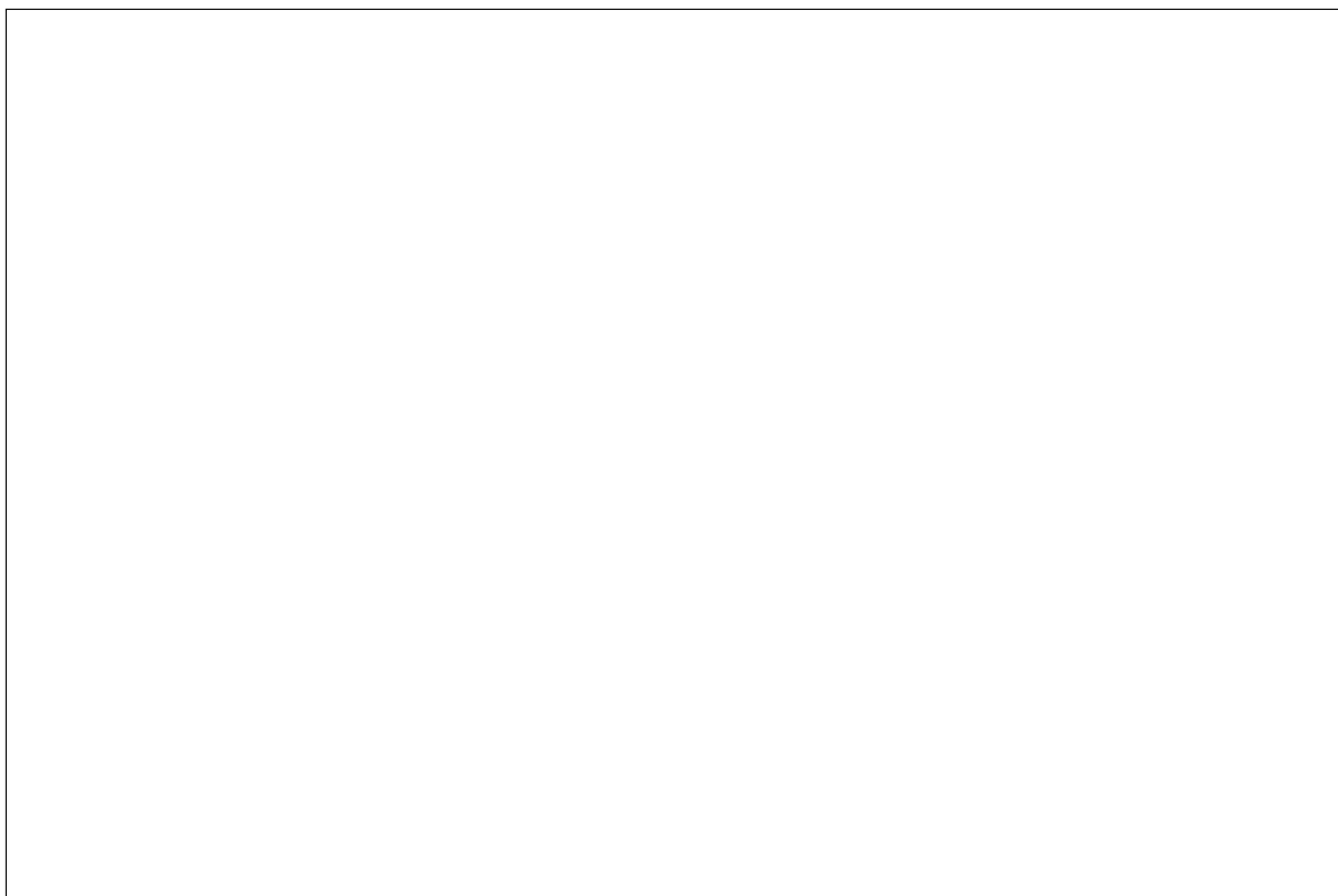


AO2000 Series Continuous Gas Analyzers
AO2000-MultiFID14 FID Analyzer

Start-Up and Maintenance Manual

41/24-105 EN Rev. 3



AO2000 Series Continuous Gas Analyzers

AO2000-MultiFID14 FID Analyzer

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Some Preliminary Comments ...

... on the contents of the start-up and maintenance manual

This Start-Up and Maintenance Manual for the AO2000-MultiFID14 FID Analyzer is a supplement to the Operator's Manual for the AO2000 Series Continuous Gas Analyzers.

It contains all information you need to install, start up, calibrate and maintain the analyzer. However, it does not contain any information on the operator interface, configuration and initialization of the analyzer; this can be found only in the AO2000 Series Operator's Manual.

... on additional documentation

In addition to the existing start-up and maintenance manual, the following publications are available for the AO2000 Series Continuous Gas Analyzers:

Operator's Manual Publication No. 42/24-10 EN
Specification Sheet Publication No. 10/24-1.10 EN

These publications can be ordered from your authorized ABB representative or from

ABB Automation GmbH, Analytical Division, Marketing Communication,
Telefax: +49-69-79 30-45 66, E-mail: analytical-mkt.deapr@de.abb.com

... on further information in the Internet

Further information on the products and services of ABB Analytical will be found in the Internet at "<http://www.abb.com/analytical>".

... on symbols and font style in the operator's manual



indicates safety notices which must be followed while handling the analyzer, in order to prevent danger to the operator.



indicates special features for handling the analyzer and for using this Start-Up and Maintenance Manual.


1, 2, 3, ... identifies reference numbers in the figures.

Display identifies an indication in the display.

Input identifies an input by the operator

- either by pressing a softkey
- or by selecting a menu item
- or by input from the numeric keypad

General Safety Notes

Intended Application	The AO2000-MultiFID14 analyzer is designed for continuous measurement of hydrocarbon concentration in gases or vapors.
Prerequisite for Safe Operation	To ensure error-free and safe operation of the analyzer, it must be appropriately transported and stored, professionally installed and started up, and also properly operated and carefully serviced.
Personnel Qualification	Only persons familiar with installation, start-up, operation and servicing of comparable instruments and having the qualification necessary for their activity may work on the analyzer.
Notices and Regulations to be Followed	<p>The following requirements are mandatory:</p> <ul style="list-style-type: none">• the content of this operator's manual,• the safety notices attached to the analyzer,• the pertinent safety regulations for erection and operation of electrical installations and• the pertinent safety regulations for handling gases, acids, condensate, etc.
National Codes	The ordinances, standards and guidelines cited in this operator's manual are applicable in the Federal Republic of Germany. When the analyzer is used in other countries, the pertinent national codes must be followed.
Analyzer Safety and Safe Operation	<p>The analyzer is built and tested per EN 61010 Part 1, "Safety regulations for electrical measuring, control, regulation and laboratory instruments", and was in safe condition when it left the factory.</p> <p>To preserve this condition and ensure safe operation, the safety notices identified with the symbol  in this operator's manual must be followed. Otherwise persons may be endangered and the analyzer itself as well as other instruments and equipment may be damaged.</p>
Notice on Explosion Protection	The AO2000-MultiFID14 analyzer must not be used for measurement of gas/air or gas/oxygen mixtures capable of exploding during operation. When measuring combustible gas that can form an explosive mixture with air or oxygen, special precautions must be taken to prevent the risk of explosion.
Further Information	<p>If the information in this operator's manual does not cover a particular situation, ABB Service is prepared to supply additional information as needed.</p> <p>Contact your local ABB service representative or</p> <p>ABB Service, Telephone: +49-180-5-12 35 80, Telefax: +49-6 21-3 81-51 35, E-mail: callcenter.automation@de.abb.com</p>


Safety Notes for Handling Electronic Measuring Instruments

Protective Lead Terminal	The connection between the protective lead terminal and a protective lead must be made before all other connections.
Danger of Broken Protective Lead	The analyzer may constitute a danger if the protective lead is broken inside or outside the analyzer or if the protective lead terminal becomes loose.
Correct Operating Voltage	Before turning on the power supply make sure the operating voltage selected on the analyzer matches the line voltage.
Danger when Opening Covers	Live parts may be exposed when opening covers or removing parts, even if tools are not needed to do so. Terminal points may also be live.
Danger when Working on the Opened Analyzer	Before work is done on the opened analyzer, the analyzer must be isolated from all voltage sources. Only professionals familiar with the dangers involved are permitted to work on the opened analyzer under voltage.
Danger due to Charged Capacitors	A period of 10 minutes after the analyzer has been isolated from all voltage sources is needed before the capacitors in its power supply are discharged.
Use of Correct Fuses	Only fuses of the specified type and rated current are permitted as replacements. Rewired fuses must not be used. The fuse holder must not be short-circuited.
If Safe Operation is no Longer Possible	<p>If it must be assumed that safe operation is no longer possible, the analyzer must be shut down and secured against inadvertent operation.</p> <p>It must be assumed that safe operation is no longer possible</p> <ul style="list-style-type: none">• when the analyzer is visibly damaged,• when the analyzer is no longer working,• after prolonged storage under unfavorable conditions,• after severe stresses and strains during shipping.

Installation Location Requirements

Short Gas Paths	<p>Install the analyzer as close as possible to the sampling location</p> <p>Locate the gas conditioning and calibration modules as close as possible to the analyzer.</p>								
Adequate Air Circulation	<p>Provide for adequate natural air circulation around the analyzer. Avoid heat buildup.</p> <p>When installing several system housings in a 19-inch rack, maintain a minimum spacing of 1 height unit between housings.</p> <p>The entire surface of the system housing is used to dissipate heat.</p>								
Protection from Adverse Conditions	<p>Protect the analyzer from:</p> <ul style="list-style-type: none">• Cold• Direct sunlight and heat• Large temperature variations• Strong air currents• Accumulations of dust and dust infiltration• Corrosive atmospheres• Vibration								
Environmental Conditions	<table><tr><td>Atmospheric pressure</td><td>600 to 1250 hPa</td></tr><tr><td>Relative humidity</td><td>max. 75 %</td></tr><tr><td>Ambient temperature at storage and transport</td><td>-25 to +65 °C</td></tr><tr><td>Ambient temperature in operation</td><td>+5 to +45 °C</td></tr></table>	Atmospheric pressure	600 to 1250 hPa	Relative humidity	max. 75 %	Ambient temperature at storage and transport	-25 to +65 °C	Ambient temperature in operation	+5 to +45 °C
Atmospheric pressure	600 to 1250 hPa								
Relative humidity	max. 75 %								
Ambient temperature at storage and transport	-25 to +65 °C								
Ambient temperature in operation	+5 to +45 °C								

Gas Inlet Conditions

 The gas inlet conditions listed in the following tables apply to the inlet of the analyzer module.

Definition

$$p_e = p_{abs} - p_{amb}$$

where p_e = gauge pressure, p_{abs} = absolute pressure, p_{amb} = atmospheric pressure


Sample Gas


Temperature	Inlet Pressure p_{abs}	Flow Rate
≤ Thermostat temperature (Thermostat temperature for measurement gas path, detector and air injector ≤ 200 °C, factory-set to 180 °C)	800 to 1200 hPa (0.8 to 1.2 bar)	80 to 100 l/h

Supply Gases

Type, Quality	Inlet Pressure p_e	Flow Rate
Instrument air:		
Quality per ISO 8573-1 class 2 (max. particle size 1 µm, max. particle concentration 1 mg/m ³ , max. oil content 0.1 mg/m ³ , max. pressure dew point -20 °C)	4000 ± 500 hPa ²⁾ (4.0 ± 0.5 bar)	approx. 1500 l/h ¹⁾
Combustion air:		
synthetic or catalytically purified air with an organic C content < 1 % of span	1200 ± 100 hPa ²⁾ (1.2 ± 0.1 bar)	< 40 l/h
Combustion gas³⁾:		
H ₂ , 5.0 grade or	1200 ± 100 hPa ²⁾ (1.2 ± 0.1 bar)	≤ 3 l/h or
H ₂ /He mixture (40 %/60 %) ⁴⁾		approx. 8 l/h

- 1) typical value (1200 l/h for integrated air injection + approx. 300 l/h for housing purge), maximum 2300 l/h (1800 l/h + 500 l/h)
- 2) typical value; for start-up (see “Analyzer Module Start-Up” section, page 32), the pressure must be set to that value specified in the analyzer data sheet.
- 3) Provide a flow limiter on the hydrogen supply.
- 4) H₂/He mixtures should only be used if the analyzer has been ordered and delivered in the proper configuration.

