$  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  $p_e = 1000$  hPa. Direct sample cell connection and housing purge with  $\text{N}_2$  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.

### $\text{O}_2$ Concentration

If an Ex model analyzer module is installed in Zone 1, the sample gas  $\text{O}_2$  concentration must not exceed 21 Vol.-% (see also page 44).

## Power Supply

### Input Voltage

24 VDC ± 5 % from the built-in power supply or an external unit

### Power Consumption

Approx. 18 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

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## Measurement Principle

Flame-ionization detector

## Sample Components and Measurement Ranges

Sample Components

Hydrocarbons

Smallest Measurement Range

0–5 mg org. C/m<sup>3</sup>

Largest Measurement Range

0–100,000 mg org. C/m<sup>3</sup>

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  $\geq 50$  mg org. C/m<sup>3</sup>, for smaller ranges these only apply if they are factory-set per customer order.

Linearity Deviation

$\leq 2$  % of the span to 10,000 mg org. C/m<sup>3</sup>

this value applies in one (calibrated) measurement range

Repeatability

$\leq 0.5$  % of measurement range

Zero-Point and Sensitivity Drift

$\leq 0.5$  mg org. C/m<sup>3</sup> per week

Output Fluctuation ( $2\sigma$ )

$\leq 0.5$  % of span at electronic T90 time = 20 sec

Detection Limit ( $4\sigma$ )

$\leq 1$  % of span at electronic T90 time = 20 sec

## Calibration

Zero-Point Calibration

With synthetic or catalytically purified air or nitrogen (N<sub>2</sub>)

Sensitivity Calibration

With propane or another hydrocarbon (equivalent gas) in air or nitrogen (N<sub>2</sub>), depending on application

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

## Influence Effects

O<sub>2</sub> Dependence

$\leq 2$  % of measured value for 0 to 21 Vol.-% O<sub>2</sub> or

$\leq 0.3$  mg org. C/m<sup>3</sup>, the greater value applies

Temperature Effect

Ambient temperature in permissible range

At zero-point and on sensitivity:  $\leq 2$  % per 10 °C in measurement range of 0 to 15 mg org. C/m<sup>3</sup>

Power Supply Effect

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

## Dynamic Response

Warm-Up Time

$\leq 2$  hours

90% Response Time

T<sub>90</sub> < 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, Viton, Teflon

## 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®. Sample gas inlet: Stainless steel filter, heated 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  $\geq 10$  mm); See page 42 for connection drawing

## 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/m<sup>3</sup>, max. oil content 0.1 mg/m<sup>3</sup>, 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 integral 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 (H<sub>2</sub>), grade 5.0  
Inlet pressure  $p_e = 1200 \pm 100$  hPa, flow rate ≤ 3 l/h  
or  
H<sub>2</sub>/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 (N<sub>2</sub>), 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 N<sub>2</sub> or air  
Inlet pressure  $p_e = 1000 \pm 100$  hPa, flow rate 130 to 250 l/h

## Power Supply

### Analyzer

Input Voltage  
24 VDC ± 5 % from the built-in power supply or an external unit

Power Consumption  
Approx. 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.

### Designation

 II 3G EEx nP II T3

### Type Examination Certificate

DMT 01 E 126 X

### Housing Protection Type

IP 54

# 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 CH<sub>4</sub>:NMHC ratio must be in the 1:9 to 9:1 range.

### Smallest Measurement Range

0–5 mg org. C/m<sup>3</sup>

### Largest Measurement Range

0–5,000 mg org. C/m<sup>3</sup>

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. It can be reduced or enlarged by a factor of max. 4 (to the smallest indicated measurement range).

### Display

The display shows the sample components C<sub>n</sub>H<sub>m</sub>, CH<sub>4</sub> 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  $\geq 50$  mg org. C/m<sup>3</sup>, for smaller ranges these only apply if they are factory-set per customer order.

### Linearity Deviation

$\leq 2$  % of the span to 5000 mg org. C/m<sup>3</sup>

this value applies in one (calibrated) measurement range

### Repeatability

$\leq 0.5$  % of measurement range

### Zero-Point and Sensitivity Drift

$\leq 0.5$  mg org. C/m<sup>3</sup> per week

### Output Fluctuation (2 $\sigma$ )

$\leq 0.5$  % of span at electronic T90 time = 20 sec

### Detection Limit (4 $\sigma$ )

$\leq 1$  % of span at electronic T90 time = 20 sec

## Calibration

### Zero-Point Calibration

With synthetic or catalytically purified air or nitrogen (N<sub>2</sub>), depending on application

### Sensitivity Calibration

With propane or methane in air or in nitrogen (N<sub>2</sub>), depending on application

## Influence Effects

### O<sub>2</sub> Dependence

$\leq 2$  % of measured value for 0 to 21 Vol.-% O<sub>2</sub> or

$\leq 0.3$  mg org. C/m<sup>3</sup>, the greater value applies

### Temperature Effect

Ambient temperature in permissible range

At zero-point and on sensitivity:  $\leq 2$  % per 10 °C in measurement range of 0 to 15 mg org. C/m<sup>3</sup>

### Power Supply Effect

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

## Catalyst

### Effectiveness

CH<sub>4</sub>:  $> 85$  %, C<sub>2</sub>H<sub>6</sub>:  $< 2$  %, C<sub>3</sub>H<sub>8</sub>:  $< 2$  %

### Switchover Time

typically 30 to 120 s

Catalyst poisons (e.g. SO<sub>2</sub>, NO<sub>x</sub>, HCl, H<sub>2</sub>S, halogenated hydrocarbons) will shorten the catalyst service life. Their respective concentration should always be  $< 20$  mg/m<sup>3</sup>.

## Dynamic Response

### Warm-Up Time

$\leq 2$  hours

### 90% Response Time

T<sub>90</sub>  $< 3$  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, Viton, Teflon, 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®.

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  $\geq 10$  mm);

See page 42 for connection drawing

## 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

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## 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  
 $p_{\text{abs}} = 850\text{--}1100$  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/m<sup>3</sup>, max. oil content 0.1 mg/m<sup>3</sup>, 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 integral 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 (H<sub>2</sub>), grade 5.0  
Inlet pressure  $p_e = 1200 \pm 100$  hPa, flow rate ≤ 4 l/h  
or  
H<sub>2</sub>/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 (N<sub>2</sub>), 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 (N<sub>2</sub>) 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 (N<sub>2</sub>) or in air (separate test gas containers)  
Zero pressure via bypass, flow rate 130 to 250 l/h

## Power Supply

### Analyzer

Input Voltage  
24 VDC ± 5 % from the built-in power supply or an external unit

Power Consumption  
Approx. 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 <sub>2</sub>	0– 1 Vol.-%	10 bar	1500 °C
CO	0– 25 mg/m <sup>3</sup>	2 bar	1200 °C
	0–3000 mg/m <sup>3</sup>	3 bar	1500 °C
CO <sub>2</sub>	0– 40 mg/m <sup>3</sup>	2 bar	300 °C
	0–3000 mg/m <sup>3</sup>	3 bar	300 °C
	0– 1 Vol.-%	2 bar	1500 °C
HCl	0– 7 mg/m <sup>3</sup>	2 bar	300 °C
H <sub>2</sub> S	0– 300 mg/m <sup>3</sup>	1.5 bar	300 °C
HF	0– 1 mg/m <sup>3</sup>	2 bar	300 °C
HCN	0– 20 mg/m <sup>3</sup>	2 bar	300 °C
NH <sub>3</sub>	0– 10 mg/m <sup>3</sup>	1.5 bar	400 °C
CH <sub>4</sub>	0– 20 mg/m <sup>3</sup>	2 bar	300 °C
H <sub>2</sub> O	0– 3 mg/m <sup>3</sup>	2 bar	400 °C
	0– 1 Vol.-%	1.5 bar	1500 °C
N <sub>2</sub> O	0– 700 mg/m <sup>3</sup>	1.5 bar	300 °C
NH <sub>3</sub> + H <sub>2</sub> O	0– 10 mg/m <sup>3</sup>	1.5 bar	400 °C
HCl + H <sub>2</sub> O	0– 10 mg/m <sup>3</sup>	1.5 bar	150–400 °C
	0– 1 Vol.-%		
HCl + H <sub>2</sub> O	0– 35 mg/m <sup>3</sup>	2 bar	150 °C
	0– 5 Vol.-%		
HF + H <sub>2</sub> O	0– 1 mg/m <sup>3</sup>	1.5 bar	300 °C
	0– 1 Vol.-%		
CO + CO <sub>2</sub>	0– 2 Vol.-%	1.5 bar	400 °C
	0– 1 Vol.-%		
O <sub>2</sub> + 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.-% O<sub>2</sub> require purging with N<sub>2</sub>. 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

