

AO2000-LS25

Laser analyzers



General purpose and hazardous areas

Measurement made easy

—
LS25

Introduction

As an integrated part of the Advance Optima series the LS25 can be combined with further analyzer modules and completely operated remotely in Ethernet networks.

The LS25 has ATEX, IECEx and CSA certificates for use in for use in hazardous areas.

Additional information

Additional documentation on AO2000-LS25 is available for download free of charge at www.abb.com/analytical. Alternatively simply scan this code:



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1 Safety

General information and instructions

These instructions are an important part of the product and must be retained for future reference.

Installation, commissioning, and maintenance of the product may only be performed by trained specialist personnel who have been authorized by the plant operator accordingly. The specialist personnel must have read and understood the manual and must comply with its instructions.

For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.

The content of these instructions is neither part of nor an amendment to any previous or existing agreement, promise or legal relationship.

Modifications and repairs to the product may only be performed if expressly permitted by these instructions.

Information and symbols on the product must be observed.

These may not be removed and must be fully legible at all times.

The operating company must strictly observe the applicable national regulations relating to the installation, function testing, repair and maintenance of electrical products.

Warnings

The warnings in these instructions are structured as follows:

DANGER

The signal word '**DANGER**' indicates an imminent danger. Failure to observe this information will result in death or severe injury.

WARNING

The signal word '**WARNING**' indicates an imminent danger. Failure to observe this information may result in death or severe injury.

CAUTION

The signal word '**CAUTION**' indicates an imminent danger. Failure to observe this information may result in minor or moderate injury.

NOTICE

The signal word '**NOTICE**' indicates possible material damage.

Note

'**Note**' indicates useful or important information about the product.

Intended use

The Laser analyzer module LS25 is designed for the continuous measurement of the concentration of individual components in a gas mix.

The LS25 laser analyzer module is part of the AO2000 integrated analyzer system and cannot be operated as a single device.

The operating instructions of the AO2000 must be observed.



OI/AO2000-EN

Any other use is not approved.

The intended use also includes taking note of this operating instruction.

Gas components

The LS25 laser analyzer module is intended for concentration measurement of the gas components listed below:

Note

The data provided is based on 1 m optical path length, 25 °C sample gas temperature and 1 bar abs sample gas pressure, sample gas in nitrogen.

Deviations from this are possible in a process-dependent manner.

| sample component | Smallest range | Max. abs. pressure | Max. temperature |
|--------------------------|----------------|--------------------|------------------|
| O ₂ | 0 to 1 vol.% | 10 bar | 1500 °C |
| NH ₃ | 0 to 20 ppm | 1.5 bar | 500 °C |
| HCl | 0 to 5 ppm | 1.5 bar | 400 °C |
| HF | 0 to 3 ppm | 1.5 bar | 300 °C |
| H ₂ S | 0 to 300 ppm | 1.5 bar | 300 °C |
| H ₂ O (ppm) | 0 to 30 ppm | 1.5 bar | 1300 °C |
| H ₂ O (vol.%) | 0 to 1 vol.% | 1.5 bar | 1500 °C |
| CO (ppm) | 0 to 20 ppm | 1.5 bar | 500 °C |
| CO (vol.%) | 0 to 1 vol.% | 1.5 bar | 600 °C |
| CO ₂ (ppm) | 0 to 100 ppm | 1.5 bar | 300 °C |
| CO ₂ (vol.%) | 0 to 1 vol.% | 1.5 bar | 1500 °C |
| NO | 0 to 1500 ppm | 1.5 bar | 300 °C |
| N ₂ O | 0 to 500 ppm | 1.5 bar | 200 °C |
| HCN | 0 to 30 ppm | 1.5 bar | 300 °C |
| CH ₄ | 0 to 1 vol.% | 1.5 bar | 500 °C |
| NH ₃ + | 0 to 20 ppm | 1.5 bar | 500 °C |
| H ₂ O | 0 to 2 vol.% | | |
| HCl + | 0 to 5 ppm | 1.5 bar | 400 °C |
| H ₂ O | 0 to 5 vol.% | | |
| HF + | 0 to 3 ppm | 1.5 bar | 300 °C |
| H ₂ O | 0 to 2 vol.% | | |
| CO (vol.%) + | 0 to 1 Vol.-% | 1.5 bar | 600 °C |
| CO ₂ (vol.%) | 0 to 1 Vol.-% | | |
| HCl + | 0 to 300 ppm | 1.5 bar | 400 °C |
| CH ₄ | 0 to 1 Vol.-% | | |
| CO (ppm) + | 0 to 20 ppm | 1.5 bar | 500 °C |
| CH ₄ | 0 to 100 ppm | | |
| CO (ppm) + | 0 to 100 ppm | 1.5 bar | 1500 °C |
| H ₂ O (vol.%) | 0 to 5 Vol.-% | | |
| O ₂ + Temp. | 0 to 1 Vol.-% | 1.5 bar | 1500 °C |

Improper use

The following are considered to be instances of especially improper use of the device:

- For use as a climbing aid, for example for mounting purposes.
- For use as a bracket for external loads, for example as a support for piping, etc.
- Material application, for example by painting over the housing, name plate or welding/soldering on parts.
- Material removal, for example by spot drilling the housing.

Notes on data safety

This product is designed to be connected to a network interface and to communicate information and data via this network interface.

It is the operator's sole responsibility to provide and continuously ensure a secure connection between the product and your network or any other network (as the case may be).

The operator must implement and uphold appropriate measures (such as the installation of firewalls, the application of authentication measures, data encryption, the installation of anti-virus programs, etc.), in order to protect the product, the network, the connected systems and the interface from any breaches of security, unauthorized access, interference, intrusion, loss and/or theft of data or information.