 If the analyzer has been delivered in the H₂/He mixture configuration, H₂ should never be used as the combustion gas. This will lead to overheating and destruction of the detector.

 Inlet pressures must be constant during operation. This can be ensured by using two-stage pressure-reducing valves.

Test Gases

Type, Quality	Inlet Pressure p_e	Flow Rate
Zero gas:		
N ₂ , 5.0 grade or synthetic or catalytically purified air with an organic C content < 1 % of span	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h
Span gas:		
Sample component or substitute gas component in N ₂ or air with a concentration adapted to the measurement range	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h

Combustion Air Conditioning (Option)

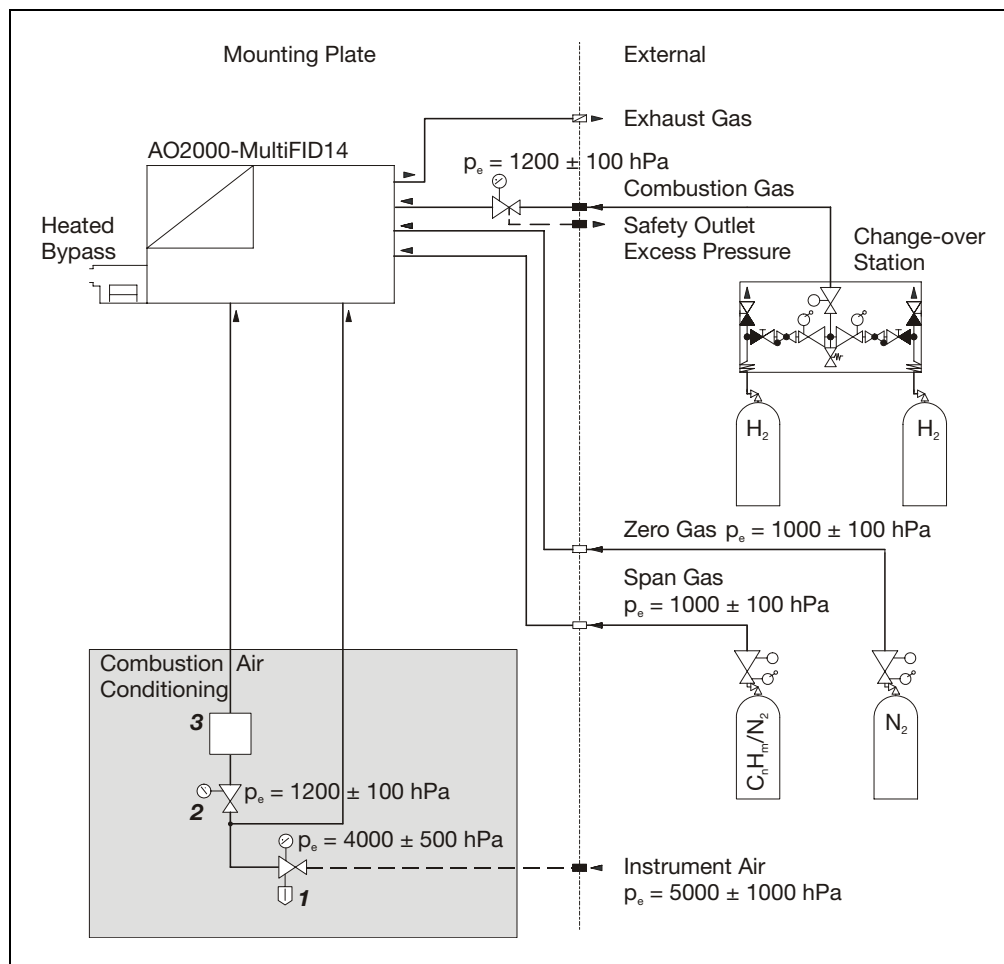
Combustion Air Conditioning

The combustion air conditioning module, which is available as an accessory, contains the following components (see Figure 1):

- 1 Pressure regulator with moisture separator and manometer (0 to 6 bar) for instrument air
- 2 Pressure regulator with manometer (0 to 4 bar) for combustion air,
- 3 Catalyst for combustion air conditioning,

The instrument air is split into motive air and purge air in the analyzer.

Figure 1
Combustion Air Conditioning



The inlet pressures for instrument air, combustion air and combustion gas indicated in Fig. 1 are typical values. At start-up (see “Analyzer Module Start-Up” section, page 32), those values indicated in the analyzer data sheet must be set.

Materials Supplied

Standard Materials Supplied

Quantity	Description
1	AO2000-MultiFID14 Analyzer
1	Analyzer Data Sheet (in the system housing)
1	AO2000 Series Operator's Manual
1	AO2000-MultiFID14 Start-Up and Maintenance Manual
1	CD-ROM containing technical documentation and communication software
1	Power cord, 5 m long, with screwed-on connector for non-heating appliances and separate grounded connector for the power supply to the electronics module
1	Power cord, 5 m long, with 4-prong plug and separate grounded connector for the power supply to the detector heater and the heated sample gas port
1	Accessories bag with threaded couplings and O-rings for the sample gas port
1	System bus terminating resistor

Materials Supplied Additionally (Depending on Analyzer Model)

Quantity	Description
1	Receptacle for heated sample gas port connector
	Interconnecting cables, tees and terminating resistors for the system bus (per purchase order)
	Socket connectors for the terminals of the I/O modules and I/O boards (per purchase order)
2	Inserts for the M23 threaded cable connectors for the IP-54 enclosure

Needed Material



The following overview should help you, before beginning installation, to procure and prepare the necessary material not supplied.

Installation

(see page 20 for instructions)

19-inch housing:

- 4 oval-head screws (M6 recommended, but depends on the cabinet/shelf system)
- 1 pair rails (version depends on cabinet/shelf system)

Wall-mount housing:

- 4 M8 or M10 bolts

Gas Connection Installation

(see page 18 for instructions)

For supply gases and test gases:

- 6 metal threaded connections with 1/8-NPT threads and PTFE (Teflon) sealing tape or
- 6 metal threaded connections with G-1/8 thread (DIN/ISO 228/1) and O-rings / sealing washers

Gas Line Connection

(see pages 21 to 25 for instructions)

For supply gases, test gases and exhaust air:

- PTFE or stainless-steel tubes with 4 mm ID and PTFE or stainless-steel tubes with ≥ 10 mm ID for exhaust air
- Threaded tube couplings
- Pressure regulators

For sample gas:

- Heated sample gas line (recommended: TBL 01) or unheated sample gas line (PTFE or stainless-steel tube with 4 mm ID)



The threaded couplings and O-rings necessary for the connection are included in the materials supplied with the analyzer module.

Guideline for Installation

Basic Steps

Step	Description	See page
1	Unpack analyzer	15
2	Gas connection installation	18
3	Analyzer installation	20
4	Gas line connection	21
	Test gases	21
	Exhaust air	21
	Sample gas	22 or 24
	Combustion gas	25
	Instrument air	26
5	Connection of the signal, control and interface lines as well as the system bus (see “Electrical Line Connection” Chapter of the AO2000 Series Operator’s Manual for instructions)	
6	Power supply line connection	27
	24 VDC Analyzer module power supply	29
	115/230 VAC Detector Heating	30
	Heated sample gas port (option)	
	Central unit power supply	

Unpack Analyzer



CAUTION!

The analyzer weighs approx. 25 kg. Two persons are needed for unpacking and carrying.

Unpacking

Step	Action
1	Remove the analyzer and foam packing or wrapping from the shipping box.
2	Remove the foam packing or wrapping and set the analyzer aside on a clean surface.
3	Clean the adhering packing residue from the analyzer.



- If there is shipping damage which points to improper handling, file a damage claim with the shipper (railway, mail or freight carrier) within seven days.
- Make sure that none of the enclosed accessories are lost during unpacking (see “Materials Supplied” section, page 12)
- Keep the shipping box and padding material for future shipping needs.

Identification Plates and Analyzer Data Sheet

Identification Plates The analyzer identification plate is located externally on one side panel of the system housing.

The MultiFID14 analyzer module has two identification plates: one also located externally on a side panel of the system housing and the other inside the analyzer on a side panel of the analyzer module.

The identification plate of the electronics module is located externally on the terminal plate above the terminals of the I/O boards.

Analyzer Data Sheet The analyzer data sheet contains essentially the following information for the central unit and for each analyzer module:

- Order number (A-No.),
- Part number (P-No.),
- Fabrication date,
- Fabrication number (F-No.),
- Serial number,
- Software version,
- Power supply voltage,
- Measurement range data,
- Configured correction functions,
- Connection diagrams for signal inputs and outputs,
- Connection diagrams for gas inlets and outlets.

In addition, the user (and also ABB Service) can document service tasks and modifications performed on your analyzer in the analyzer data sheet.

Where is the analyzer data sheet located? The analyzer data sheet is kept in an envelope which is attached

- to the left inside side panel of the 19-inch housing or
- to the door inside of the wall-mount housing.



- The analyzer data sheet should be kept with the gas analyzer so that it is always available for reference.
- During operation be sure to note the device- and system-specific data in the analyzer data sheet. These data can differ from the information contained in this operator's manual.

Dimensional Diagrams

Figure 2
19-Inch Housing
 (Dimensions in mm)

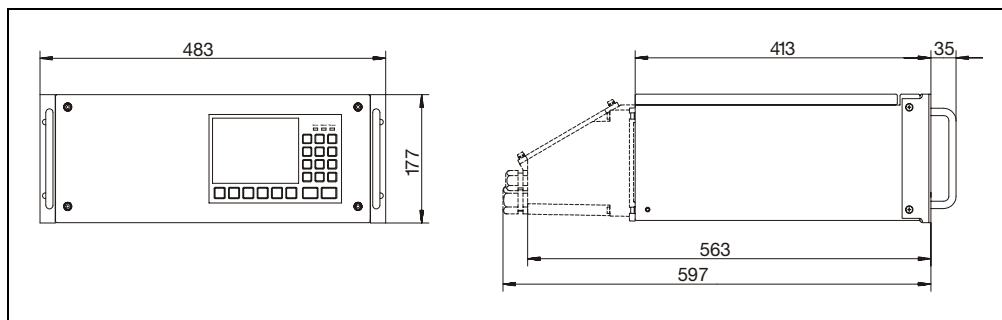
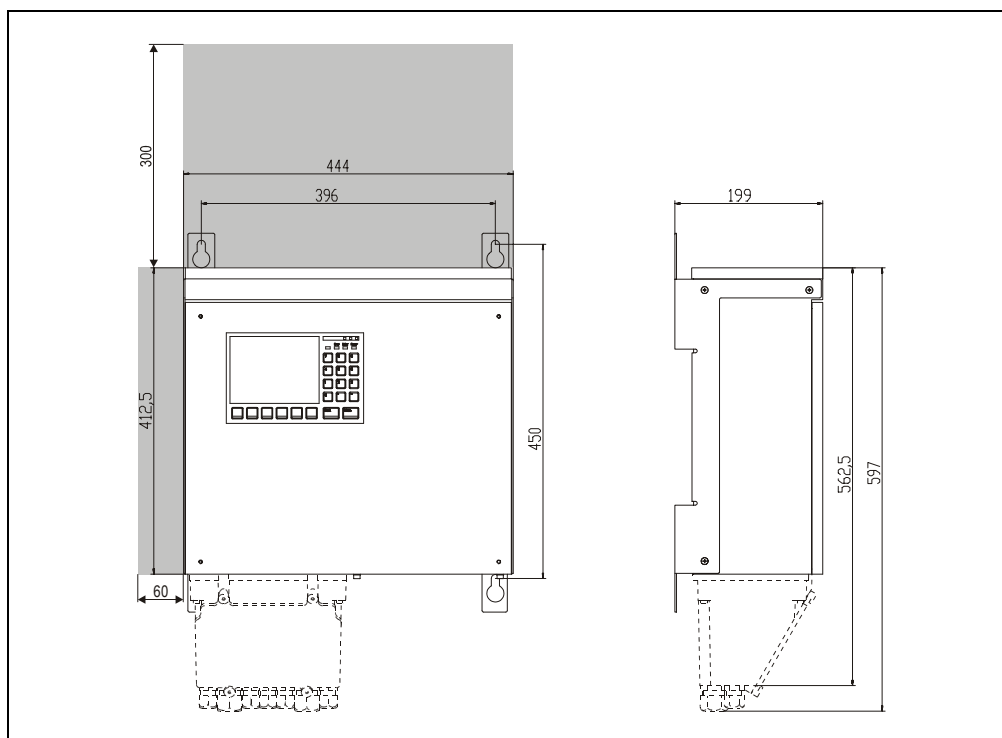