### Detection Limit

≤ 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. N<sub>2</sub>, 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

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## 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, option 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

1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®; see page 39 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

## 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

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

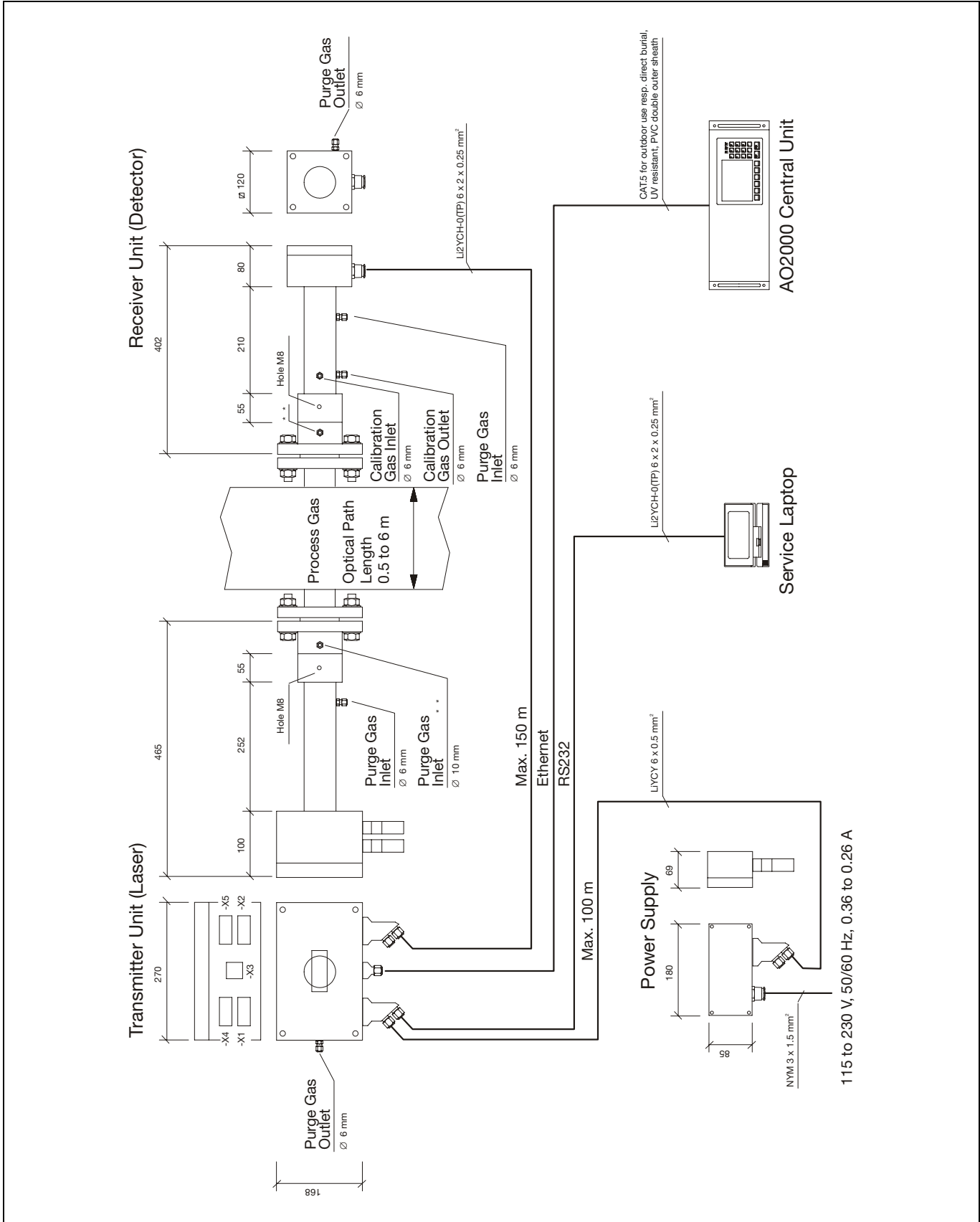
### Ambient Temperature

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

Storage and transport: –25 to +65 °C

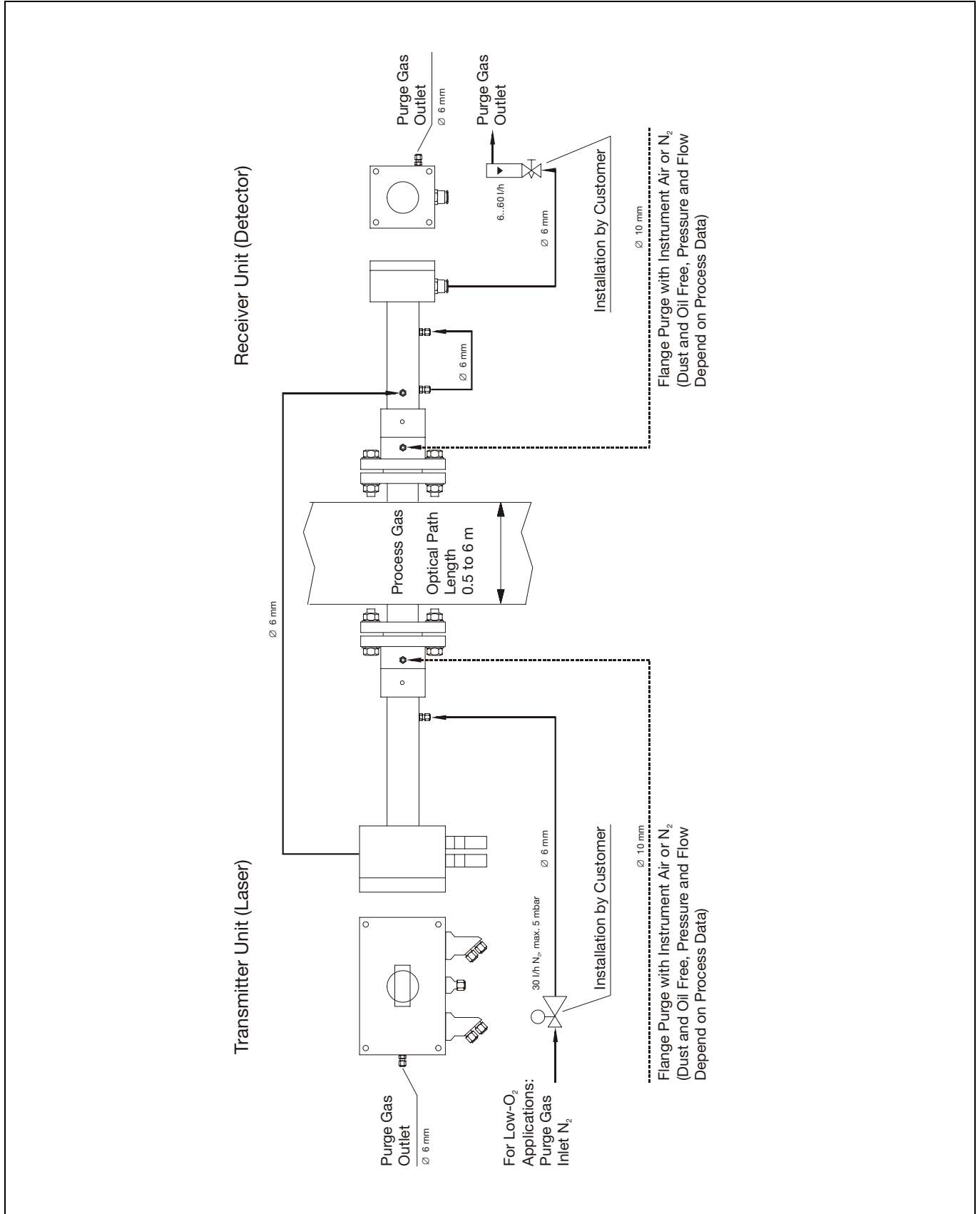
# Laser Analyzer Module LS25

## Dimensions and Electrical Connections (Ex-free application)



# Laser Analyzer Module LS25

## Gas Connections (Ex-free application)



# Oxygen Sensor

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## Measurement Principle

Electrochemical oxygen sensor

## Measurement Ranges

Smallest Measurement Range

0–5 Vol.-% O<sub>2</sub>

Measurement Range 1

Adjustable from 0–5 Vol.-% O<sub>2</sub> to 0–25 Vol.-% O<sub>2</sub>

Measurement Range 2

Set to 0–25 Vol.-% O<sub>2</sub>

## Stability

Linearity Deviation

Linear in the range > 1 Vol.-% O<sub>2</sub>

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

Detection Limit

≤ 0.5 % of the measurement range

## Calibration

End-Point Calibration

With ambient air at 20.96 Vol.-% O<sub>2</sub>

## 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.-% O<sub>2</sub> 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:  $p_{\text{abs}} = 600\text{--}1250$  hPa

## Dynamic Response

90% Response Time

$T_{90} \leq 30$  sec, depending on sample gas flow and system layout

## Materials in Contact with the Sample Medium

Sensor

Polystyrol-ABS, Teflon, Viton

Housing Body

PVC, Viton seals

Gas Ports

Rust- and acid-resistant steel 1.4571

## 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.

Moisture Content

H<sub>2</sub>O dew point ≥ 2 °C

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

Inlet Pressure

$p_e = 2\text{--}500$  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: H<sub>2</sub>S, 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 should be installed in the same housing with that analyzer module.

The oxygen sensor is connected to the analyzer module with Viton hoses. For this reason it cannot be used with the following analyzer modules:

- Uras14, Limas11 with stainless steel gas lines
- Magnos106, Magnos17, Caldos17 with direct sample cell connection