ABB Automation GmbH and its subsidiaries do not accept liability for any damage and/or loss resulting from such breaches of security, unauthorized access, interference, intrusion or loss and/or theft of data or information.

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Service address

If the information in this Operating Instruction does not cover a particular situation, ABB Service will be pleased to supply additional information as required.

Please contact your local service representative.

For emergencies, please contact:

Customer service center

Tel: +49 180 5 222 580
Email: automation.service@de.abb.com

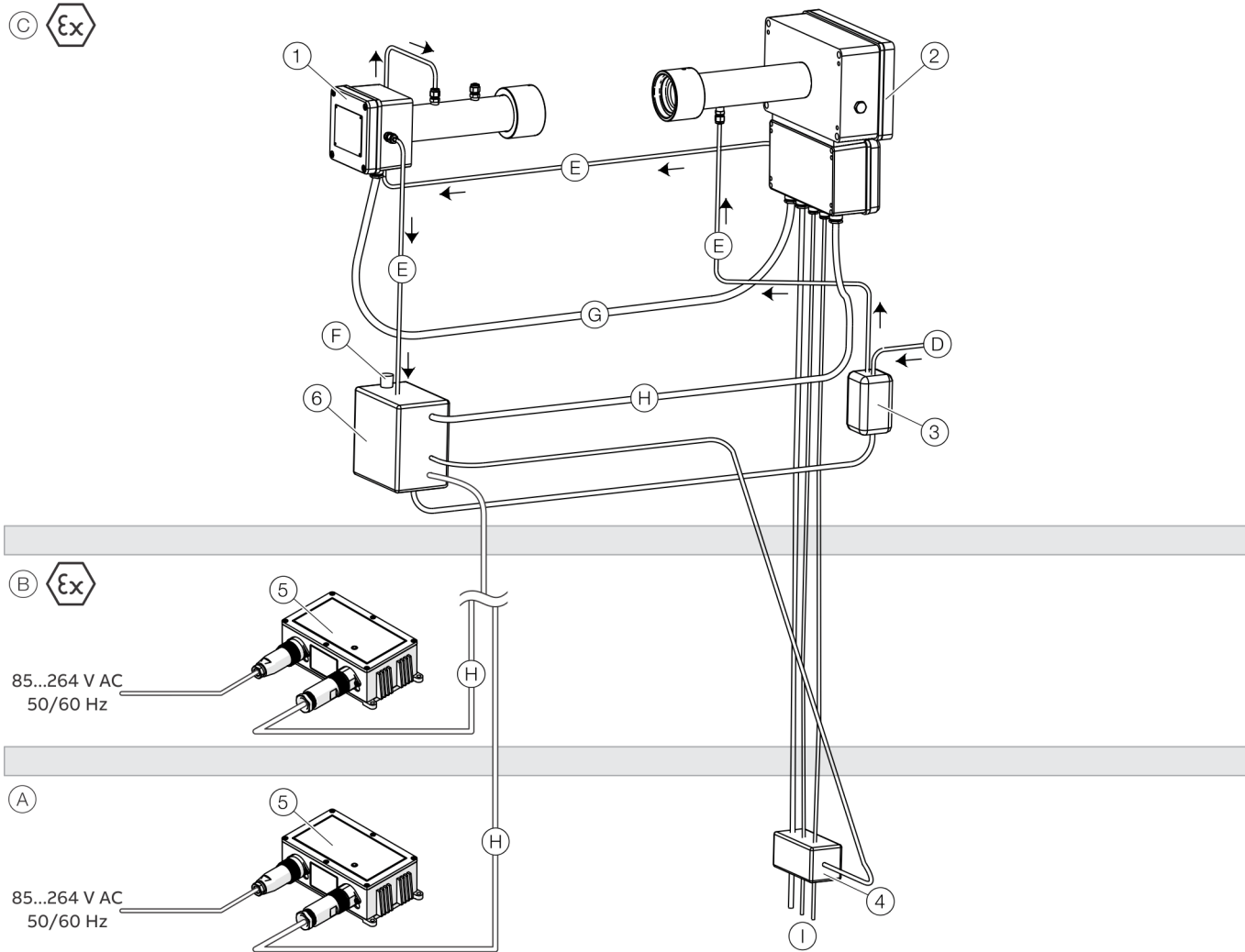
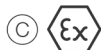
2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Use in ATEX / IECEx Zone 1

Introduction

This part of the Operating Instruction contains information of installation, operation and maintenance of the analyzer, ATEX / IECEx Zone 1 version.

Design



- | | |
|---|--|
| (A) Non-hazardous area | (F) Purge gas outlet |
| (B) Hazardous area (Atex / IECEx, Zone 2) | (G) Signal cable |
| (C) Hazardous area (Atex / IECEx, Zone 1) | (H) Power supply cable 24 V DC |
| (D) Purge gas inlet | (I) Inputs / Outputs |
| (E) Purge gas lines | |
| (1) Receiver unit | (4) Interface relays |
| (2) Transmitter unit | (5) Power supply, either in Atex / IECEx, Zone 2 or outside the hazardous area |
| (3) Purging gas valve (pressurized encapsulation) | (6) Purging and monitoring unit (pressurized enclosure) |

Figure 1: Device design ATEX / IECEx version with pressurized enclosure

The analyzer consists of four separate modules:

- Transmitter unit with purge fittings and connection box with terminals for the connection of power supply and signal cables as well as optional inputs.
- Receiver unit with purge fittings
- Pressurized enclosure for Zone 1 with purging and monitoring unit, purge gas valve and interface relays
- Power supply unit

DANGER

Explosion hazard

The power supply unit is only approved for Zone 2 and must not be installed in Zone 1 hazardous areas.

- Install the power supply unit in the hazardous area of Zone 2 or in a non-hazardous area.