Figure 3
Wall-Mount Housing
 (Dimensions in mm)



- The connection box shown with dashed lines in the dimensional diagram is flange-mounted to the IP-54 housing.
- Observe the installation location requirements (see Page 9).
- Consider the additional space required for connecting lines (approx. 100 mm).
- When installing the analyzer with a heated sample gas port, consider the space requirement for the heated sample gas line (observe the manufacturer's recommended minimum bend radius).
- When installing the wall-mount housing, consider the free space required on the left side to open the door (approx. 60 mm, shown in gray in Figure 3).
- When installing the wall-mount housing, allow for additional space above the housing since some units can only be accessed from the top (approx. 300 mm, shown in gray in Figure 3).
- Install the housing so that the screen is oriented vertically.
- Multiple system housings in a 19-inch rack should be installed with a separation of at least one height unit.

Gas Connection Installation



Since the gas ports are now easily accessible connect the gas lines to the analyzer module before the analyzer is installed.

Port Design

The ports for the supply gases and test gases are designed as connection nipples with 1/8 NPT internal threads.

The ports for sample gas and exhaust air are designed as threaded couplings for PTFE or stainless-steel tubes with 6 mm OD.

Materials Needed

Quantity	Material (not supplied)
6	Metal threaded connections with 1/8-NPT threads and PTFE (Teflon) sealing tape or
6	Metal threaded connections with G-1/8 thread (DIN/ISO 228/1) and O-rings/sealing washers




CAUTION!

The fittings must be clean and free of residue. Contaminants can enter the analyzer and damage it or lead to false measurement results.

Do not use sealing compounds to seal the gas connections. Sealing compound components can lead to false measurement results.

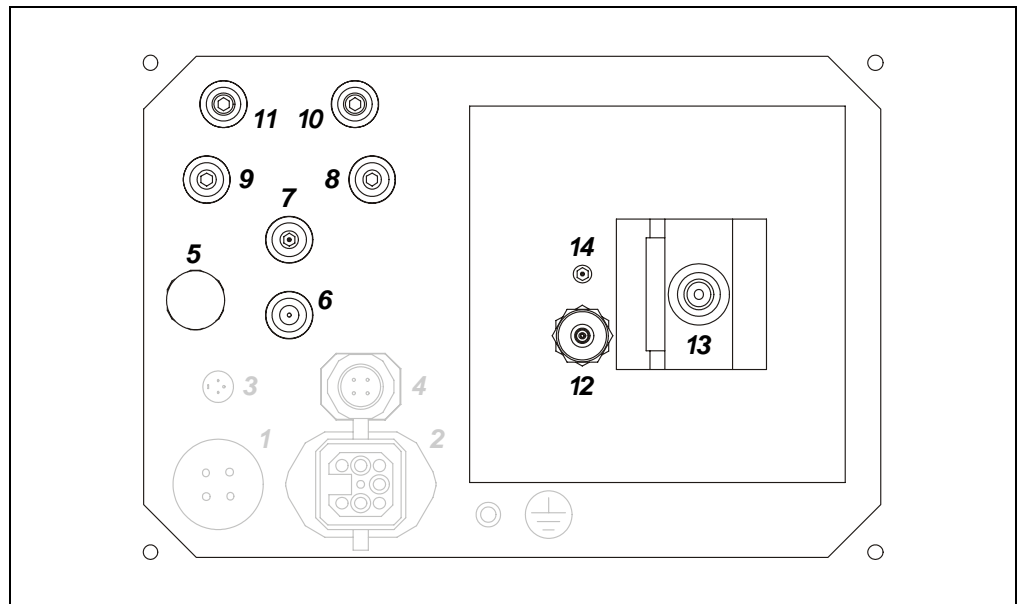
Use only metal threaded connectors.

Gas Connection Installation

Step	Action
1	Remove plastic sealing stoppers from the connection ports.
2	Using appropriate sealing material (Teflon sealing tape, O-rings, sealing washers), insert the tubing or threaded connectors in the connection ports.  Screw the fittings on carefully and not too tightly. Follow the manufacturer's installation instructions.

Continued on next page

Figure 4
Connection Diagram
(Gas Ports)



- 5** Pressure compensator opening with particle filter
- 6** Instrument air inlet
- 7** Test gas outlet
- 8** Span gas inlet
- 9** Zero gas inlet
- 10** Combustion gas inlet
- 11** Combustion air inlet
- 12** Exhaust air outlet
- 13** Sample gas inlet (the figure shows an unheated sample gas port)
- 14** Bypass nozzle



- Protect the particle filter at pressure compensator opening **5** from moisture.
- Follow instructions for connecting the gas lines (see pages 21 to 25).



DANGER!

Do not open any threaded connections in the analyzer gas paths. Doing so will damage gas path seal integrity.

Combustion gas flowing out of the leak points thus formed in the internal gas paths can cause fire and explosions (even outside the analyzer itself).

If device-internal gas path threaded connections are opened, a seal integrity check must be performed with a leak detector (thermal conductivity) when the device is reassembled.



CAUTION!

The combustion gas path inside the analyzer is checked for leaks at the factory. No seal integrity testing is required during normal operation.

Analyzer Installation



CAUTION!

The analyzer weighs approx. 25 kg. The following points should be observed:

- Two persons are needed for installation.
- The location (e.g., bay, 19-inch rack, wall) must be capable of supporting the analyzer's weight.
- The 19-inch housing must be supported with rails in the bay or rack.
- Neither the 19-inch nor the wall-mount housings use hinges to secure the housing cover. The cover can drop when opened.

Materials Needed

Quantity	Fastener (not supplied)
19-inch housing:	
4	Oval-head screws (Recommendation: M6; this depends on the cabinet/shelf system)
1 pair	Rails (Design depends on cabinet/shelf system)
Wall-mount housing:	
4	M8 or M10 bolts

Installation

Install the system housing in the cabinet/shelf or on the wall with the required fasteners. Observe the dimensional diagrams and the additional notes on page 17.

Gas Line Connection



CAUTION!

The gas lines and fittings must be free of any residue (e.g., particles left over from manufacturing). Contaminants can enter the analyzer and damage it or lead to false measurement results.



Follow the fitting manufacturer's instructions. Be sure to use a backup wrench when tightening gas line threaded connections (gas ports).

Which gas lines must be connected?

Gas line	See
Sample gas (heated sample gas port) or Sample gas (unheated sample gas port)	Page 22 Page 24
Combustion gas	Page 25
Instrument air	Page 26
Test gases	below
Exhaust air	below

Test Gas Connection

The test gas outlet is connected to the sample gas connection at the factory (see Figure 16 "Gas diagrams", page 57).

If the test gas is supplied directly at the sampling site, remove the link between the sample gas outlet and sample gas inlet on the sample gas port (see Figure 5, page 22) and seal the sample gas connection opening with an M6 screw.

Exhaust Air Connection

Exhaust air should be routed without pressurization to the atmosphere or to an exhaust pipe directly or via the shortest possible large-diameter line.

Use PTFE or stainless steel exhaust air line. The medium temperature reaches 200 °C.

The ID of the exhaust line should be increased to ≥ 10 mm within no more than 30 cm from the exhaust outlet.

Do not route exhaust gases via flow reducers or shutoff valves.

Purging the Sample Gas Line

Install a shutoff valve in the sample gas line (this is definitely recommended for pressurized sample gas) and provide a means of purging the sample gas line via the sampling port with an inert gas, e.g. nitrogen.

Sample Gas Line Connection (Heated Sample Gas Port)



CAUTION!

Before start-up of the analyzer module it is imperative to remove any plastic sealing stopper inserted in a sample gas inlet at the factory.

Sample Gas Line Material

Use PTFE or stainless steel sample gas line. (Recommendation: use heated sample gas line TBL 01.) The medium temperature reaches 200 °C.

Sample Gas Line Connection

With a heated sample gas port the sample gas line can be connected to any of the sample gas inlets I, II and III (see Figures 5 and 6). With the wall-mount housing, a sample gas line cannot be connected to sample gas inlet III (structural constraints); it must always be kept closed.

Connect the heated sample gas line directly to the sample gas inlet. Make sure the O-rings are properly seated and that the sample gas line is fully inserted in the sample gas port.

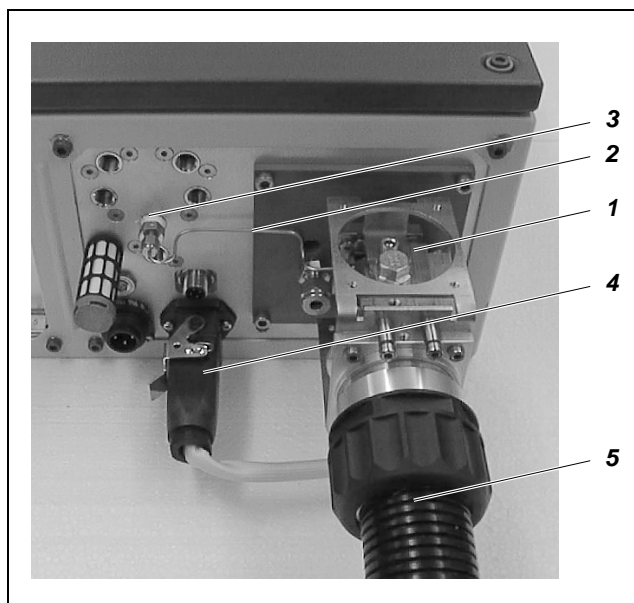
Unused Sample Gas Inlets

If ...	then ...
the analyzer draws in sample gas through the sample gas line	the unused sample gas inlets should be blocked with the threaded cap inserted at the factory.
the sample gas is under positive pressure	one sample gas inlet must be open and connected with an exhaust gas line to avoid any accumulation of positive pressure in the analyzer module.

Fittings and O-Rings

The required fittings and O-rings are supplied in the accessory kit.