- Caldos15
- MultiFID14
- Analyzer modules in Category 2G



# Pneumatics Module

## Fine Filtration

Disposable Filter  
Borosilicate glass microfiber filter element

Retention Rate  
99.99 % for particles > 0.1  $\mu\text{m}$

## Test Gas Supply

Solenoids  
Available one or three 3/2-way solenoid valves

Power Consumption  
Approx. 3 W per solenoid

## Gas Supply

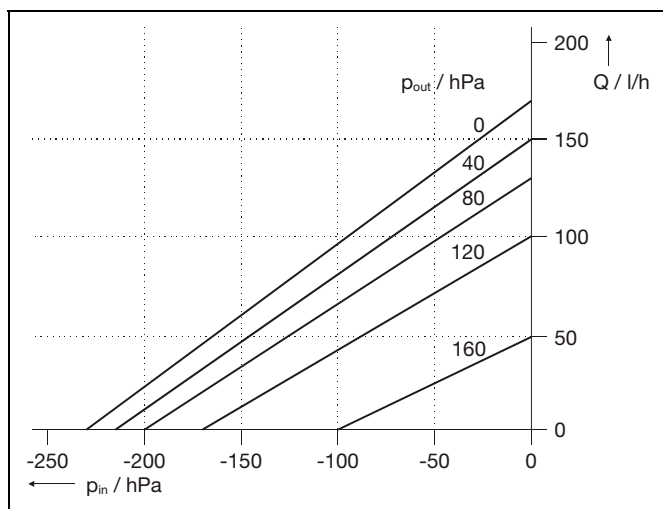
Pump  
Diaphragm pump

Feed Rate  
Max. of 60 l/h, depending on analyzer module and inlet/outlet pressure

Flow Rate  
Adjustable

Power Consumption  
Approx. 10 W

## Gas Supply Diagram



## Flow Monitor

Type  
Miniature flow sensor

Readout and Limit Value Monitoring  
Configurable

## Materials in Contact with the Sample Medium

Disposable Filter  
Nylon, borosilicate glass with PVDF binder

Solenoid  
PVDF, FPM

Pump  
PVDF, EPDM, 1.4571

Flow Monitor  
 $\text{Al}_2\text{O}_3$ , silicon, gold, GFK

Gas Lines and Connectors  
FPM, PVDF, PP

## Gas Inlet Conditions

Temperature  
+5 to +45  $^{\circ}\text{C}$   
The sample gas dew point should be at least 5  $^{\circ}\text{C}$  below the ambient temperature throughout the sample gas path. Otherwise a sample gas cooler or condensate trap is required.

Inlet Pressure  
 $p_e = -80$  to +20 hPa

Flow Rate  
30–60 l/h

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

Flammable Gas  
The pneumatics module should not be used if the sample gas is flammable.

## Notes

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

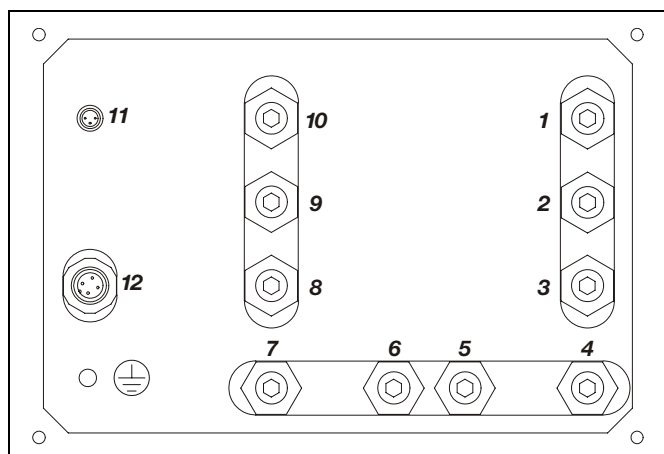
The pneumatics module is connected to the analyzer module with Viton hoses. For this reason it cannot be used with the following analyzer modules:

- Uras14, Limas11 with stainless steel gas lines
- Magnos106, Magnos17, Caldos17 with direct sample cell connection
- Caldos15
- MultiFID14
- Analyzer modules in Category 2G

# Analyzer Module Connection Drawings

## Uras14

Sample cells in series, internal gas connections with hoses, with or without pneumatics module

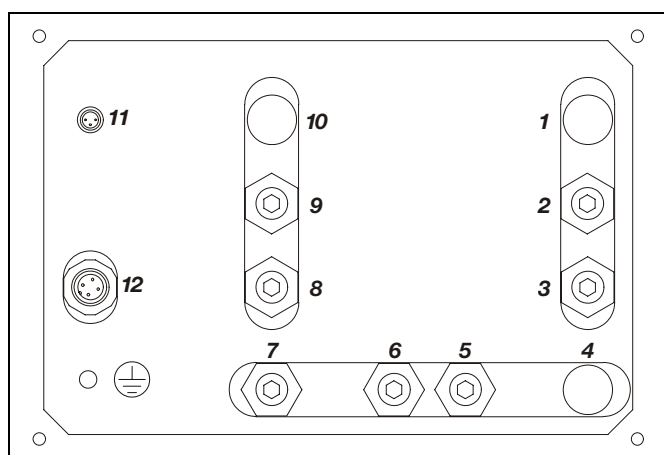


- 1 Sample Cell 1 Reference Gas Inlet <sup>1)</sup>
- 2 Sample Cell 1 Reference Gas Outlet <sup>1)</sup>
- 3 Sample Gas Outlet
- 4 Sample Cell 2 Reference Gas Inlet <sup>1)</sup>
- 5 Housing Purge Gas Inlet
- 6 Housing Purge Gas Outlet
- 7 Sample Cell 2 Reference Gas Outlet <sup>1)</sup> or Pressure Sensor <sup>1)</sup>
- 8 Sample Gas Inlet
- 9 Zero-Point Gas Inlet (with pneumatics module with 1 or 3 solenoids) <sup>1)</sup>
- 10 End-Point Gas Inlet (with pneumatics module with 3 solenoids) <sup>1)</sup>
- 11 System Bus
- 12 24 VDC Power Supply