Ex marking

ATEX Marking



| | |
|--|---|
| ATEX certificate: | Presafe 20 ATEX 69761X |
| Ambient temperature T_{amb} . | $-20^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$ |
|  II 2 G Ex pxb [op is Ga] IIC T4 Gb | |
|  II 2 D Ex pxb [op is Da] IIIC T100°C Db | |

Table 1: Ex mark according to ATEX

IECEx marking

| | |
|----------------------------------|---|
| IECEx certificate: | IECEx PRE 20.0072X |
| Ambient temperature T_{amb} . | $-20^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$ |
| Ex pxb [op is Ga] IIC T4 Gb | |
| Ex pxb [op is Da] IIIC T100°C Db | |

Table 2: Ex marking according to IECEx

Explanation of the Ex marking

Device group II

Device group II indicates equipment intended for use in installations in all other Ex areas except for mining.

Category 2

Devices of this category are intended for use in areas where a hazardous area is expected to occur due to vapors, gases, mist or dust-air mixtures.

The protections for devices of this category guarantee the required level of protection, even in the event of frequent faults or faults in the device, which normally must be taken into account.

The device is suitable for areas classified as Zone 1 (flammable gases, vapors or liquids) or Zone 21 (flammable dusts) as defined below. The device is suitable for all gas groups.

G / D

The device is approved for gases, vapors or dusts.

T4 / T100°C – Temperature class

Specifies the maximum surface temperature outside the device.

Ex px / pD – Type of protection

Type of protection housing purging / pressurized enclosure

[op is Ga/Da]

The laser radiation emitted by the device is considered non-incendive and thus allows radiation to pass through Zone 0 or Zone 20.

IIC/IIIC – Gas / dust group

No limitation to specific gases / dusts.

IP66 – IP rating

Dust-tight, complete protection against contact / protection against powerful water jets

EPL Gb (Zone 1) / EPL Db (Zone 21)

EPL Gb: an area where partially ignitable concentrations of flammable gases, vapors or liquids may occur under normal operating conditions.

EPL Db: an area where ignitable dusts may be present under normal operating conditions all the time or part of the time.

Note

- The gas analyzer meets Ex approval only with a suitably approved purging and monitoring unit for the pressurized enclosure.
- The components of the pressurized enclosure are not included in the standard delivery scope of the device, but can optionally be supplied from ABB.

... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

... Use in ATEX / IECEx Zone 1

Ambient conditions

Operating temperature

-20 °C to +55 °C

Storage temperature

-20 °C to +55 °C

IP rating

Designed for outdoor applications (all IP 66-certified modules)

Degree of contamination

2

Installation category (overvoltage category)

II

Installation height

2000 m

Air humidity

0 to 95 %

Device data

Laser classification

Class 1 according to IEC 60825-1

Class 1M according to IEC 60825-1*

* All O₂ analyzers supplied after October 2017



ENOHD

For O₂ analyzers: 7.88 m

NOHD: Nominal Ocular Hazard Distance

Eye safety distance is the distance at which the irradiation level or irradiation is equal to the corresponding exposure limit of the eye's cornea.

If the eye safety distance also includes the possibility of viewing with optical aids (e.g. telescope), we refer to the extended eye safety distance (ENOHD: Enlarged Nominal Ocular Hazard Distance).

Installing the pressurized enclosure

Purge parameters for pressurized enclosure

The purging and monitoring unit must guarantee the following purge parameters.

| Parameter | Variant 1 | Variant 2 |
|----------------------|----------------------|----------------------|
| Purge gas | Air / N ₂ | Air / N ₂ |
| Internal free volume | 12 l | 12 l |
| Min. purge current | 11 l/min | 48 l/min |
| Min. purge time | 3 min 40 sec | 1 min 15 sec |
| Min. overpressure | 0.8 mbar | 4 mbar |
| Max. overpressure | 20 mbar | 20 mbar |
| Max. leakage rate | 2 l/min | 2 l/min |

Table 3: Ex "p" specifications

Purge air properties for pressurized enclosure

| Parameter | Value/Description |
|-------------|--|
| Quality | Class 533, in accordance with DIN ISO 8573-1 |
| Temperature | Maximum 55 °C* |
| Flow rate | See Table 3: Ex "p" specifications |

Table 4: Purge air characteristics

* in accordance with EN 60079-2 (pressurized enclosure, Ex "p")

Installation

NOTICE

Damage to the optical components

Damage to the optical components due to contaminated purge gas.

- The purge gas must meet the quality requirements in accordance with **Table 4** on page 9.

Note

- The gas analyzer meets Ex approval only with a suitably approved purging and monitoring unit for the pressurized enclosure.
- The components of the pressurized enclosure are not included in the standard delivery scope of the device, but can optionally be supplied by ABB.

The installation of the pressurized enclosure must be performed according to the schematic diagram in **Figure 1** on page 6.

- Metal pipes with a 6 mm outside diameter are used as purge gas lines and are connected to the corresponding Swagelok® fittings on the transmitter and receiver unit.

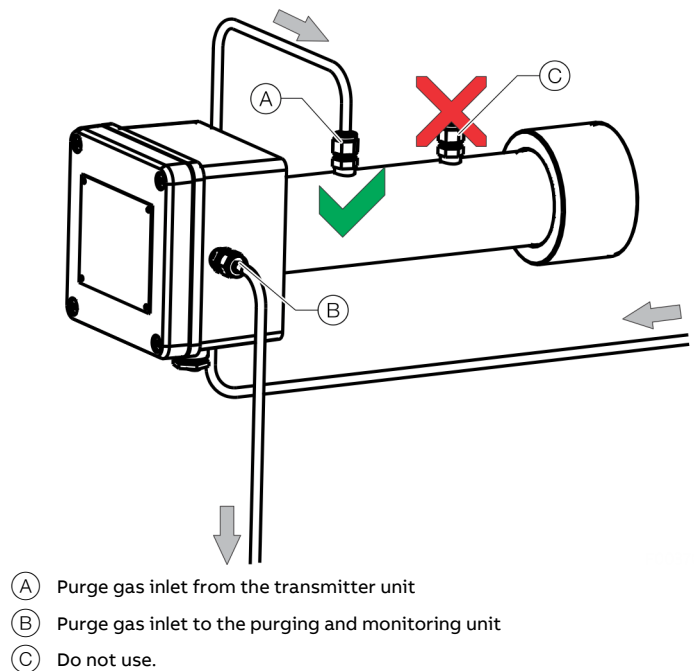


Figure 2: Purge gas connection to the receiver unit (air as purge gas)

... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

... Use in ATEX / IECEx Zone 1

- The purge gas inlet must be connected to the Swagelok® fitting (A) on the receiver unit. Keep gland (C) closest to the connection flange free.
- The flow direction of the purge gas must be designed according to **Figure 1** on page 6.
- The electrical inputs/outputs of the device must be routed via a suitable interface relay. The interface relay is controlled by the purging and monitoring unit and disconnects the inputs / outputs on all poles in the event of a fault.
- The operating instructions of the purging and monitoring unit as well as other components of the pressurized enclosure must be observed during installation.
- The customer must check and, if necessary, set the process-specific purge parameters (see **Purge parameters for pressurized enclosure** on page 9) in the purging and monitoring unit during commissioning.

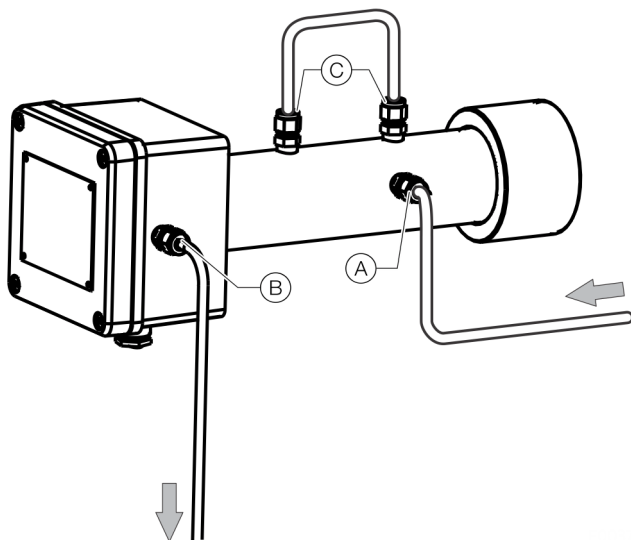
Pressurized enclosure with nitrogen N₂

⚠ WARNING

Risk of suffocation

Risk of suffocation in the event of uncontrolled escaping nitrogen.

- Ensure that all purge gas lines are tight and that the purge gas emerges into the outside air in a controlled fashion.



- (A) Purge gas entry from the transmitter unit
- (B) Purge gas entry to the purging and monitoring unit
- (C) Jumper connections

Figure 3: Purge gas connection to the receiver unit (N₂ as purge gas)

If nitrogen purging is required for the measurement (e.g. in high-temperature applications or small O₂ / H₂O measuring ranges), the purge gas connection must be as shown in Figure 3. The connection of the transmitter unit is unchanged.

Housing purge control flow

The power supply of the gas analyzer is provided via the purging and monitoring unit of the housing purging.

- The power supply to the gas analyzer may only be released from the purging and monitoring unit after the successful initial purge.
- The purging and monitoring unit monitors the overpressure inside the housing and de-energizes the gas analyzer if the level is below the minimum overpressure (e.g. due to a leakage or purge gas supply failure).

Sequence of the purging and monitoring unit

The gas analyzer is powered from the purging and monitoring unit, i.e. the purging and monitoring unit prevents the gas analyzer from being energized before the purge is completed.

The flow sequence of the purging and monitoring unit is as follows:

1. After the start of the sequence, the purge gas flow and overpressure in the monitor are monitored by the purging and monitoring unit.
2. If the minimum flow rate of the purge gas and the overpressure are within the specified limits (see **Purge parameters for pressurized enclosure** on page 9), the purge timer (initial purge time) can be started;
3. After the initial purge time has elapsed, the power supply is released for the gas analyzer.
4. In the event of an error in one of the sequence steps, the controller must be set up to be reset to the beginning.

This sequence is presented in Figure 4.

Each state of the system is defined in response to the inputs of the monitor. The states are unique. Transitions between the states are only allowed along the paths defined by the arrows and towards the arrows.

The logical conditions for each state are defined by the following boolean logical expressions:

Logical expressions of the purging sequence

Initial state – S0

Conditions for starting the purge – S1

$[MOP] \& [\overline{XOP}] \& [PFLO] \& [PTIM]$

Initial purging in progress – S2

$[MOP] \& [\overline{XOP}] \& [PFLO] \& [PTIM]$

Initial purging completed, power supply released – S3

$[MOP] \& [\overline{XOP}] \& [PTIM]$

$[XOP]$ Exceeds maximum overpressure

$[MOP]$ Gage pressure > minimum

$[PFLO]$ Purge flow > minimum

$[PTIM]$ Initial purging time completed

$[PTIM]$ Initial purging time incomplete

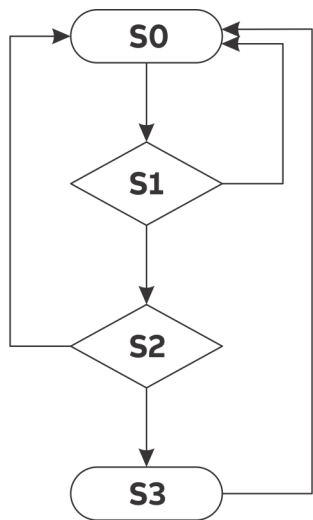


Figure 4: Status diagram of housing purging

Opening and closing the housing

Observe the following safety instructions when opening and closing the housing with the type of protection Ex “p” – pressurized enclosure:

⚠ DANGER

Explosion hazard

There is a risk of explosion if the housing is opened in a hazardous atmosphere.