Figure 5
Heated Sample Gas Connection



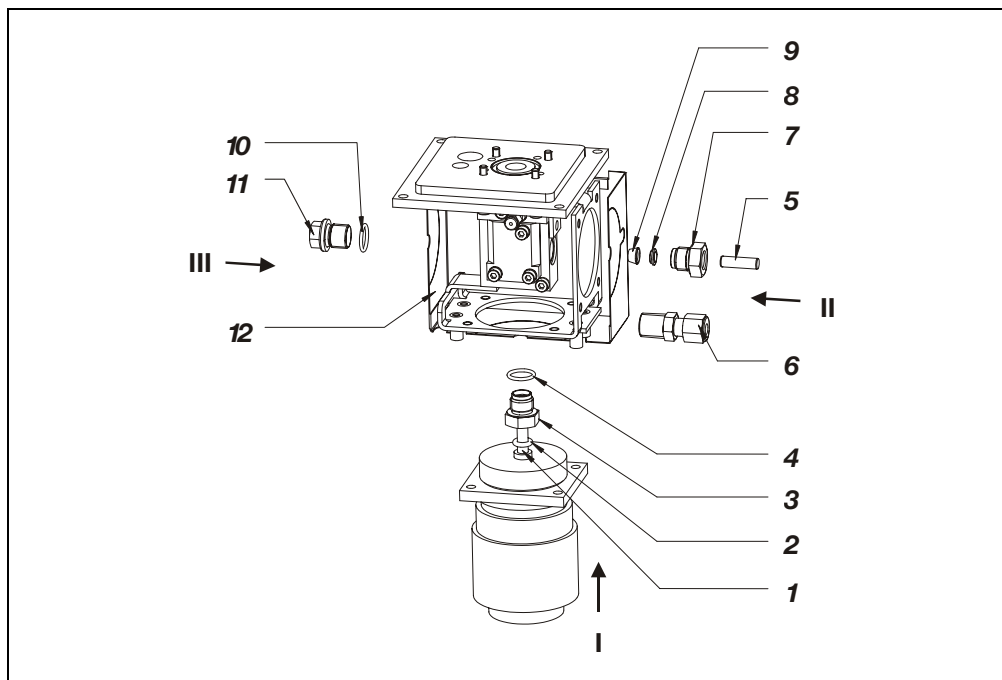
- 1 Heated Sample Gas Port
- 2 Connection between Test Gas Outlet and Sample Gas Port
- 3 Test Gas Outlet
- 4 Electrical Connection to the Heated Sample Gas Port
- 5 Heated Sample Gas Line

Continued on next page

Figure 6

Sample Gas Line Connection on Heated Sample Gas Port

(Wall-mount housing, view from above right)



- 1** Heated Sample Gas Line (tube with 4/6-mm ID/OD)
 - 2** O-Ring 6.02 x 2.62
 - 3** Fitting
 - 4** O-Ring 12.42 x 1.78
- Connection of Additional Sample Gas Line or Plug:
- 5** Sample Gas Line (tube with 4/6-mm ID/OD) or 6 x 20 Stopper Pin either with
 - 6** 1/4 NPT Threaded Fitting (with PTFE (Teflon) sealing tape; not supplied) or with
 - 7** Fitting
 - 8** Cone Ring
 - 9** Sealing Ring
- Plug:
- 10** O-Ring 12.42 x 1.78
 - 11** Plug Screw
 - 12** Cover

Sample Gas Inlets:	Sample Gas Line Connection On wall-mount housing	Sample Gas Line Connection On 19-inch housing
I	Below	Behind
II	Right	Above
III	Not Possible	Below

Maximum Sample Gas Line Length

The maximum length of the heated sample gas line (4 mm ID) is 30 m.

Sample Gas Line Connection (Unheated Sample Gas Port)



CAUTION!

Before start-up of the analyzer module it is imperative to remove any plastic sealing stopper inserted in the sample gas inlet at the factory.

Sample Gas Line Connection

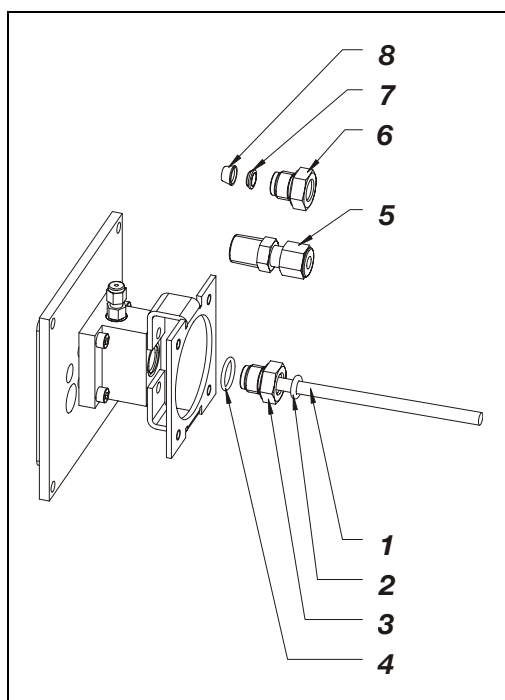
There is only one sample gas inlet for an unheated sample gas line (see Figure 7).

If the sample gas is under positive pressure, a tee should be installed between the sample gas line and sample gas inlet. The free end of the tee should be connected to an exhaust line to avoid any accumulation of positive pressure in the analyzer module.

Figure 7

Sample Gas Line Connection on Unheated Sample Gas Port

(Wall-mount housing and 19-inch housing)



- 1 Sample Gas Line (PTFE or stainless-steel tube with 4/6-mm ID/OD)
Connection either with
- 2 O-Ring 6.02 x 2.62
- 3 Fitting
- 4 O-Ring 12.42 x 1.78
or with
- 5 1/4 NPT Threaded Fitting (with PTFE (Teflon) sealing tape; not supplied)
or with
- 6 Fitting
- 7 Cone Ring
- 8 Sealing Ring

Maximum Sample Gas Line Length

The maximum length of the heated sample gas line (4 mm ID) is 50 m.

Combustion Gas Line Connection






CAUTION!

The pertinent safety regulations for handling combustible gases must be followed.

The combustion gas path inside the analyzer is checked for leaks at the factory. No seal integrity testing is required during normal operation.


Combustion Gas Line Connection

Step	Action
Combustion Gas Line Cleaning	
1	Pump cleaning agent (alkaline cleaner, solvent, stainless steel pickling fluid) through the tube.
2	Purge tube thoroughly with distilled water.
3	Purge tube for several hours at a temperature above 100 °C with synthetic air or nitrogen (10 to 20 l/h).
4	Close off tube ends.
Combustion Gas Line Connection	
5	Connect two-stage pressure-reducing valve (for ultra-pure gases) to the combustion gas cylinder.
6	Connect combustion gas line to the pressure-reducing valve.
7	Connect combustion gas line through a pressure regulator (0 to 1.6 bar) directly to combustion gas inlet 10 of the analyzer module (see Figure 1, page 11, and Figure 4, page 19).
Combustion Gas Line Seal Integrity Check	
	 Air leaking into the combustion gas line can prevent ignition of the analyzer flame. Check seal integrity of the combustion gas line after connecting it
8	Adjust the high-pressure stage of the pressure-reducing valve of the combustion gas cylinder to $p_e = 1200 \pm 100 \text{ hPa}$ ($1.2 \pm 0.1 \text{ bar}$) and purge the combustion gas line.
9	Check seal integrity of the combustion gas line with a leak detector (measuring principle: thermal conductivity).
10	Close combustion gas cylinder.  Leak search spray must not be used for the seal integrity test.
Combustion Gas Line Purge	
	 Purge the combustion gas line before start-up. This should ensure that the combustion gas line is free of impurities – especially containing hydrocarbons – that could lead to erroneous measurement values.
11	Purge the combustion gas line for approx. 20 seconds with a nitrogen flow of approx. 100 l/h.

Instrument Air Line Connection

Instrument Air	Instrument air is used as <ul style="list-style-type: none">• motive air for the air injector (if installed),• purge air and• combustion air.
Instrument Air Line Connection	Connect instrument air line <ul style="list-style-type: none">• either to the combustion gas conditioning (see Figure 1, page 11)• or via a pressure regulator (0 to 6 bar) directly to instrument air inlet 6 of the analyzer module (see Figure 4, page 19).
Instrument Air Alternative	<p>If instrument air with the required properties (see “Gas Inlet Conditions” section, page 10) is not available, an internal suction pump is necessary instead of the air injector.</p> <p>You can request detailed information on installing an internal pump from ABB Analytical, Telefax +49-69-79 30-45 66.</p>

Housing Purge

Why should the housing be purged?	Analyzers equipped with the MultiFID14 analyzer module must always be purged since combustible gases (H ₂ or H ₂ /He mixture) are routed into the module.
Purge Air Supply	Part of the instrument air (approx. 300 to 500 l/h) to the air injector is routed as purge air through the housing.
Separate Purging of Central Unit and Analyzer Module	<p>There is no gas-tight separation of the central unit and analyzer module. Therefore, they can only be purged together.</p> <p>If the central unit and analyzer must be purged separately, the analyzer module must be installed in a separate IP-54 system housing.</p>
	Due to differing purge gas supply requirements, the MultiFID14 analyzer module should not be purged in series with the Caldos15, Caldos17, Limas11, Magnos106, Magnos17 and Uras14 analyzer modules.

Power Supply Line Connection – Safety Notes

**CAUTION!**

Comply with the pertinent national safety regulations for installation and operation of electrical equipment as well as the following safety notices.

Before connecting the power supply, make sure that the operating voltage setting of the analyzer matches the line voltage.

Connect the protective lead terminal to a protective lead before making any other connections. When the supplied power cord is used, this is ensured by the leading pin of the protective lead.

The analyzer may become hazardous if the protective lead breaks inside or outside the analyzer or the protective lead terminal is separated.

Use only fuses of the specified type and rated current as replacements. Do not use rewired fuses. The fuse holder must not be short-circuited.

Parts of the power-supply circuit may continue to be under voltage even if the line fuse blows.

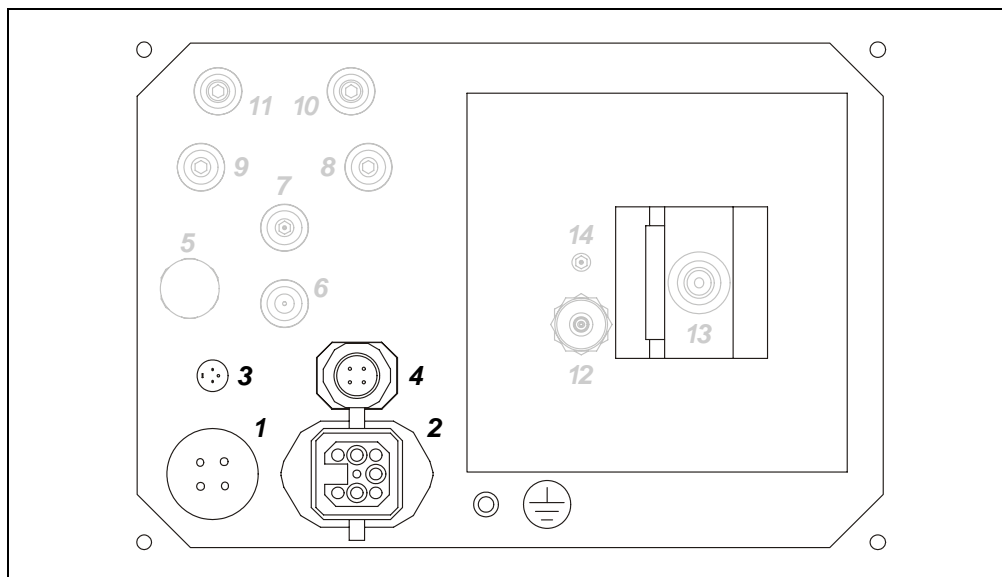
Never connect line voltage (115 VAC or 230 VAC) to the 24-VDC input of the analyzer module. This would destroy the electronics of the analyzer module.

Install a circuit breaker close to the analyzer so that all poles can be disconnected from the power supply. Label the breaker to ensure that the circuit it controls is clearly identifiable.

Never pull the plug connectors of the 115/230 VAC power supply for the detector heater and the heated sample gas port while the power is on.

Connection Diagram (Electrical Connections)

Figure 8
Connection Diagram
(Electrical
Connections)



- 1** 115/230 VAC power supply of detector heater and if necessary of heated sample gas port (see also Figure 12)
Never pull the plug connector while the power is on!
- 2** Electrical connection to heated sample gas port
Never pull the plug connector while the power is on!
- 3** System bus
- 4** 24 VDC power supply (see also Figure 10)

Power Consumption

Power Consumption	Component	Power supply	Power consumption
	Central unit	115/230 VAC	175 VA
	Detector heater	115/230 VAC	120 VA
	Heated sample gas port	115/230 VAC	100 VA
	Analyzer module	24 VDC	65 W

24 VDC Power Supply Line Connection

24 VDC Connection Cable

If the analyzer system is set up so that an analyzer module is to be powered by an external 24 VDC power source, a 5-meter long cable (2 x 0.5 mm²) with a 4-prong plug will be supplied for connection to the analyzer module. The wires on the free end of the cable are to be connected to an external power source (see Figure 9).