1) Option

## Uras14

Parallel sample cells, internal gas connections with hoses or pipes, without pneumatics module

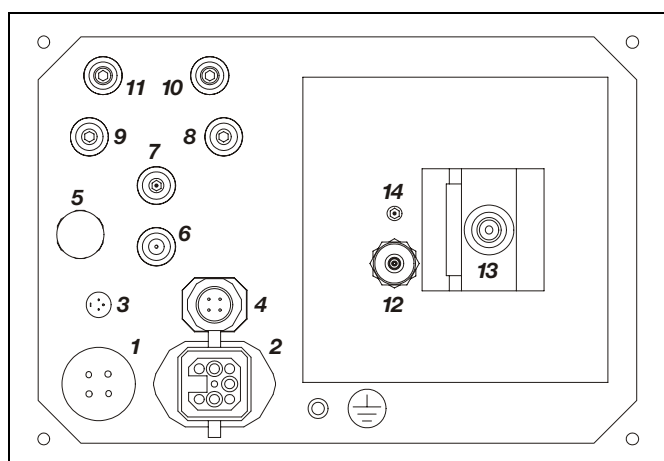


- 1 not used
- 2 Sample Cell 1 Sample Gas Inlet
- 3 Sample Cell 1 Sample Gas Outlet
- 4 not used
- 5 Housing Purge Gas Inlet
- 6 Housing Purge Gas Outlet
- 7 Pressure Sensor <sup>1)</sup>
- 8 Sample Cell 2 Sample Gas Outlet
- 9 Sample Cell 2 Sample Gas Inlet
- 10 not used
- 11 System Bus
- 12 24 VDC Power Supply

1) Option

**Note:** Two of the several possible Uras14 connection arrangements are shown. The actual connection arrangement of an analyzer module is found in the "Analyzer Data Sheet" for the delivered instrument.

## MultiFID14, MultiFID14 NMHC



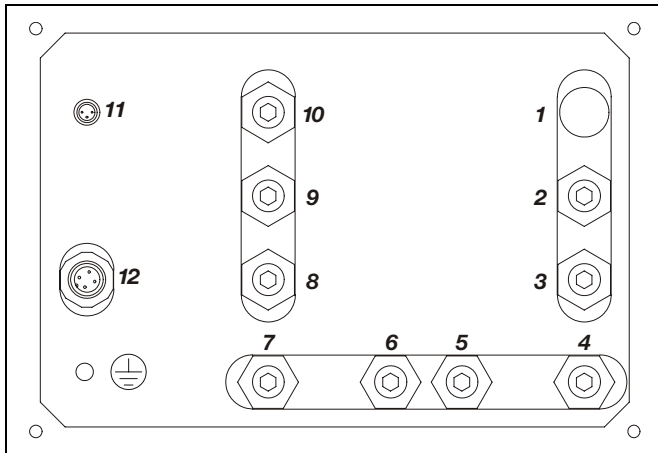
- 1 115 or 230 VAC Power Supply for Detector and Heated Sample Gas Connection
- 2 Electrical Connection to Heated Sample Gas Connection
- 3 System Bus
- 4 24 VDC Power Supply
- 5 Pressure Compensation Opening with Protection Filter
- 6 Instrument Air Inlet
- 7 Test Gas Outlet
- 8 End-Point Gas Inlet
- 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.

# Analyzer Module Connection Drawings

## Magnos106, Magnos17, Caldos17

### Internal gas connections with hoses, with or without pneumatics module

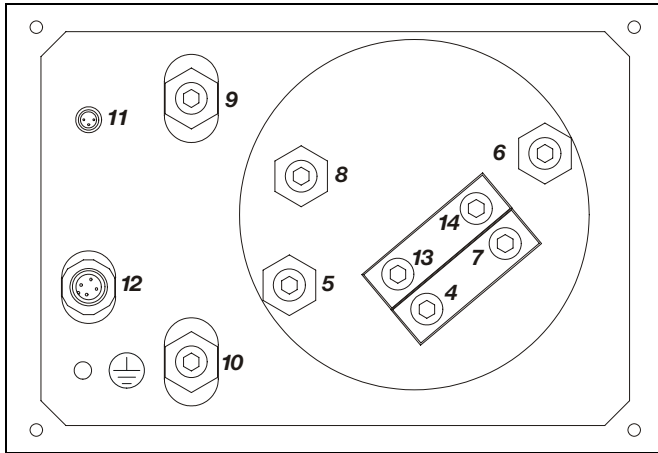


- 1 not used
- 2 End-Point Gas Inlet (with pneumatics module with 3 solenoids)<sup>1)</sup>
- 3 Zero-Point Gas Inlet (with pneumatics module with 1 or 3 solenoids)<sup>1)</sup>
- 4 Sample Gas Inlet
- 5 Analyzer Purge Gas Inlet
- 6 Analyzer Purge Gas Outlet
- 7 Sample Gas Outlet
- 8 Pressure Sensor (Magnos106<sup>1)</sup> and Caldos17 only)
- 9 Housing Purge Gas Outlet<sup>1)</sup>
- 10 Housing Purge Gas Inlet<sup>1)</sup>
- 11 System Bus
- 12 24 VDC Power Supply

1) Option

## Magnos17, Caldos15, Caldos17

### Internal gas connections directly to bottom of housing (wall-mount housing only<sup>3)</sup>), without pneum. module



- 4 Sample Gas Inlet
- 5 Analyzer Purge Gas Inlet
- 6 Analyzer Purge Gas Outlet
- 7 Sample Gas Outlet
- 8 Pressure Sensor (Caldos17 only)
- 9 Housing Purge Gas Outlet<sup>1)</sup>
- 10 Housing Purge Gas Inlet<sup>1)</sup>
- 11 System Bus
- 12 24 VDC Power Supply
- 13 Reference Gas Outlet<sup>2)</sup>
- 14 Reference Gas Inlet<sup>2)</sup>

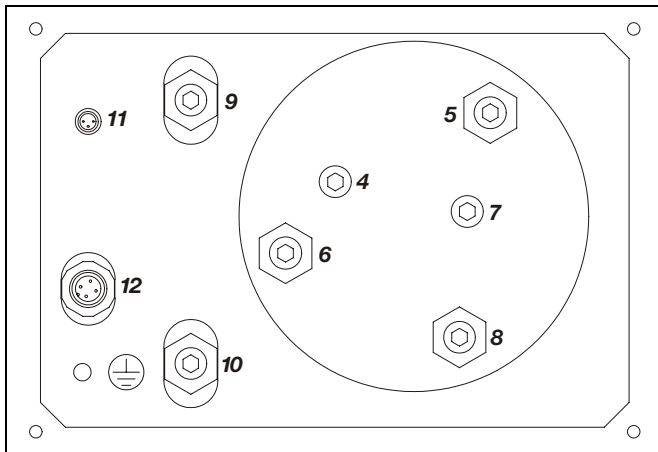
1) Option

2) Caldos15 with flowing reference gas only

3) For Caldos17, the direct sample cell connection is possible also in 19-inch housing.