Before opening the housing:

- A valid fire permit must be present.
- Make sure that there is no explosion hazard.
- Before opening the housing, switch off the power supply.

⚠ WARNING

Risk of suffocation

Risk of suffocation when using inert purging gases such as nitrogen (N₂).

- Before opening the housing, switch off the housing purging.

Recommissioning after opening the housing

- Before closing the housing and recommissioning, all dust deposits in and on the device must be removed.
- After closing the housing, the power supply must not be restored until an initial purge duration of at least 3 minutes at 20 l/min has elapsed.

Only original spare parts must be used to seal the housing.

... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

Use in ATEX / IECEx Zone 2

Introduction

This part of the Operating Instruction contains information of installation, operation and maintenance of the analyzer, ATEX Zone 2 version.

Design

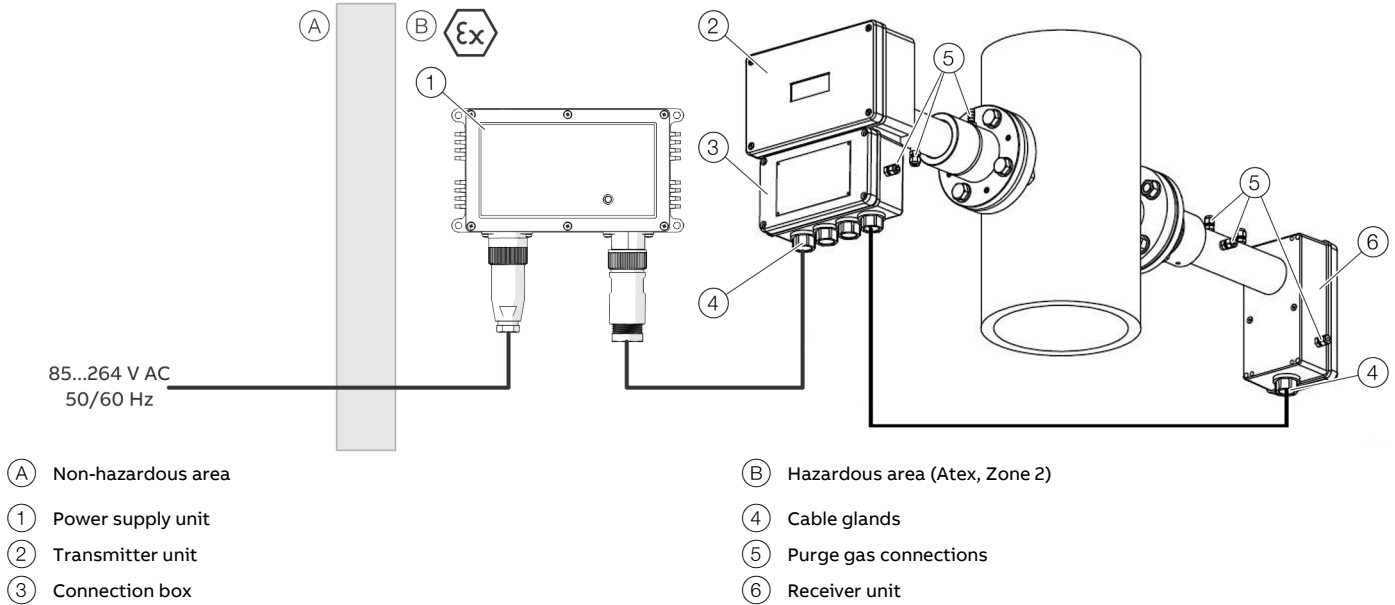


Figure 5: Device design ATEX / IECEx version

The analyzer consists of three separate modules:

- Transmitter unit with purge fittings and connection box with terminals for the connection of mains and signal cables as well as optional inputs.
- Receiver unit with purge fittings.
- Power supply unit.

Ex marking

Gas analyzer AO2000-LS25

ATEX Marking



| | |
|---|---|
| ATEX certificate: | Presafe 16 ATEX 8621X |
| Ambient temperature T_{amb} . | $-20^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$ |
|  II 3 G Ex nA nC [op is Ga] IIC T4 Gc | |
|  II 3 D Ex tc [op is Da] IIIC T100°C Dc | |

Table 5: Ex mark according to ATEX

IECEX marking

| | |
|---------------------------------|---|
| IECEX certificate: | IECEX PRE 20.0071X |
| Ambient temperature T_{amb} . | $-20^{\circ}\text{C} \leq T_a \leq +55^{\circ}\text{C}$ |
| Ex nA nC [op is Ga] IIC T4 Gc | |
| Ex tc [op is Da] IIIC T100°C Dc | |

Table 6: Ex mark according to IECEx

Power supply unit TEX 120-124

Ex marking

| | |
|--|---|
| Atex certificate*: | EPS 08 ATEX 1137 X |
| Ambient temperature T_{amb} . | -40°C to 70°C |
|  3 G Ex nA IIC T4 Gc | |

* Power supply unit tested according to IECEx

For more information about the power supply unit, go to:

www.tracopower.com/series/tex-120

Explanation of the Ex marking

Device group II

Device group II indicates equipment intended for use in installations in all other Ex areas except for mining.

Category 3

Devices of this category are intended for use in areas where the occurrence of hazardous areas due to vapors, gases, mist or air-dust mixtures is unlikely and if they occur, then only sporadically and over a short period of time.

G/D

The device is approved for gases, vapors or dusts.

Ex nA nC tc

The basic protection type is “n”. This type of protection is used for equipment that is not able to ignite an ambient hazardous atmosphere during normal operation.