Figure 9

24 VDC Connection Cable

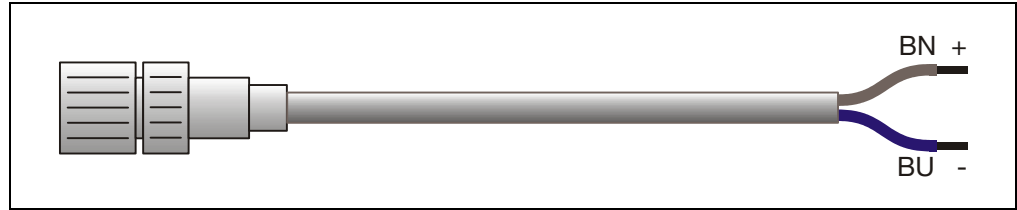
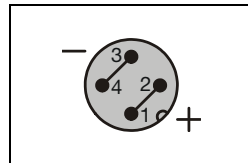


Figure 10

Analyzer Module 24 VDC Connection



The illustration shows the pin side of the analyzer plug **4** and thus the solder side of the matching female jack.

24 VDC Connection to the Analyzer Module

Proceed as follows to connect the 24 VDC power supply to an analyzer module not installed in the central unit:

Step	Action
1	Connect the supplied 24 VDC connection cable and plug to analyzer module power supply connector 4 and screw tight.
2	Connect the free end of the connection cable to an external power supply.

Extending the 24 VDC Connection Cable

The 24 VDC connection cable can be extended if necessary. The following conditions should be satisfied:

- The extension cable should have a conduction section of at least 2.5 mm².
- The extension cable should be no more than 30 m long.
- The extension cable should be connected as close as possible to the 24 VDC connection cable supplied, i.e., the 24 VDC connection cable should be as short as possible.

115/230 VAC Power Supply Line Connection

115/230 VAC Connection Cable

A 5-m connection cable (3 x 1.5 mm², see Figure 11) with 4-prong plug for connection to the analyzer module (see Figure 12) is supplied for the 115/230 VAC power supply of detector heater and if necessary of heated sample gas port.

Figure 11
115/230 VAC Connection Cable

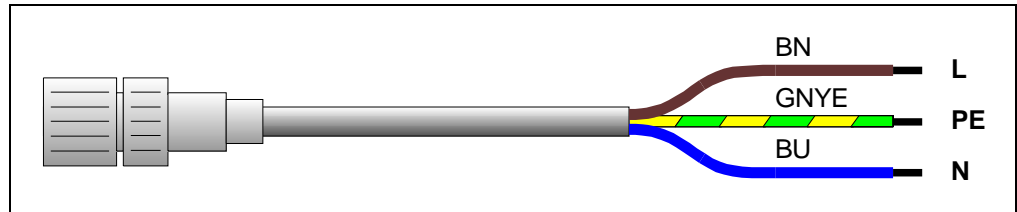
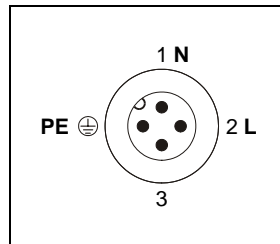


Figure 12
Analyzer Module 115/230 VAC Connection



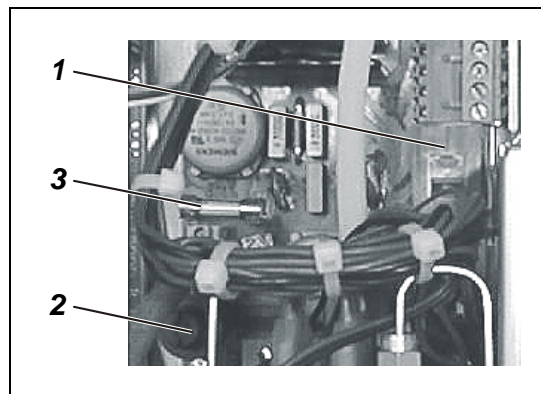
The illustration shows the pin side of plug **1** on the analyzer module.

Operating Voltage Change

The operating voltage of the detector heater can be switched between 115 VAC and 230 VAC by switch **1** on the power distribution board (see Figure 13). Fuse **2** must be replaced when the operating voltage is changed.

The operating voltage of the sample gas port heater is indicated on the plug connector; it cannot be changed.

Figure 13
Position of Switches and Fuses on the Power Distribution Board





- 1** 115/230 VAC switch
- 2** 230 VAC M 2A or 115 VAC M 4A fuse
- 3** 24 VDC M 3.15A fuse


Continued on next page

115/230 VAC Power Supply Line Connection, *continued*

115/230 VAC Connection

Step	Action
1	 Make sure the analyzer system power supply is set to the proper line voltage. Adjust the operating voltage setting as necessary. Make sure the operating voltage indicated on the MultiFID14 analyzer module identification plate is the same as the line voltage. If applicable, set the proper operating voltage on the power supply board.
2	Make sure the power supply cable has an adequately dimensioned protective device (breaker).
3	Install a breaker in the power supply or a switched receptacle near the analyzer to make sure the analyzer system can be completely separated from the power source. Label the breaker to ensure that the circuit it controls is clearly identifiable.
4	Using the connector for non-heating equipment, connect the power cord supplied to the -X01 power supply connector in the electronics module and secure with the clip.
5	Connect the supplied 115/230 VAC connection cable with 4-prong plug to the analyzer module power supply connector 1 of the analyzer module and screw tight.
6	Connect the wires on the free end of each power cord to the power source – by means of the attached grounded plug as the case may be.  The analyzer may start when the power supply is connected.




Potential Compensation Connection

The electronics module and the analyzer modules have a potential compensation connector designated by the symbol . The connector has M5 internal threads for the installation of a matching screw or clamp.





Use this connection to link each module to the building's potential compensator in accordance with local regulations.

Analyzer Start-Up

Analyzer Start-Up

Step	Action
Turn on power supply, initial heating phase, turn on supply gases	
1	 Before connecting the power supply, check once again that both the operating voltage set on the analyzer power supply and the operating voltage indicated on the MultiFID14 analyzer module identification plate match the line voltage.
2	Turn on the power supplies for the <ul style="list-style-type: none"> • Analyzer • Detector heater • Heated sample gas port, if applicable. When the analyzer module is not built into the central unit: <ul style="list-style-type: none"> • Turn on the separately installed 24-VDC power supply of the analyzer module.
3	The following events will occur after the power supply is turned on: <ol style="list-style-type: none"> 1. The three “Power,” “Maint” and “Error” LEDs light up. 2. The analyzer system power-on message appears on the screen. The power-on message shows the software version. The booting consists of the “Booting Database” and “Booting Display” phases. 3. After a brief time the screen switches to measurement mode. 4. The  softkey appears on the screen. This indicates the possibility of a temperature or flow problem during the warm-up phase. By pressing the softkey the user can recall the status message summary and view status message details.
4	Select the Controller values menu item: MENU → Diagnostic/Information → Module specific → Controller values The variables for the temperature regulators are indicated under this menu item: T-Re . D Detector temperature T-Re . E Heated sample gas port temperature The temperature values will rise slowly after the power supply is activated.
5	Turn on instrument air, combustion air and combustion gas (H ₂ or H ₂ /He mixture). Using the appropriate external pressure regulator, adjust the initial pressure to the value specified in the analyzer data sheet.  The pressure values shown on the gas port labels, in the data sheet and in the “Gas Inlet Conditions” section (see page 10) are only typical values. Only the factory-determined values shown on the analyzer data sheet of the analyzer module are applicable for safe operation.

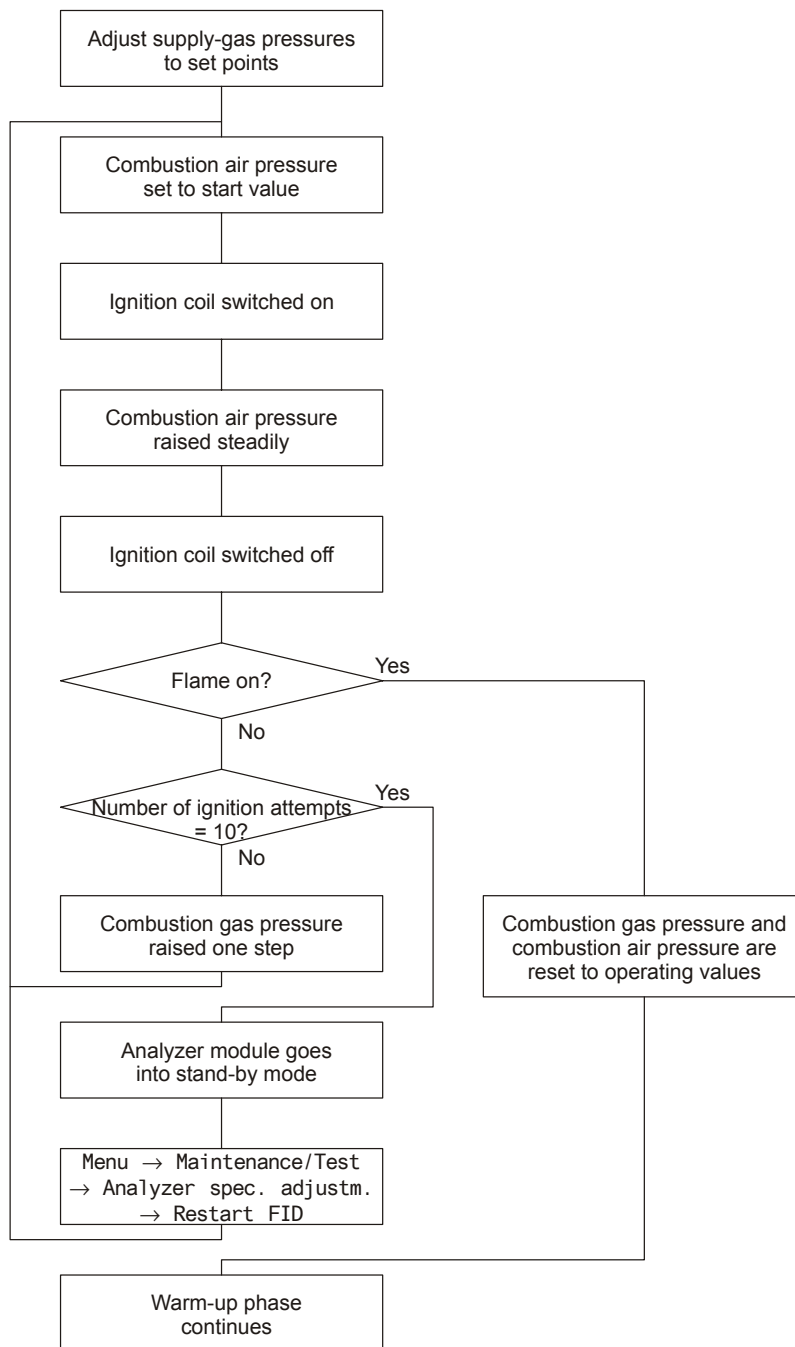
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Step	Action
6	<p>In the Controller values menu item also the variables for the internal pressure regulators are indicated; set the supply gas pressures by means of the variables:</p> <p>Input Instrument air at combustion-chamber inlet Output Instrument air at combustion-chamber outlet Air Combustion air H2 Combustion gas (H₂ or H₂/He mixture)</p> <p> Random values may be displayed at first for the variables. The values are updated for the first time approx. 30 seconds. after selection of the menu item and thereafter approx. every 30 seconds. Pressure control continues to run in the background. Depending on the pilot pressure setting, pressure setting times can be long.</p> <p> If the operator does not press any key for more than five minutes while in menu operation, the analyzer switches automatically to measuring operation to display of sample values ("time out").</p>
7	<p>As soon as the temperature of the detector has reached the threshold value (150 °C) the appropriate solenoid valve in the analyzer module automatically connects the instrument air. The vacuum and combustion air controllers work to keep pressures at the applicable set points.</p> <p> Sample gas begins to flow through the analyzer as soon as the instrument air is connected.</p>
8	<p>After the pressures are at the applicable set points, the associated solenoid valve in the analyzer module automatically starts the combustion gas supply. The combustion gas controller attempts to establish the set point pressure value.</p>
Adjust the variables for the internal pressure regulators	
	<p> Steps 9 to 11 should only be performed if the analyzer module does not automatically start operation at the pressure values indicated on the analyzer data sheet. If the internal pressure controller values do not match these values, the pilot pressures must be changed.</p>
9	<p>Instrument air: Use the external pressure regulator to set the Output variable to approx. 60 % (max. 70 %). Variable too large ⇒ reduce pressure. Variable too small ⇒ raise pressure. (The Input variable depends on the sample gas flow rate.)</p>
10	<p>Combustion air: Use the external pressure regulator to set the Air variable to approx. 50 % (max. 60 %). Variable too large ⇒ raise pressure. Variable too small ⇒ reduce pressure.</p>
11	<p>Combustion gas: Use the external pressure regulator to set the H2 variable to approx. 35 % (max. 40 %). Variable too large ⇒ raise pressure. Variable too small ⇒ reduce pressure.</p>

Continued on next page

Step	Action
Flame ignition (automatic)	

12



Flame ignition may take up to 10 minutes, depending on the number of ignition attempts.