## Magnos106

### Internal gas connections directly to bottom of housing (wall-mount housing only), without pneum. module



- 4 Sample Gas Inlet
- 5 Analyzer Purge Gas Inlet
- 6 Analyzer Purge Gas Outlet
- 7 Sample Gas Outlet
- 8 Pressure Sensor<sup>1)</sup>
- 9 Housing Purge Gas Outlet<sup>1)</sup>
- 10 Housing Purge Gas Inlet<sup>1)</sup>
- 11 System Bus
- 12 24 VDC Power Supply

1) Option

# Explosion Protected Model in Category 2G: Analyzer Modules


## Description

The AO2060-Caldos15, -Caldos17, -Magnos106 and -Uras14 analyzer modules in category 2G are capable of measuring flammable and non-flammable gases under atmospheric conditions which can form an explosive environment (Zone 1).

Analyzer modules in category 2G have "Flameproof Enclosure" explosion protection per EN 50018. All gas connections are routed via flame barriers.

## Explosion Protection

Designation

 II 2G EEx d IIC T4

Compliance Certification

DMT 03 ATEX E 009 X

## Special Measurement-Relevant Data

Flow Effect

AO2060-Caldos15, -Caldos17: as standard analyzer module  
AO2060-Magnos106: Sample gas air: 0.1 Vol.-% O<sub>2</sub> at a flow rate change of ±10 l/h; sample gas N<sub>2</sub>: per standard analyzer module  
AO2060-Uras14: 0.5 % of span at a flow rate change of ±10 l/h

Pressure Drop at Flame Barriers

Sample Gas or Reference Gas Inlet: Approx. 40 hPa at a flow rate of 50 l/h  
Purge gas inlet: Approx. 20 hPa at a flow rate of 10 l/h

## Housing

Design

Pressure-tight aluminum cylinder

Housing Protection Type

IP 54 (horizontally mounted with O-ring seals only)

Dimensions

See dimensional drawing on page 45

Weight

Approx. 26 kg

Housing Purge

To avoid corrosion in corrosive environments or when using corrosive sample or associated gases an option is available to allow the housing to be purged with air from the ex-free area; purge gas pressure  $p_{abs} \leq 1080$  hPa.

## Gas Connections

Layout and Design

Gas ports with internal flame barriers on the bottom of the pressure-tight cylinder with 1/8 NPT internal threads for commercially available adapters, e.g. Swagelok®

## Electrical Connections

System Bus, Power Supply

Two 10-meter long cables (8 x 0.5 mm<sup>2</sup> and 3 x 2.5 mm<sup>2</sup>) securely fastened to the analyzer module and routed through sealed cable openings. The cables should not be shortened to a length of ≤ 1 meter.

## Gas Inlet Conditions

Sample Gas

Flammable and non-flammable gases under atmospheric conditions which can form an explosive environment. The maximum oxygen content of the sample gas mixture should be 21 Vol.-%, corresponding to atmospheric conditions.

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 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.

The analyzer modules in category 2G must not be used to measure chlorine-containing gases.

Temperature

AO2060-Caldos15, -Caldos17, -Magnos106: +5 to +50 °C  
AO2060-Uras14: +5 to +45 °C

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

$p_e \leq 100$  hPa /  $p_{abs} \leq 1100$  hPa

Flow Rate

Maximum of 100 l/h, but not greater than in the non-explosion protected version of the analyzer module.

## Power Supply

Input Voltage

24 VDC ± 5 %, Safe Low Voltage (SELV) or Operational Low Voltage with definite isolation (PELV), maximum value in failure mode 35 V

## Environmental Conditions

The analyzer modules must not be installed outdoor.

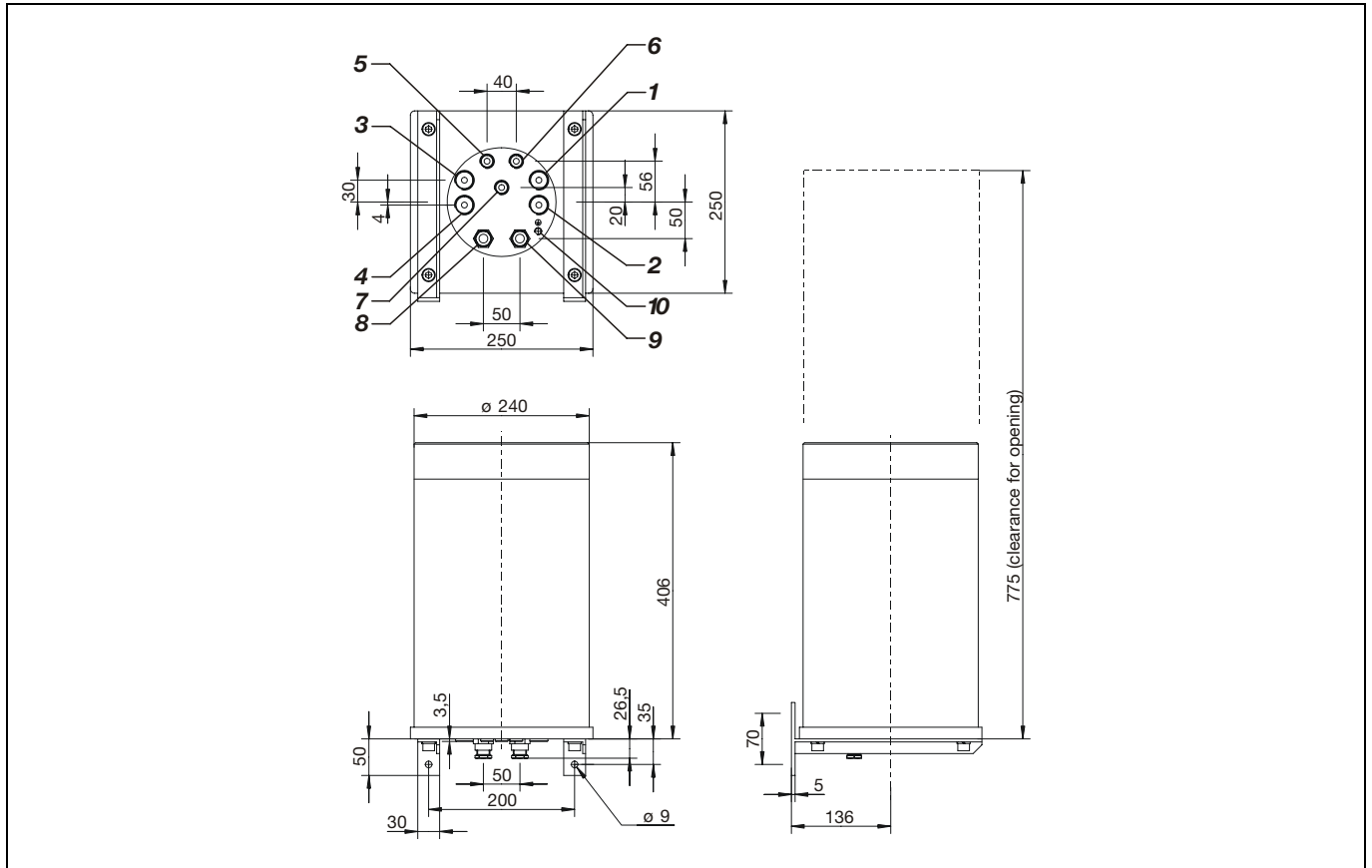
Ambient Temperature

Storage and transport: -25 to +65 °C; Operation:  
AO2060-Caldos15, -Caldos17, -Magnos106: +5 to +50 °C,  
AO2060-Uras14: +5 to +45 °C

The explosion protection is not impaired if the gas analyzer is operated at temperatures less than +5 °C and down to -20 °C. However in this temperature range the compliance with the metrological data cannot be guaranteed.

# Explosion Protected Model in Category 2G: Analyzer Modules

## Dimensional and Connection Drawing (dimensions in mm)



### AO2060-Uras14

Gas Connections:

- 1 ) The actual sample gas inlet and outlet configuration
- 2 ) is documented in the "Analyzer Data Sheet" supplied
- 3 ) with the instrument.
- 4 )
- 5 Purge Gas Inlet <sup>1)</sup>
- 6 Purge Gas Outlet <sup>1)</sup>
- 7 Pressure Sensor <sup>2)</sup>

Electrical Connections:

- 8 System Bus
- 9 24 VDC Power Supply
- 10 Potential Compensation Connector

- 1) Option
- 2) The pressure sensor connection should not be connected to the sample gas path.