“nA” is applied to non-sparking equipment, i.e., equipment designed to minimize the risk of occurrence of sparks that may create an ignition hazard under normal operating conditions.

“nC” is added because there are relays in the device which are hermetically sealed. “tc” means that the dust protection is the housing.

[op is Ga/Da]

The laser radiation emitted by the device is considered non-incendive and thus allows Zone 0 or Zone 20.

IIC/IIIC – Gas / dust group

No limitation to specific gases / dusts.

T4 / T100°C

Specifies the maximum surface temperature outside the device.

EPL Gc (Zone 2) / EPL Dc (Zone 22)

An area where flammable concentrations of flammable gases, vapors or liquids or ignitable dusts are unlikely, and if they occur, then only sporadically and over a short period of time

... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

... Use in ATEX / IECEx Zone 2

Ambient conditions

Operating temperature

-20 °C to +55 °C

Storage temperature

-20 °C to +55 °C

IP rating

Designed for outdoor applications (all IP 66-certified modules)

Degree of contamination

2

Installation category (overvoltage category)

II

Installation height

2000 m

Air humidity

0 to 95 %

Device data

Laser classification

Class 1 according to IEC 60825-1

Class 1M according to IEC 60825-1*

* All O₂ analyzers supplied after October 2017



ENOHD

For O₂ analyzers: 7.88 m

NOHD: Nominal Ocular Hazard Distance

Eye safety distance is the distance at which the irradiation level or irradiation is equal to the corresponding exposure limit of the eye's cornea.

If the eye safety distance also includes the possibility of viewing with optical aids (e.g. telescope), we refer to the extended eye safety distance (ENOHD: Enlarged Nominal Ocular Hazard Distance).

Electrical data

Power supply

Power supply unit (input)

85 to 264 V AC, 50 / 60 Hz

Power supply unit (output)

24 V DC, maximum 5 A

Transmitter unit (input)

18 to 32 V DC, maximum 20 W

Interfaces

Service interface

- RS232 according to EIA/TIA-232 and V.28/V.24
- Level: max. ± 15 V.
- Current (short-circuit): max. ± 60 mA

Ethernet interface

- Protocol 10/100Base-T
- Max. voltage: ± 2.5 V

Electrical connections

Safety instructions

- The cable glands which are not used must be closed in accordance with the instructions of the manufacturer and the relevant standard applicable in the country of installation.
- The power supply unit is described in **Connecting the power supply** on page 41.
 - The power supply is not suitable for installation in Zone 1 areas.
 - If the power supply cannot be installed in Zone 2 or outside the hazardous area, a suitable third-party power supply unit approved for Zone 1 must be used. For more information, please contact the local ABB representative.
- The PC with the software for service communication with the analyzer must be placed in an explosion safe area. For long distance communication it is recommended to use the optional Ethernet connection.

... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

... Electrical connections

Cable glands on the transmitter unit

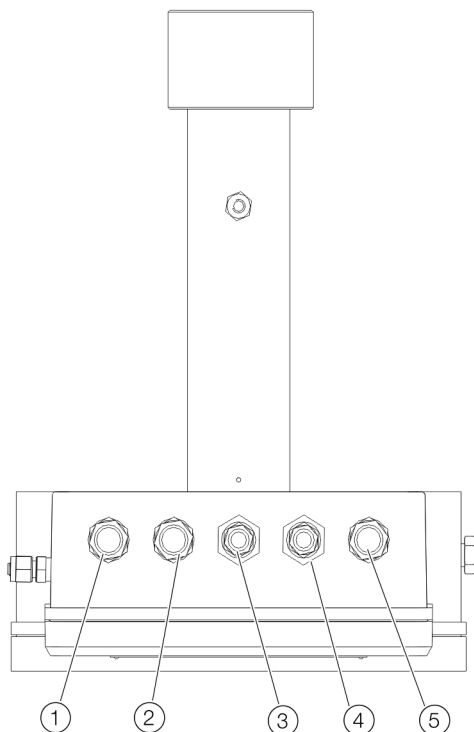


Figure 6: Cable glands on the transmitter unit (viewed from below)

| Pos. | Description |
|------|--|
| ① | Cable gland M20 for cables to receiver unit Power supply and signals from and to the receiver unit. Connection assignment, see Signal cable on page 37. |
| ② | Not assigned |
| ③ | Cable gland M16 for network cable 10 or 10/100 Base-T Ethernet (RJ45). Connection assignment, see Service interface (RS232) on page 38. |
| ④ | Cable gland M16 for service connection RS232 interface (galvanically isolated). Connection assignment, see Service interface (RS232) on page 38. |
| ⑤ | Cable gland M20 for power supply and analog inputs Power supply and signals from the external sensors. Connection assignment, see Power supply / analog inputs on page 38. |

Screwed cable glands M20:

Outside diameter of the cable 7 to 12 mm

Screwed cable glands M16:

Outside diameter of the cable 3.5 to 8 mm

Cable connections

Preliminary remarks

The transmitter and receiver units are connected with a cable (signal cable).

This cable should not be exchanged without ABB's permission nor should the cable length be modified with more than 20 m (65.6 ft) as this may influence calibration or the device's accuracy.

- The max. length of the signal cable (transmitter to receiver unit) is 150 m (492 ft).
- The max. length of the power cable (power supply to transmitter unit) is 100 m (328 ft).
- The max. length of the (optional) Ethernet cable is 100 m (328 ft) or more (depending on configuration of local network).
- The service PC cable is 3 m (9.8 ft) long, but can be extended to approx. 10 m (32.8 ft).