The flame temperature is displayed in the Flame parameter under the Auxiliary raw values menu item; it must be at least 30 °C higher than the detector temperature.

Actual start-up of the analyzer is complete when the flame ignites.

Continued on next page

Date and Time Check A correct date and time setting is required for proper operation of functions such as automatic calibration and time/date logging of error messages.

Step	Action
1	Select the Date/time menu item: MENU → Configure → System → Date/Time
2	Check and, if necessary, correct the date and time (for more information see AO2000 Series Operator's Manual).

Adjusting the Filter (T90 time)

The MultiFID14 analyzer module has a non-linear filter.

Menu path:

**MENU → Configure → Component specific → Filter
→ Select component → ...**

Parameters	Explanation	Value ¹⁾
T90-1	Low-pass time constant for constant measured value.	20 sec.
T90-2	Low-pass time constant for measured value changes.	1 sec.
Switching Threshold	Switching threshold relative to measurement range. T90-2 applies on over/undershoot.	1%

1) Recommendation

Warm-Up Phase

Definitions

The *warm-up* phase covers the period after the power supply has been turned on until measurement drift is acceptable. This depends on the measurement span. The warm-up phase includes the initial heating phase.

The *initial heating phase* covers the period after the power supply has been turned on until the detector temperature reaches the threshold value (150 °C).

Warm-Up Phase Duration

The warm-up phase lasts approx. 2 hours.

The warm-up phase can take longer if the analyzer was not brought to room temperature before the power supply was activated.

During the warm-up phase measurement values can be outside the ranges specified in the data sheet.

Status Messages

The following status messages are present during the initial heating phase:

Short Text	Description
Working temperature	The detector temperature has not yet reached the threshold value.
Flame fault	The flame is not yet lit.
Temperature limit value 1, 2	The temperature of the detector (T-Re . D) and possibly of the heated sample gas port (T-Re . E) is above or below the upper or lower limit value 1 (2).
Pressure limit value 1, 2	The pressure at one of the internal pressure regulators for instrument air (Input, Output), combustion air (Air) or combustion gas (H2) is above or below the upper or lower limit value 1 (2).

Reading

The reading and `--E--` flash alternately, signaling that the displayed measurement value is not valid.

Readiness

At the end of the warm-up phase the analyzer is ready to carry out measurements and can be calibrated.



CAUTION!

Never pull the 115/230 VAC power supply plug connectors for the detector heater and the heated sample gas port while the power is on.



CAUTION!

The heated sample gas port cover is hot during operation. Its temperature is higher than 70 °C.



Please also read the Chapter “Analyzer System Calibration” of the AO2000 Series Operator’s Manual.

Sample Component and Measurement Ranges

Sample Component and Measurement Ranges

The MultiFID14 analyzer module always has at least 1 sample component with 1 measurement range.

At most 4 sample components with up to 4 measurement ranges per sample component are possible.

Measurement Range Setting

The measurement ranges are factory-set per customer order.

Each measurement range can be increased by a maximum factor of 4 or reduced (down to the smallest measurement range given).

The smallest measurement range is 0 to 10 mg C/m³, corresponding to 0 to 20 ppm CH₄.



The associated amplification levels are factory-set. They can only be changed using the TCT Test and Calibration Tool.

Test Gases

Test Gases for Calibration

Type, Quality	Inlet Pressure p_e	Flow Rate
Zero gas:		
N ₂ , 5.0 grade or synthetic or catalytically purified air with an organic C content < 1 % of span	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h
Span gas:		
Sample component or substitute gas component in N ₂ or air with a concentration adapted to the measurement range	1000 ± 100 hPa (1.0 ± 0.1 bar)	130 to 250 l/h

Zero Offset

If the zero gas is not absolutely free of hydrocarbons (even high-purity nitrogen contains some hydrocarbons), negative readings may be displayed in low-level measurement ranges (the process gas is “cleaner” than the zero gas). This can be prevented by setting the zero at a positive value instead of zero during calibration.

To produce hydrocarbon-free zero gas, air is passed through a combustion furnace at 800 °C in order to burn all hydrocarbons. This gas can be used to determine the necessary offset relative to cylinder gases or catalytically purified zero gases.

Test Gas Concentration

Set the zero and span test gas concentrations, which are used as set point values for calibration.

Menu Path

MENU → Configure → Calibration data → Manual calibration or Automatic calibration or Ext. controlled cal. → Test gas concentration

Test Gas Flow Monitor (Pressure Switch)

Test Gas Pressure and Test Gas Flow Rate By setting the test gas pressure such that the test gas flow at the sample gas inlet corresponds to the gas inlet conditions (130 to 250 l/h) the test gas surplus will flow toward the sampling site and prevent sample gas traces from influencing the calibration results.

If the test gas is connected directly to the sample gas port (see "Gas Line Connection" section, page 21), it must be available as unpressurized excess (130 to 250 l/h) here also.

Flow Monitoring during Automatic Calibration (Pressure Switch)

If test gases are supplied to the separate test gas inlets, during automatic calibration the integral pressure switch can be activated for flow monitoring. Calibration is discontinued in case of inadequate flow.

The pressure switch can be activated for

- Zero gas
- Span gas and
- Zero and span gas

Menu Path

MENU → Configure → Calibration Data → Automatic Calibration → Other Parameters → Pressure Switch

Test Gas Supply at Sample Gas Inlet during Manual Calibration

If the test gas is supplied directly to the sample gas inlet during manual calibration the following message will appear in the display when the pressure switch is active:

No calibration gas. Pressure switch has not detected any calibration gas.

This message can be overridden by pressing the Back key.

Calibration Method



Please also consult Chapter “Analyzer System Calibration” of the AO2000 Series Operator’s Manual for a detailed description of calibration methods.

Calibration Method Choice

The calibration method choice depends on

- number of sample and/or substitute gas components and
- number of measurement ranges.

The calibration method can be set separately for all three types of calibration control: manual, automatic and externally controlled calibration.

For common and substitute-gas calibration, the component setting as well as the measurement range settings for zero and span calibrations act commonly on all three types of calibration control.

Menu Path

MENU → Configure → Calibration data → Manual calibration → Calibration method

Analyzer Module with 1 Sample Component

Proceed substantially as follows to set the calibration method as well as the measurement ranges for zero and span calibration for an analyzer module with 1 sample component:

Step	Action
1	Select calibration method: Test gas → Single / Common
2	Select measurement range for zero calibration: Zero range
3	Select measurement range for span calibration: Span range

Analyzer Module with Several Sample Components

Proceed substantially as follows to set the calibration method as well as the measurement ranges for zero and span calibration for an analyzer module with several sample components:

Step	Action
1	Select calibration method: Test gas / Substitute gas
2	Select component for zero calibration: Zero component
3	Select measurement range for zero calibration: Zero range
4	Select component for span calibration: Span component
5	Select measurement range for span calibration: Span range

Substitute Gas Calibration

Substitute Gas Calibration If the test gases for calibration are not available the analyzer module can be factory-set for calibration with substitute gases.

Example Substitute gas calibration of the MultiFID14 analyzer module is described using the example of Acetone in Ambient Air.

Acetone in Ambient Air Test gas containers cannot be filled with high concentrations of acetone. For this reason the MultiFID14 is calibrated with propane in N₂ as a substitute gas.

Measurement Ranges	Component 1	Acetone (C ₃ H ₆ O) in ambient air	Range 1	0 to 10.000 ppm
	Component 2	Propane (C ₃ H ₈) in N ₂ (substitute gas)	Range 1	0 to 10.000 ppm

Calibration Data	Calibration method	Substitute gas calibration
	Zero component	Component 1 (Acetone) Range 1 or Component 2 (Propane) Range 1
	Span component	Component 2 (Propane – substitute gas) Range 1

- Calibrate**
- Calibrate zero with air (component 1 or component 2).
 - Calibrate span with test gas propane in N₂.



For other measurement tasks select the test gases and measurement ranges in a similar manner according to the sample gas composition.

Analyzer Module Manual Calibration



- The MultiFID14 analyzer module should only be calibrated after the warm-up phase, i.e., approx. 2 hours after connecting the power supply.
- The zero should be calibrated manually prior to a manual span calibration.

Test Gas Supply

If the test gases enter at the zero or span gas input, the test gas supply is controlled by the integral valves.

If the test gas enters directly via the sample gas inlet, the zero and span gases must be blocked off.

Analyzer Module Manual Calibration

Step	Action
1	Select the Manual Calibration menu: MENU → Calibrate → Manual calibration
2	For single calibration: Select Measurement range with the arrow keys.
Zero calibration:	
3	Select Zero gas with the arrow keys, ENTER .
4	Turn on the zero gas supply.
5	If necessary use the numeric keypad to enter the test gas concentration ¹⁾ , ENTER .
6	When the sample value indication stabilizes, initiate zero calibration with ENTER .
7	Accept the calibration result with ENTER or REPEAT calibration ²⁾ (back to step 5) or reject calibration with Back (back to step 6) or reject calibration with Meas (back to measurement value readout).
Span calibration:	
8	Select Span gas with the arrow keys, ENTER .
9	Turn on the span gas supply.
10	If necessary use the numeric keypad to enter the test gas concentration ¹⁾ , ENTER .
11	When the sample value indication stabilizes, initiate span calibration with ENTER .
12	Accept the calibration result with ENTER or REPEAT calibration ²⁾ (back to step 10) or reject calibration with Back (back to step 11) or reject calibration with Meas (back to measurement value readout).
For single calibration: Repeat steps 2 to 12 for other measurement ranges.	

- 1) The initialized test gas concentration (see page 38) is shown as the set point.
- 2) It may be necessary to repeat calibration if the measurement value is still not stable after calibration has been started. The subsequent process is based on the measurement value obtained in the previous calibration.

Concentration Data Conversion

Different Concentration Data Units

The concentration is expressed in various units in the measurement of organic carbon compounds (total C):

- mg org. C/m³ (e.g., in measurements per 17. BImSchV [17th Regulation of Federal Emission Protection Act])
- mg C_nH_m/m³
- ppm C_nH_m (e.g., in measurements per TA-Luft [Technical Directive for Air], data on test-gas cylinders)

Thus it is often necessary to convert concentration data from one unit to another.