### AO2060-Caldos15, -Caldos17, -Magnos106

Gas Connections:

- 1 Sample Gas Inlet
- 2 Sample Gas Outlet
- 3 not used
- 4 not used
- 5 Purge Gas Inlet <sup>1)</sup>
- 6 Purge Gas Outlet <sup>1)</sup>
- 7 Pressure Sensor <sup>2)</sup> (Magnos106 <sup>1)</sup> and Caldos17 only)

Electrical Connections:

- 8 System Bus
- 9 24 VDC Power Supply
- 10 Potential Compensation Connector

- 1) Option
- 2) The pressure sensor connection should not be connected to the sample gas path.

# Explosion Protected Model in Category 2G: Central Unit

---

## Description

The AO2040-CU Ex central unit in category 2G is used in conjunction with the AO2060-Caldos15, -Caldos17, -Magnos106 and -Uras14 analyzer modules.

The system housing is configured as a wall-mount unit. It is designed for ignition suppression per EN 50016 "Pressurized Apparatus with Leak Compensation". The required control unit is mounted on the outside left sidewall of the system housing.

Intrinsically safe and non-intrinsically safe signal circuits can be brought into the central unit in category 2G. Non-intrinsically safe circuits which remain energized when the positive pressure containment is switched off must be connected to isolation relays. Intrinsically safe circuits must be connected to suitable isolators. The display and control unit circuits underneath the keypad sheet are intrinsically safe.

## Explosion Protection

Designation

 II 2G EEx ped [ib] IIC T4

Compliance Certification

DMT 03 ATEX E 006

## Gas Data

Minimum Flow Rate

Preliminary purge: 1 l/sec; during operation, to compensate leak losses: approx. 40 l/h at 2 hPa

Preliminary Purge Volume

320 l / 1100 l without/with ER 144A/Ex or Contrans I

Pre-Pressure

$p_e = 250$  to 500 kPa

Ignition Suppression Gas

Air, Quality per ISO 8573-1 class 3 (max. particle size 40  $\mu\text{m}$ , max. oil content 1  $\text{mg}/\text{m}^3$ , max. pressure dew point +3  $^\circ\text{C}$ )

Ignition Suppression Gas Connection

G 1/4 inch internal thread

## Housing

Design

Wall-mount housing

Housing Protection Type

IP 54

Dimensions

See dimensional drawing on page 47

Weight

Approx. 28 kg

## Electrical Connections

Output and Input Signals

Intrinsically Safe Circuits: Via ER 144A/Ex or Contrans I modules (e.g. condensation monitor or flow rate monitor)  
Connection data are shown on the conformity certificates of the modules.

Non-Intrinsically Safe Circuits: Via isolation relays (e.g. measurement signals, status signals), max. 30 VDC/0.4 A

System Bus

Via isolation relays

The terminating resistor is inserted in the electronics module.

Power Supply

Connection on positive pressure containment monitor control unit

## Power Supply

Input Voltage

230 VAC or 115 VAC (non-switchable), 48 to 62 Hz

Power Consumption

Approx. 190 VA

## Environmental Conditions

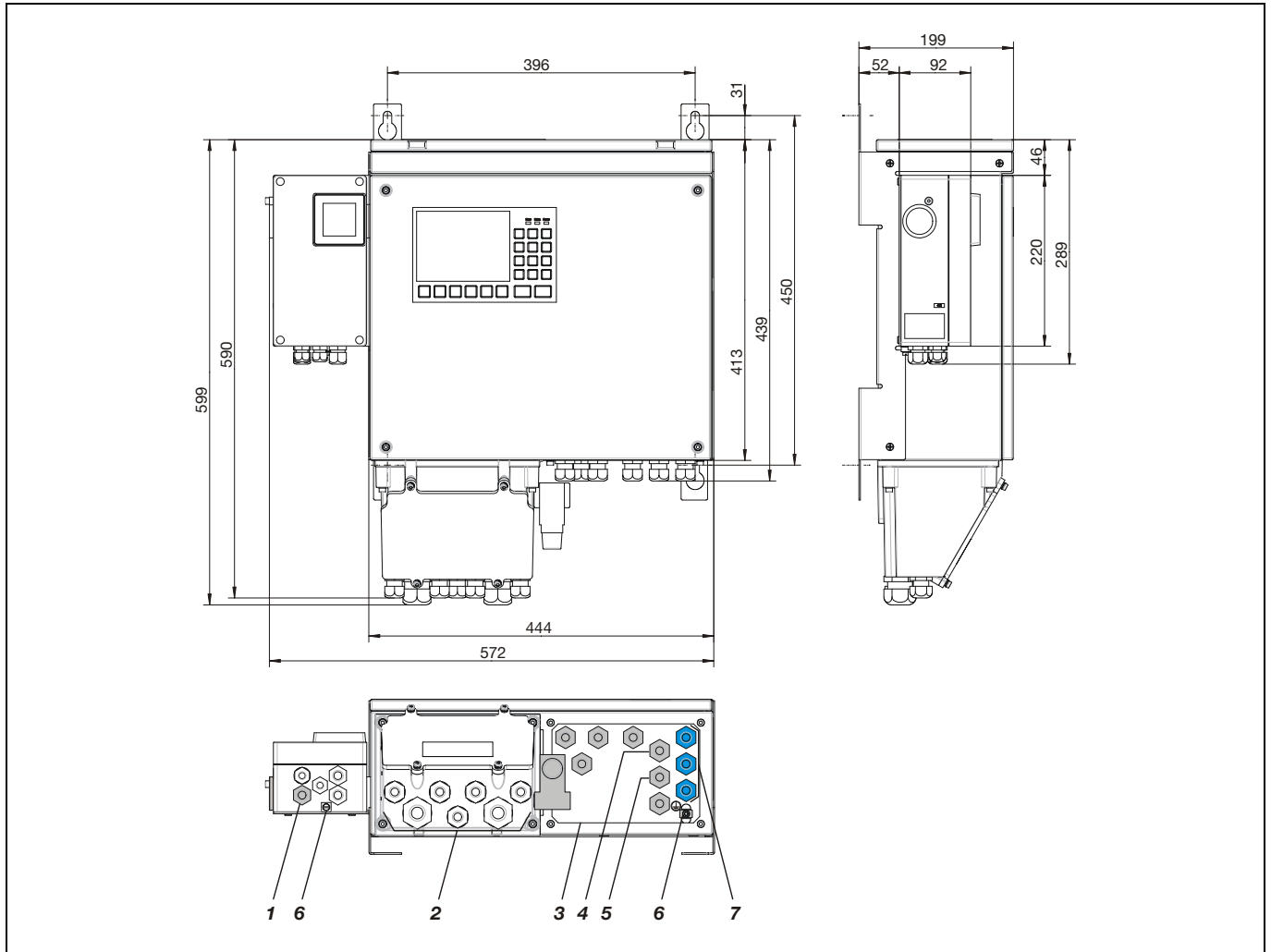
Ambient Temperature

Operation: +5 to +50  $^\circ\text{C}$ ,

Storage and transport: -25 to +65  $^\circ\text{C}$

# Explosion Protected Model in Category 2G: Central Unit

## Dimensional and Connection Drawing (dimensions in mm)



- 1** Cable Opening M20 for Power Supply on Positive Pressure Containment Monitoring Control Unit
- 2** Cable Openings for Internal Wiring Connections
- 3** Connection Plate with 5 Cable Openings M20 for Non-Intrinsically Safe Connection Lines
- 4** Metal Cable Opening M20 for Shielded System Bus Cable of the AO2060-... Analyzer Module
- 5** Cable Opening M20 for 24 VDC Connection Cable of the AO2060-... Analyzer Module
- 6** Potential Compensation Connector
- 7** 3 Cable Openings M20 for Intrinsically Safe Connection Lines

# Explosion Protected Model in Category 3G

## Version for Measurement of Flammable and Non-flammable Gases ("Safety Concept")

The "Safety Concept" gas analyzers include:

- AO2020/AO2040-Limas11 and AO2020/AO2040-Uras14 in the version with safety cell and purged sample cell windows
- AO2040-Caldos15, AO2020/AO2040-Caldos17 and AO2040-Magnos106 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) and is built to EN 50021 and IEC 60079-2. 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 and
- Simplified positive pressure containment per IEC 60079-2.