Notes for installation

- If not pre-assembled at the factory, connect the power cable and signal cable to the transmitter unit terminal box, see **Transmitter unit – signal cable to receiver unit** on page 22 and **Transmitter unit – power supply / analog inputs** on page 17.
- If not pre-assembled at the factory, connect the signal cable to the receiver unit, see **Receiver unit – signal cable** on page 17.
- The input signals (such as external temperature and pressure sensors) are connected to the corresponding terminals in the transmitter unit, see **Transmitter unit – power supply / analog inputs** on page 17.
Use the cable gland for power supply and analog inputs, see **Cable glands on the transmitter unit** on page 16.
If connected to the terminals in the transmitter the factory-mounted wires should be removed from the terminals in question.
- The supplied power supply unit may only be installed outside the hazardous area.

Note

- In the table columns labeled "Signal", the indicated polarities of the items are for naming only and do not necessarily reflect the polarity of real voltages.
- All potentials are floating and none of them should be grounded to box. This applies to all connection tables.

Terminal layout

Transmitter unit – signal cable to receiver unit

| Terminal | Wire pair | Color | Signal | |
|----------|-----------|-------|--------------|---------------|
| J7 | 1 | — | — | |
| | 2 | 3 | Pink | RU Temp – |
| | 3 | 3 | Grey | RU Temp + |
| | 4 | 4 | Red | MODSQ – |
| | 5 | 4 | Blue | MODSQ + |
| | 6 | 5 | Black | RU PWR + |
| | 7 | 5 | Violet | RU GND + |
| | 8 | 7 | Green/White* | Servo Sig* |
| J8 | 9 | 6 | Grey/Pink | RU GND – |
| | 10 | 6 | Blue/Red | RU PWR – |
| | 11 | 1 | Brown | Direct – |
| | 12 | 1 | White | Direct + |
| | 13 | 2 | Yellow | 2. Harmonic – |
| | 14 | 2 | Green | 2. Harmonic + |
| | 15 | 7 | Green/Brown* | Servo +5 V* |

Table 7: Transmitter unit – signal cable connection assignment

* Only connected for devices equipped with option “Span check with internal sealed cell”. This option is only available on request.

| Signal | Description |
|-------------|--|
| RU Temp | Signal from embedded receiver temperature sensor |
| MODSQ | Modulation signal from transmitter to receiver (used for detection of 2. harmonic) |
| RU PWR | Power supply to receiver unit |
| Direct | Direct laser transmission signal from receiver detector |
| 2. Harmonic | Detected second harmonic signal from receiver detector |
| Servo | Control of servomotor moving sealed cell |

Table 8: Description of signals

Note

The voltage for alignment purposes (see **Setting the maximum transmission** on page 45) is also available at plug J14.

Receiver unit – signal cable

| Terminal | Wire pair | Color | Signal |
|----------|-----------|--------------|---------------|
| 1 | 7 | Green/White* | Servo Sig* |
| 2 | — | — | — |
| 3 | — | — | — |
| 4 | 7 | Green/Brown* | Servo +5 V* |
| 5 | 3 | Grey | RU Temp + |
| 6 | 3 | Pink | RU Temp – |
| 7 | 4 | Blue | MODSQ + |
| 8 | 4 | Red | MODSQ – |
| 9 | 5 | Black | RU PWR + |
| 10 | 5 | Violet | RU GND + |
| 11 | 6 | Grey/Pink | RU GND – |
| 12 | 6 | Blue/Red | RU PWR – |
| 13 | 1 | White | Direct + |
| 14 | 1 | Brown | Direct – |
| 15 | 2 | Green | 2. Harmonic + |
| 16 | 2 | Yellow | 2. Harmonic – |

Table 9: Receiver unit – signal cable connection assignment

* Only connected for devices equipped with option “Span check with internal sealed cell”. This option is only available on request.

Transmitter unit – power supply / analog inputs

| Terminal | Color code | Description | |
|----------|-------------|-------------|---------------------------------------|
| J5 | 1 | — | Temperature sensor – |
| | 2 | — | Temperature sensor + |
| | 3 | — | Pressure sensor – |
| | 4 | — | Pressure sensor + |
| | 5 | — | Flow sensor – |
| | 6 | — | Flow sensor + |
| | 7 | — | Sensors +24V |
| | 8 | — | Sensors AGND |
| J6 | +18-36 V in | White | +18 to 36 V DC from power supply unit |
| | | Green | |
| | | Grey | |
| | 0 V in | Brown | 0 V from the power supply unit |
| | | Yellow | |
| | Pink | | |

Table 10: Transmitter unit – connection assignment for power supply / analog inputs

* Factory mounted cables may be replaced.

J6 – Power supply from power supply unit to transmitter unit. All 3 power pairs should be wired to ensure even current flow.

External temperature and pressure sensors can be connected inside the transmitter connection box to J5 terminals 1 to 8.

... 2 Use in potentially explosive atmospheres in accordance with ATEX and IECEx

... Electrical connections

Transmitter unit – service interface (RS232)

| Terminal | Signal | Remark | |
|----------|--------|---------------------|-------------------------|
| J13 | 1 | Data Carrier Detect | Connected to terminal 4 |
| | 2 | Transmit Data | — |
| | 3 | Receive Data | — |
| | 4 | Data Terminal Ready | — |
| | 5 | Ground | — |
| | 6 | Data Set Ready | Connected to terminal 4 |
| | 7 | Request To Send | Connected to terminal 8 |
| | 8 | Clear To send | Connected to terminal 7 |
| | 9 | Ring Indicator | Not assigned |

Table 11: Transmitter unit – RS232 connection

Alternatively connector J15 may be used (remember “Gender Changer”).