Conversion ppm → mg C_nH_m/m³

$$\text{mg C}_n\text{H}_m/\text{m}^3 = \text{ppm} \times \frac{\text{Molecular Weight}}{V_m}$$

Conversion ppm → mg C/m³

$$\text{mg C}/\text{m}^3 = \text{ppm} \times \frac{\text{Number of C atoms} \times 12.011}{V_m}$$

Mole volume $V_m = 22.414$ for 0 °C and 1013 hPa, $V_m = 24.05$ for 20 °C and 1013 hPa

Example 1

A MultiFID14 analyzer has a measurement range of 0-50 mg C/m³. Propane (C₃H₈) in N₂ or in air is used as the test gas.

How large can the maximum test gas concentration be in ppm or mg/m³ without exceeding the measurement range?

$$\frac{50 \times 22.414}{3 \times 12.011} = 31.102 \text{ ppm C}_3\text{H}_8$$

$$\frac{31.102 \times (3 \times 12.011 + 8 \times 1.008)}{22.414} = 61.19 \text{ mg C}_3\text{H}_8/\text{m}^3$$

Continued on next page

Example 2

If a gas other than propane is used, its response factor must be considered (see "Response Factor" section on page 45).

If methane (CH₄) is used, how large can the maximum test gas concentration be in ppm or mg/m³ without exceeding the measurement range?

$$\frac{50 \times 22.414}{1 \times 12.011} = 93.306 \text{ ppm CH}_4$$

$$\frac{93.306 \times (1 \times 12.011 + 4 \times 1.008)}{22.414} = 66.785 \text{ mg CH}_4/\text{m}^3$$

The methane response factor is 1.07; i.e. the sample value indication is too large by this factor. To determine the maximum test gas concentration that avoids exceeding the measurement range, the measured value reading should be divided by the response factor.

$$\frac{93.306}{1.07} = 87.202 \text{ ppm CH}_4$$

$$\frac{66.785}{1.07} = 62.416 \text{ mg CH}_4/\text{m}^3$$

A test gas container with approx. 80 ppm of CH₄ is specified. According to the certificate, the test gas concentration in the test gas container is 81.2 ppm CH₄.

This is equivalent to a concentration of

$$\frac{81.2 \times 1 \times 12.011}{22.414} = 43.513 \text{ mg C/m}^3$$

Considering the response factor, the indication should be adjusted to

$$43.513 \times 1.07 = 46.559 \text{ mg C/m}^3$$

Response Factor

Definition

$$\text{Response factor} = \frac{\text{Meas. value indication}}{\text{Concentration}} \text{ or}$$

$$\text{Concentration} = \frac{\text{Meas. value indication}}{\text{Response factor}}$$

By definition, the response factor for propane (C_3H_8) is equal to 1.00.

Response Factors

Response factors for the MultiFID14 analyzer module are listed in the table below.



Response factors for an individual analyzer module may differ slightly from the values below.

Sample Component		Response Factor
Acetone	$\text{C}_3\text{H}_6\text{O}$	0.71
Benzene	C_6H_6	1.07
Butane	C_4H_{10}	0.98
Butyl acetate	$\text{C}_6\text{H}_{12}\text{O}_2$	0.84
Chlorobenzene	$\text{C}_6\text{H}_5\text{Cl}$	1.02
Cyclohexane	C_6H_{12}	1.02
Ethane	C_2H_6	1.01
Ethyl acetate	$\text{C}_4\text{H}_8\text{O}_2$	0.72
Ethylbenzene	C_8H_{10}	0.89
Ethyne (Acetylene)	C_2H_2	0.95
Isopropanol	$\text{C}_3\text{H}_8\text{O}$	0.74
Methane	CH_4	1.07
n-Heptane	C_7H_{16}	0.94
Perchloroethylene (Tetrachloroethene)	C_2Cl_4	0.97
Propane	C_3H_8	1.00
p-Xylene	C_8H_{10}	0.89
Toluene	C_7H_8	0.96




Sample Gas Filter Replacement at Heated Sample Gas Port

When is replacement needed? Replace the sample gas filter in the heated sample gas port if it is contaminated and the sample gas flow is reduced.

- Material Required**
- Sample gas filter with O-rings (part number 0768649)
 - 4 mm hex wrench

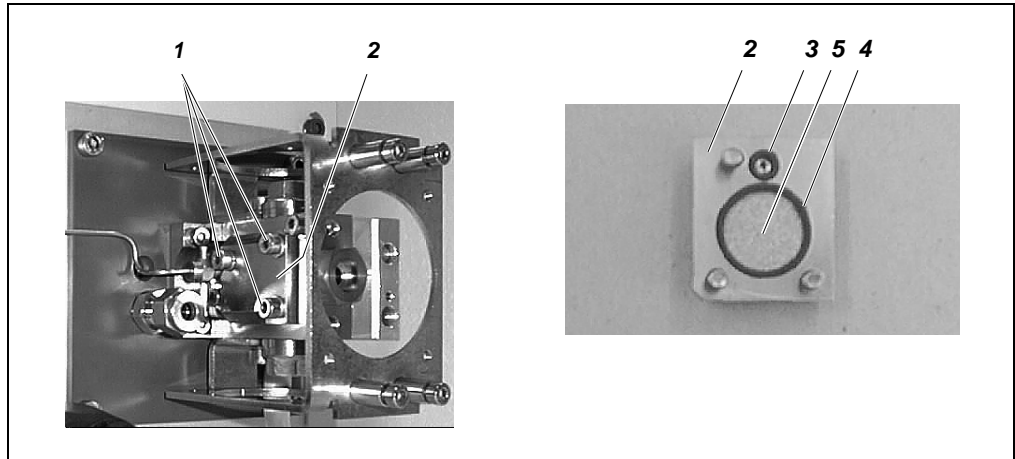
Sample Gas Filter Replacement

(see Figure 14)

Step	Action
1	 Turn off the sample gas supply to the analyzer module. Turn off 115/230 VAC power supply of analyzer and heater and, if applicable, the separate 24 VDC supply of the analyzer module.  The heated sample gas port is hot (approx. 180 °C).
2	Loosen the three mounting screws 1 (4 mm hex key) and remove the sample gas filter 2 from the sample gas port unit.
3	Remove O-rings 3 and 4 , as well as the contaminated sample gas filter 5 from sample gas filter holder 2 .
4	Place the new sample gas filter 5 and new O-rings 3 and 4 in the sample gas filter holder 2 .  Always use new O-rings with a new sample gas filter. Contaminated or damaged O-rings will reduce sample gas path seal integrity and lead to erroneous measurement values.
5	Place sample gas filter holder 2 on the sample gas port block and secure it with three mounting screws 1 . Tighten mounting screws only sufficiently to achieve metal-to-metal contact of the sample gas filter holder. Make sure that O-rings 3 and 4 do not fall out of the sample gas filter holder.
6	Restore sample gas supply to the analyzer module.
7	Activate power supply.
8	Check supply gas variables and adjust if necessary (see page 33).
9	Calibrate analyzer at end of warm-up phase.

Continued on next page

Figure 14
Sample Gas Filter in
Heated Sample Gas
Inlet



- 1** Mounting screws
- 2** Sample Gas Filter Holder

- 3** O-Ring
- 4** O-Ring
- 5** Sample Gas Filter

Cleaning the Air Injector

When is cleaning needed?




The air injector should be cleaned when the sample gas outlet pressure is too high, i.e. if the negative pressure can no longer be set to $p_{\text{abs}} < 600$ hPa.

Material Required

- 14-mm open-end wrench
- Detector O-ring set (part number 0768646)
- Ultrasound bath with aqueous cleaner (e.g. Extran)

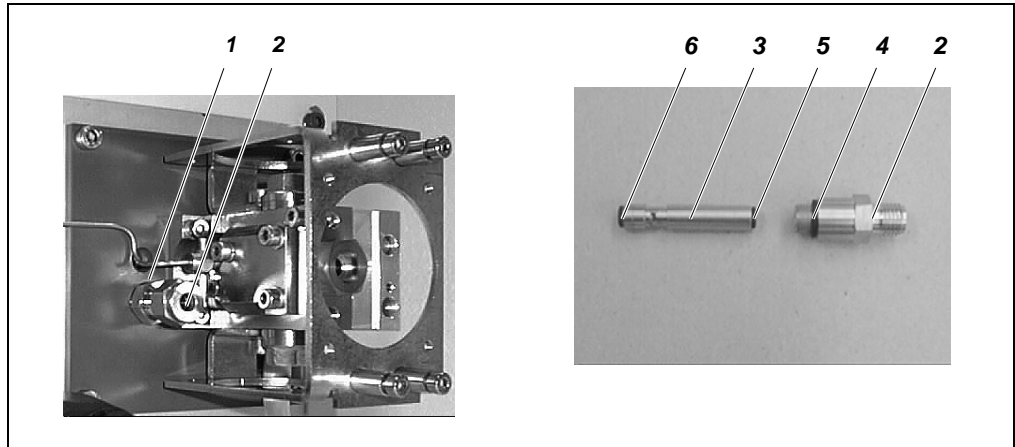
Cleaning the Air Injector

(see Figure 15)

Step	Action
1	 Turn off the sample gas supply to the analyzer module. Turn off 115/230 VAC power supply of analyzer and heater and, if applicable, the separate 24 VDC supply of the analyzer module.  The heated sample gas port is hot (approx. 180 °C).
2	Remove the exhaust line from exhaust outlet 1 .
3	Loosen fastener 2 (14-mm wrench). Remove air injector 3 from the exhaust outlet.
4	Clean the air injector in an ultrasound unit. Use aqueous cleanser (e.g., Extran).
5	Replace O-rings 4 , 5 and 6 with new O-rings.  Always replace O-rings when cleaning the air injector. Contaminated or damaged O-rings will reduce sample gas path seal integrity and lead to erroneous measurement values.
6	Place air injector 3 in the exhaust outlet (orient as shown in Figure 15). Tighten fastener 2 .
7	Connect the exhaust line to the exhaust air outlet 1 .
8	Restore sample gas supply to the analyzer module.
9	Activate power supply.
10	Check supply gas variables and adjust if necessary (see page 33).
11	Calibrate analyzer at end of warm-up phase.

Continued on next page

Figure 15
Air Injector



1 Exhaust Outlet
2 Fastener

3 Air Injector
4 O-Ring

5 O-Ring
6 O-Ring

Troubleshooting

Flow Problem

Sample gas nozzle or sample gas filter plugged Check for obstructions in sample gas nozzle and sample gas filter in sample gas port. Change the sample gas filter (see page 46 for instructions).

Temperature Problem

Faulty temperature sensor or heater connections Check the connecting lines and plug connectors. Check the line seating in the insulated jackets.

Unstable Readings

Vibration Reduce vibrations where the analyzer is installed.

Sample gas path leakage Check the integrity of the analyzer module sample gas paths.

Loss of sensitivity Check the sensitivity variation. Contact service personnel for sample gas nozzle replacement.

Excessive sample gas outlet pressure Check air injector for obstructions and clean as needed (see page 48 for instructions). Increase instrument air pressure. Check exhaust air line: It must have a large ID.

Combustion air contaminated Check combustion air supply.

Fluctuating supply gas pressures Check instrument air, combustion air and combustion gas supply.

Continued on next page

Pressure Regulator Problems

Unstable pressure values	Adjust supply gas pressures such that the variables have the following values (see page 33):		
		for instrument air (Outlet)	approx. 60 %
		for combustion air (Air)	approx. 50 %
		for combustion gas (H2)	approx. 35 %
Have the pressure regulator modules checked.			
Pressure regulator variables do not match set values	Air	Variable \leq 40 %	Lower combustion air pressure.
		Variable \geq 90 %	Raise combustion air pressure.
	H2	Variable \leq 30 %	Lower combustion gas pressure.
		Variable \geq 90 %	Raise combustion gas pressure.
	Inlet	Variable \leq 50 %	Lower sample gas inlet pressure. Clean bypass nozzle.
	Outlet	Variable \leq 50 %	Raise instrument air pressure. Clean air injector (see page 48 for instructions). Reduce sample gas line length.
	Variable \geq 90 %	Clean bypass nozzle. Lower instrument air pressure.	