Designation

 II 3G EEx nAP T4/T6

Compliance Certification

BVS 03 E 267 X

Housing Protection Type

IP 54

## Sample Gas Inlet Conditions

Sample Gas

- Flammable and non-flammable gases and vapors
  - under atmospheric conditions ( $p_{\text{abs}} \leq 1.1$  bar, oxygen content  $\leq 21$  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 (N<sub>2</sub>)

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, Uras14: 1.6 minutes at min. 15 l/h

Caldos15, Caldos17, Magnos106: 33 minutes at min. 15 l/h or 10 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

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

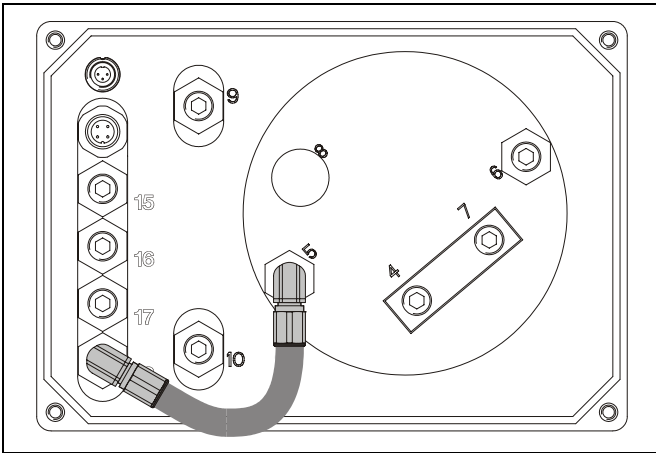
IP 54



# Explosion Protected Model in Category 3G

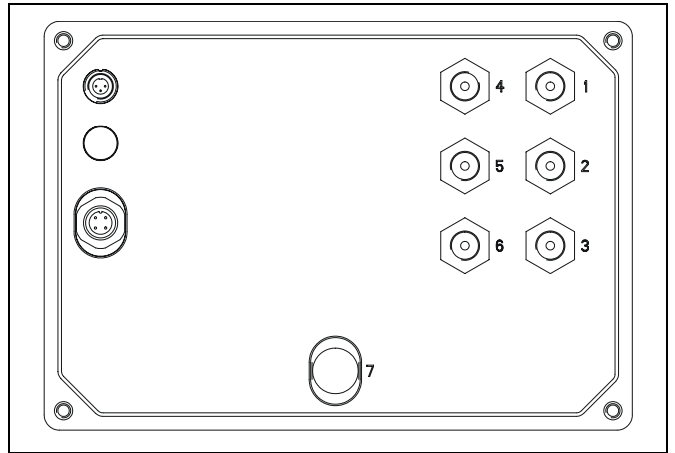
## “Safety Concept” Connection Drawings

AO2040-Caldos15, AO2020 / AO2040-Caldos17



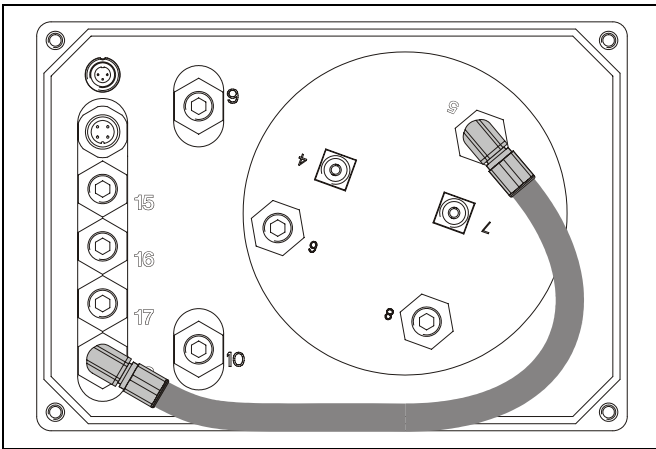
- 4 Sample gas inlet
- 5 Purge gas outlet thermostat chamber
- 6 Purge gas inlet thermostat chamber “Analyzer Purge In”
- 7 Sample gas outlet
- 8 Pressure sensor
- 9 Housing purge gas outlet
- 10 Housing purge gas inlet
- 15 not used, sealed
- 16 not used, sealed
- 17 Purge gas outlet flow rate monitor “Analyzer Purge Out”
- 18 Purge gas inlet flow rate monitor

AO2020 / AO2040-Limas11



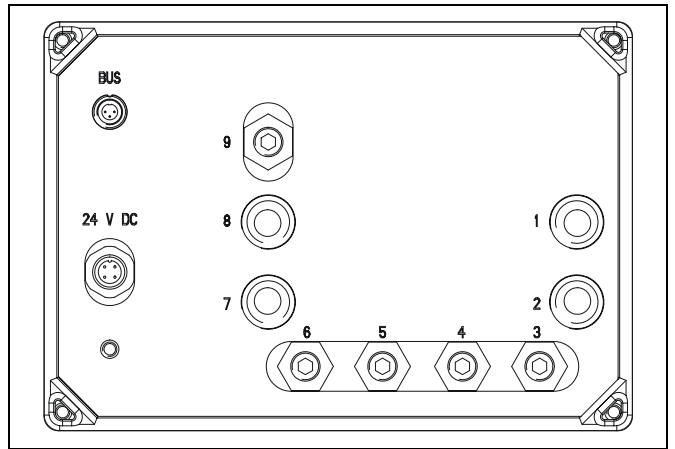
- 1 Sample gas inlet
- 2 Sample gas outlet
- 3 Housing purge gas inlet
- 4 Purge gas inlet sample cell windows “Analyzer Purge In”
- 5 Purge gas outlet flow rate monitor “Analyzer Purge Out”
- 6 Housing purge gas outlet
- 7 Pressure sensor (option)

AO2040-Magnos106



- 4 Sample gas inlet
- 5 Purge gas outlet thermostat chamber
- 6 Purge gas inlet thermostat chamber “Analyzer Purge In”
- 7 Sample gas outlet
- 8 Pressure sensor
- 9 Housing purge gas outlet
- 10 Housing purge gas inlet
- 15 not used, sealed
- 16 not used, sealed
- 17 Purge gas outlet flow rate monitor “Analyzer Purge Out”
- 18 Purge gas inlet flow rate monitor

AO2020 / AO2040-Uras14



- 1 Sample gas inlet beam path 1
- 2 Sample gas outlet beam path 1
- 3 Purge gas inlet sample cell windows “Analyzer Purge In”
- 4 Housing purge gas inlet
- 5 Housing purge gas outlet
- 6 Purge gas outlet flow rate monitor “Analyzer Purge Out”
- 7 Sample gas outlet beam path 2
- 8 Sample gas inlet beam path 2
- 9 Pressure sensor (option)

# Certifications

## CE Declaration of Conformity

AO2000 satisfies 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 61326-1:1997, EN 61326/A1:1998, EN 61326/A2:2001, EN 61000-3-2:1998 + A14/2000 and EN 61000-3-3:1995.

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.