Zero Drift

Sample gas line contaminated	Clean sample gas line.
Inadequate combustion air catalytic converter performance	Reduce hydrocarbon content.
Contaminated combustion gas line	Clean combustion gas line.
Saturated active charcoal filter	Replace active charcoal filter (see Service Manual for instructions).

Continued on next page

Flame Does Not Ignite

- Air in the Combustion Gas Line** Make sure no air enters the combustion gas feed lines when the combustion gas tank is connected or changed. Air drawn into the combustion feed line can cause the flame to go out in the analyzer.
- The analyzer module will attempt to restart the flame up to 10 times in a period of approx. 10 minutes using progressively higher combustion gas pressures. If this is not successful, the unit goes into the stand-by mode. In this case the flame ignition process is restarted:
- Menu → Maintenance/Test → Analyzer spec. Adjustm. → Restart FID**
- Note*
Standby operation means: Heater on, combustion gas valve closed, instrument air valve closed.
- Excessive combustion air pressure** Reduce combustion air pressure (per analyzer data sheet).

Status Messages



The MultiFID14 analyzer module status messages are listed below.

Please also consult Chapter "Status Messages" of the AO2000 Series Operator's Manual, which also contains the complete list of all status messages.

List Structure

The list of status messages contains the following information:

- No.** Number of the status message; appears in the menu bar of the detailed display
- Text** Full text of the status message as it appears in the detailed display
- O** x = Status message sets the overall status
- E** x = Status message sets the "Error" individual status
- M** x = Status message sets the "Maintenance Request" individual status
- F** x = Status message sets the "Maintenance Mode" individual status
- Reaction** Explanations and measures to react to the status message

No.	Text	O	E	M	F	Reaction
321	The detector temperature is below the condensation limit.	x	x			Error message during the warm-up phase. If the error message appears after warm-up, check the thermal link and replace as needed.
322	The flame is out.	x	x			Error message during the warm-up phase. If the error message appears after warm-up, check the supply gases. Check ignition coil.
323	The analyzer is in the fail-safe state.	x	x			Inadequate combustion gas supply; turn power supply off and back on after ≥ 3 seconds. Notify service if the error message recurs. <i>Note</i> <i>Fail safe status means: Heater off, combustion gas valve closed, instrument air valve closed. Cause:</i> <i>Flame temperature > 400 °C</i> <i>Detector temperature > set point + 30 °C</i> <i>Pt-100 lead break or short.</i>
324, 325	The temperature is above or below the upper or lower limit value 1 (2).				x	The temperature of the detector (T - Re . D) and of the heated sample gas port (T - Re . E) is outside the limit values. Error message during the warm-up phase. It disappears as soon as the temperature has reached the respective set point. If the error message appears after the warm-up phase, check whether the ambient temperatures are within the permissible range (+5 to +45 °C). Check thermal link.
329, 330	The pressure is above or below the upper or lower limit value 1 (2).				x	Check supply gas pressures: Output Instrument air Air Combustion air H2 Combustion gas

Analyzer Shutdown

Analyzer Shutdown

Step	Action
Temporary Shutdown:	
1	Turn off the sample gas and the combustion air and combustion gas supplies.
2	Purge the gas lines and analyzer module with dry fresh air or nitrogen for at least 5 minutes.
3	Turn off the analyzer power supply.
4	Turn off the instrument air supply.
Additional Steps for Long-Term Shutdown:	
5	Remove the gas lines from the analyzer module ports. Tightly seal the gas ports.
6	Disconnect the electrical wiring from the electronic module and, if applicable, the analyzer module connections.

Ambient Temperature Ambient temperature during storage and transport: -25 to +65 °C

Preparing the Analyzer for Shipping and Packing



CAUTION!

The analyzer weighs approx. 25 kg. Two persons are needed for removal and carrying.

Preparation for Shipping

Step	Action
1	Remove the system bus terminating resistor from the electronics module and secure it to the housing, e.g. with adhesive tape. If the terminating resistor remains in the electronics module it can be broken during shipment causing damage to the resistor as well as to the electronic module system bus receptacle.
2	Unscrew the adapters from the gas ports.
3	Tightly seal the gas ports with plugs.
4	In the IP-54 version of the system housing close off the connection box cable openings by inserting the appropriate plates.



When returning an analyzer or an analyzer module to the service department, e.g. for repair, please indicate which gases have been supplied to the analyzer module.

This information is needed so that service personnel can take any safety precautions required for harmful gases.

Packing

Step	Action
1	<p>If the original packaging is not available, wrap the analyzer in bubble foil or corrugated cardboard.</p> <p>When shipping overseas additionally place the analyzer in a 0.2-mm thick polyethylene bag, add a drying agent (such as silica gel) and seal the bag air-tight.</p> Use an amount of drying agent appropriate for the package volume and the planned shipping schedule (at least 3 months).
2	<p>Place the analyzer in an adequately sized box lined with cushioning material (foam or similar substance).</p> The cushioning material's thickness should be adequate for the analyzer's weight. <p>When shipping overseas additionally wrap the box in a layer of protective waterproof wrapping.</p>
3	Mark the box as "Fragile Material".

Ambient Temperature Ambient temperature during storage and transport: -25 to +65 °C

Description

Measurement Principle of the Flame Ionization Detector

The flame ionization detector (FID) uses as measuring effect the ionization of organic carbon atoms in a hydrogen flame. Hydrocarbon-free combustion air must be supplied to maintain the flame.

The hydrogen flame burns in an electric field generated by a DC voltage between two electrodes. Ionized particles are produced when hydrocarbons present in the sample gas are burned in the hydrogen flame. As a result, an ionization current directly proportional to the number of organic carbon atoms in the sample gas flows between the electrodes. The ionization current is electrically amplified and converted to a voltage signal.

Design

The analyzer consists of the central unit and MultiFID14 analyzer module. The analyzer module is connected with the electronics module of the central unit via the system bus.

The analyzer module contains the following components (see Figure 16, page 57):

- detector **A** with combustion chamber **B** and integrated air injection pump (option) **C**,
- negative pressure regulator **D**,
- combustion air regulator **E**,
- combustion gas regulator **F** and
- sample gas inlet **13** (heated or unheated).

The negative pressure regulator **D** generates a constant negative pressure of $p_{\text{abs}} = 700 \text{ hPa}$ or 600 hPa ($= 0.7 \text{ bar}$ or 0.6 bar) downstream from the nozzle at the sample gas inlet and in combustion chamber **B**. The major part of the sample gas drawn in (approx. 80 to 100 l/h) flows through combustion chamber bypass nozzle **14** and is carried together with the instrument air for air injector pump **C** to exhaust air outlet **12**. A small constant fraction of the sample gas is mixed with the combustion gas and passed through a burner nozzle into combustion chamber **B**. This mixture is burned in contact with the combustion air.

The flow rates of combustion air and combustion gas are maintained constant with pressure regulators **E** and **F**. The combustion air is prepared in an upstream catalyst (option).

The sample gas line is connected to the (heated or unheated) sample gas inlet **13**, where pressure fluctuations of $p_{\text{abs}} = 800$ to 1200 hPa ($= 0.8$ to 1.2 bar) are permissible without changing the sample gas flow rate in the combustion chamber.

Working Principle

Once the detector temperature has reached the threshold value of $150 \text{ }^\circ\text{C}$, the instrument air for the air injector is turned on and the negative pressure regulator and the combustion air controller set the working pressures. Next, the combustion gas supply is activated and the combustion gas pressure is set to a constant value. A built-in ignition coil ignites the hydrogen flame, and a temperature sensor monitors the flame temperature.

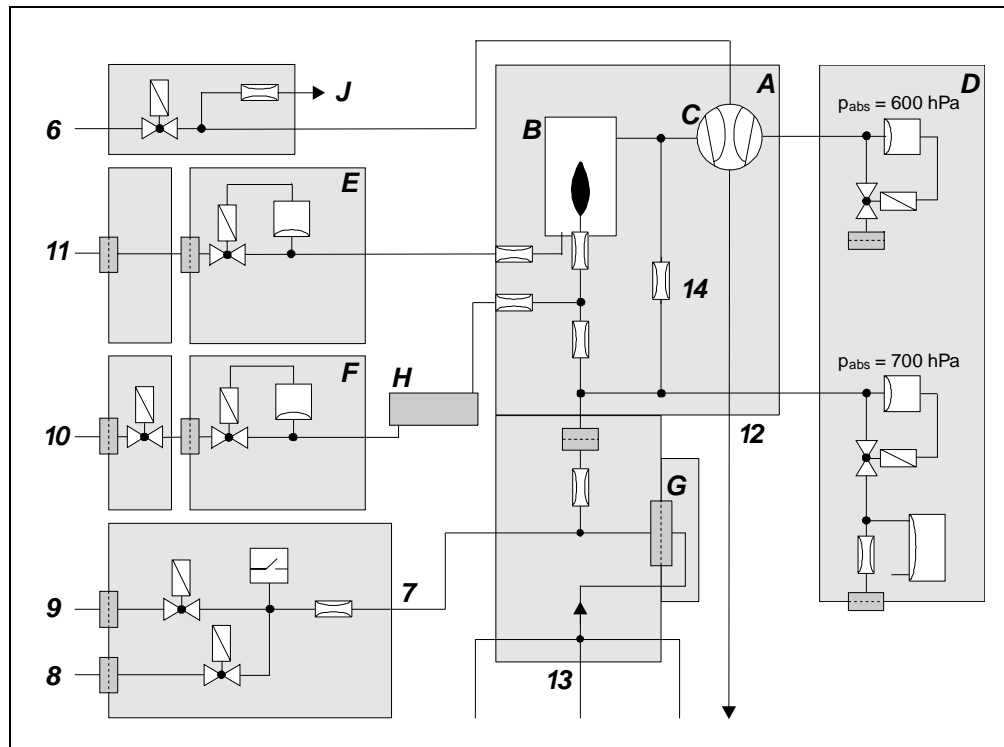
During operation the analyzer module monitors all relevant temperatures and pressures and transmits an error message in the event of faulty values.

Gas Diagram

Figure 16

Gas Diagrams

MultiFID14 Analyzer Module with Heated Sample Gas Port (3x) and Air Injector



- | | | |
|--------------------------------|-----------------------------|--------------------------------------|
| 6 Instrument air inlet | 13 Sample gas inlet | D Negative pressure regulator |
| 7 Test gas outlet | 14 Bypass nozzle | E Combustion air regulator |
| 8 Span gas inlet | A Detector | F Combustion gas regulator |
| 9 Zero gas inlet | B Combustion chamber | G Sample gas filter |
| 10 Combustion gas inlet | C Air injector | H Active charcoal filter |
| 11 Combustion air inlet | | J Housing purge |
| 12 Exhaust outlet | | |



Port numbers correspond to the connection diagram (see Figure 4, page 19) and the inscriptions on the back of the analyzer module.

Operating Specifications

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

Linearity deviation	$\leq 2\%$ of measuring ranges to 10,000 mg org. C/m ³ , this value applies to one (calibrated) range
Repeatability	$\leq 0.5\%$ of measurement range
Zero-point and sensitivity drift	≤ 0.5 mg org. C/m ³ per week
Output signal variation	$\leq 0.5\%$ of smallest measurement range at 2σ
Detection limit	$\leq 2\%$ of final value in measurement range > 0 to 15 mg org. C/m ³
O₂ dependence	$\leq 2\%$ of measured value for 0 to 21 Vol.-% O ₂ or ≤ 0.3 mg org. C/m ³ , whichever is greater
Temperature influence	Ambient temperature in permissible range; on zero-point and on sensitivity: $\leq 2\%$ per 10 °C in 0 to 15 mg org. C/m ³ measurement range
Power supply influence	24 VDC $\pm 5\%$: $\leq 0.2\%$ of measuring range
T₉₀ time	T ₉₀ < 0.9 seconds (with unheated sample gas inlet; applies to an analyzer unit with 1 analyzer module)

Electrical Safety

Test	per EN 61010-1:2001
Protection Class	I
Overload Category/ Pollution Level	Power supply 115/230 VAC: II/2 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

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