## Approval for USA and Canada – CSA

AO2000 with housing, electronics module, pneumatics module and the Uras14, Limas11IR, Limas11UV, Limas11HW, Magnos106, Magnos17, Caldos15, Caldos17, LS25, ZO23, MultiFID14 and MultiFID14 NMHC analyzer modules is certified to

- Class 2258 01 Process Control Equipment and
- Class 2258 81 Process Control Equipment – Certified to U.S. Standards

Certificate No. 1105720

## Approval for Russian Federation – GOST-R

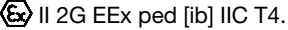
GOST-R and Metrological Certificates are available for AO2000 with housing, electronics module, pneumatics module and the Uras14, Limas11IR, Limas11UV, Limas11HW, Magnos106, Magnos17, Caldos15, Caldos17, LS25, ZO23 and MultiFID14 analyzer modules.

## Explosion Protection

### Explosion Protection to European Standards

AO2040-CU Ex central unit in category 2G satisfies the following European standards:

- EN 50014:1997 + A1 – A2 General requirements
- EN 50016:1995 Pressurized apparatus "p"
- EN 50018:2000 Flame-proof enclosure "d"
- EN 50019:2000 Increased safety "e"
- EN 50020:1994 Intrinsic safety "i"

The designation is  II 2G EEx ped [ib] IIC T4.

EC-Type Examination Certificate No. DMT 03 ATEX E 006

AO2060-Caldos15, -Caldos17, -Magnos106 and -Uras14 analyzer modules in category 2G and 3G (flammable sample gas) satisfy the following European standards:


- EN 50014:1997 + A1 – A2 General requirements
- EN 50018:2000 Flame-proof enclosure "d"

The designation is  II 2G EEx d IIC T4.

EC-Type Examination Certificate No. DMT 03 ATEX E 009 X

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 Tamb: 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 standards:

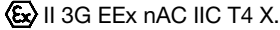
- EN 50021:1999 Ignition prevention type "n"
- IEC 60079-2

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 standard:

- EN 50021:1999 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 the Uras14, Limas11IR, Limas11UV, Limas11HW, Magnos106, Magnos17, Caldos15, Caldos17 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

## Explosion Protection for Russian Federation – GOST-R

**Category 3G:** GOST-R and Metrological Certificates and a Gosortekhnadzor license are available for the AO2040 model with the Uras14, Limas11IR, Limas11UV, Magnos106, Magnos17, Caldos15, Caldos17 und MultiFID14 analyzer modules.

**Category 2G:** GOST-R and Metrological Certificates and a Gosortekhnadzor license are available for the AO2040-CU Ex central unit and the AO2060-Uras14, -Caldos15, -Caldos17 and -Magnos106 analyzer modules.

### Note Regarding the Analyzer Module Performance Characteristics

The analyzer module 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 N<sub>2</sub> as the associated gas. Compliance with these characteristics when measuring other gas mixtures can only be assured if their composition is known.

# Sample Components and Analyzer Modules

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

In each case, the smallest measurement ranges are given. Please see the specifications of the individual analyzer modules.

Sample Component	Requirements (Examples)	Smallest Meas. Range	Analyzer Module	Data	
Acetylene	C <sub>2</sub> H <sub>2</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
Ammonia	NH <sub>3</sub>	Process measurement	Uras14	Page 12	
Argon	Ar in N <sub>2</sub>	Especially short T <sub>90</sub> time	Caldos17	Page 30	
	Ar in O <sub>2</sub>	Especially short T <sub>90</sub> time	Caldos17	Page 30	
Butane	C <sub>4</sub> H <sub>10</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
Chlorine	Cl <sub>2</sub>	Corrosive gases	Limas11 UV	Page 14	
Nitrous Oxide	N <sub>2</sub> O	Small measurement ranges	Uras14	Page 12	
Ethane	C <sub>2</sub> H <sub>6</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
Ethylene	C <sub>2</sub> H <sub>4</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
Helium	He in N <sub>2</sub>	Especially short T <sub>90</sub> time	Caldos17	Page 30	
Hexane	C <sub>6</sub> H <sub>14</sub>	Selective measurement	Uras14	Page 12	
Refrigerant	R 134a	Small measurement ranges	Uras14	Page 12	
Carbon Dioxide	CO <sub>2</sub>	Small measurement ranges	Uras14	Page 12	
		Corrosive/toxic/flammable gases	Limas11 IR	Page 14	
	CO <sub>2</sub> in N <sub>2</sub> or air	Especially short T <sub>90</sub> time	Caldos17	Page 30	
Carbon Disulfide	CS <sub>2</sub>	Toxic/flammable gases	Limas11 UV	Page 14	
Carbon Monoxide	CO	Small meas. ranges, emission measurement	Uras14	Page 12	
		Toxic/flammable gases, process	Limas11 IR	Page 14	
Carbon Oxide Sulfide	COS	Toxic/flammable gases	Limas11 UV	Page 14	
Hydrocarbons	Total	Fast hot measurement	MultiFID14	Page 32	
	C <sub>n</sub> H <sub>m</sub> - CH <sub>4</sub>	Non-methane measurement	MultiFID14 NMHC	Page 34	
Methane	CH <sub>4</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
	CH <sub>4</sub> in N <sub>2</sub>	Especially short T <sub>90</sub> time	Caldos17	Page 30	
	CH <sub>4</sub> in N <sub>2</sub> or air	Especially short T <sub>90</sub> time	Caldos17	Page 30	
Propane	C <sub>3</sub> H <sub>8</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
Propylene	C <sub>3</sub> H <sub>6</sub>	Small meas. ranges, selective measurement	Uras14	Page 12	
		Flammable gases, selective measurement	Limas11 IR	Page 14	
Hydrochloric Acid	HCl	Corrosive gases	Limas11 IR	Page 14	
Oxygen	O <sub>2</sub>	Magnetomechanical measurement principle	0-1 Vol.-%	Magnos106	Page 22
		Trace measurement with ZrO <sub>2</sub> cell	0-1 ppm	ZO23	Page 26
		Electrochemical measurement principle	0-5 Vol.-%	Oxygen sensor	Page 40
	O <sub>2</sub> in N <sub>2</sub>	Thermomagnetic measurement principle	0-3 Vol.-%	Magnos17	Page 24
	O <sub>2</sub> in flue gas	Thermomagnetic measurement principle	0-3 Vol.-%	Magnos17	Page 24
Sulfur Dioxide	SO <sub>2</sub>	Emission measurement	0-25 ppm	Uras14	Page 12
		Corrosive gases	0-25 ppm	Limas11 UV	Page 14
	SO <sub>2</sub> in N <sub>2</sub> or air	Corrosive gases	0-1.5 Vol.-%	Caldos15	Page 28
Hydrogen Sulfide	H <sub>2</sub> S	Exhaust gas, process measurement	0-25 ppm	Limas11 UV	Page 14
Nitrogen Dioxide	NO <sub>2</sub>	Corrosive gases	0-125 ppm	Limas11 UV	Page 14
		Combustion exhaust gas	0-40 ppm	Limas11 HW	Page 18
Nitrogen Monoxide	NO	Emission measurement	0-150 ppm	Uras14	Page 12
		Small measurement ranges	0-10 ppm	Limas11 UV	Page 14
		Combustion exhaust gas	0-25 ppm	Limas11 HW	Page 18
Hydrogen	H <sub>2</sub> in Ar	Especially short T <sub>90</sub> time	0-0.25 Vol.-%	Caldos17	Page 30
	H <sub>2</sub> in Cl <sub>2</sub>	Corrosive gases	0-0.5 Vol.-%	Caldos15	Page 28
	H <sub>2</sub> in stack gas	Especially short T <sub>90</sub> time	0-0.5 Vol.-%	Caldos17	Page 30
	H <sub>2</sub> in N <sub>2</sub>	Especially short T <sub>90</sub> time	99-100 Vol.-%	Caldos17	Page 30
	H <sub>2</sub> in N <sub>2</sub> or air	Corrosive gases	0-0.5 Vol.-%	Caldos15	Page 28
		Especially short T <sub>90</sub> time	0-0.3 Vol.-%	Caldos17	Page 30

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