Transmitter unit – network interface (Ethernet)

| Terminal | Color code | Signal | |
|---|------------|--------------|-----|
| For straight-through connection (switch) | | | |
| J2 | 1 | White/Orange | TX+ |
| | 2 | Orange | TX- |
| | 3 | White/Green | RX+ |
| | 4 | Green | RX- |
| For cross over connection (direct to PC) | | | |
| J2 | 1 | White/Green | TX+ |
| | 2 | Green | TX- |
| | 3 | White/Orange | RX+ |
| | 4 | Orange | RX- |

Table 12: Transmitter unit – Ethernet connection

Operating instructions

Protection against electrostatic discharges

DANGER

Risk of explosion!

The painted surface of the device can store electrostatic charges. As a result, the housing can form an ignition source due to electrostatic discharges in the following conditions:

The device is operated in environments with a relative humidity of $\leq 30\%$.

- Instructions on avoiding ignition in potentially explosive environments due to electrostatic discharges in accordance with PD CLC/TR 60079-32-1 and IEC TS 60079-32-1 must be complied with!

Instructions on cleaning

DANGER

Risk of explosion!

Risk of explosion when cleaning the device due to static discharges.

- Only clean the painted surface of the device with a damp cloth.

3 Use in hazardous areas in accordance with CSA

Introduction

This part of the Operating Instruction contains information of installation, operation and maintenance of the analyzer, Class I Division 2 version (CSA approved).

The Advance Optima Series gas analyzers must be connected in accordance with the CSA Division 2 specifications. Alternatively, the devices can be installed in a suitable housing, cabinet or rack certified according to CSA Division 2. The housing, cabinet or rack must be accepted by the local competent authorities.

conduit seals prevent an explosion from spreading due to dangerous chain reactions in piping systems and igniting the external hazardous area.

When properly installed and sealed with a CSA/UL-listed sealing compound, this prevents the passage of gases, vapors, or flames from spreading from a hazardous location to a nonhazardous location.

Note

The installation instructions of the manufacturer of the conduit sealing must be observed without fail.

Design

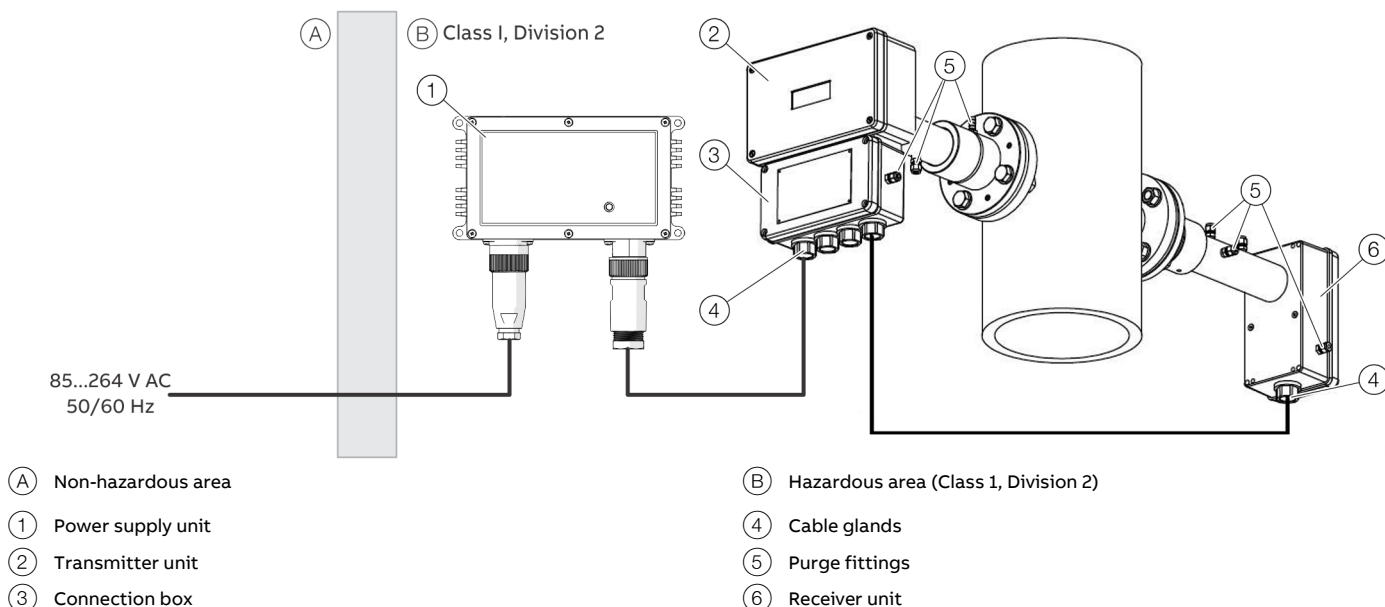


Figure 7: Device design, CSA version

The analyzer consists of three separate modules:

- Transmitter unit with purging fittings and connection box with terminals for connection of power and receiver cable and optional inputs.
- Receiver unit with purge fittings.
- Power supply unit.

... 3 Use in hazardous areas in accordance with CSA

CSA certification

CSA certification, gas analyzer

CSA Class I Division 2 Groups A, B, C, D, Temperature class T4, electrical equipment

Applicable requirements:

- CAN/CSA C22.2 No. 0-M91 (R2001): General Requirements – Canadian Electrical Code, Part II
- CSA standard C22.2 No. 142-M1987: Process Control Equipment
- CSA standard C22.2 No. 213-M1987: Non-Incendive Electrical Equipment for Use in Class I, Division 2 Hazardous Locations
- UL standard No. 916-2007: Energy Management Equipment
- ANSI/ISA-12.12.01-2010: Non-Incendive – Electrical Equipment for Use in Class I and II, Division 2 and Class III, Divisions 1 and 2 Hazardous (Classified) Locations

Certificate no.:

1105720

CSA certification, power supply unit

The power supply unit has its own CSA approval, which is registered under UL File e213613 (Class I, Division 2, group A, B, C & D, temp. Class T4).

Ambient conditions

Operating temperature

-20 °C to +55 °C

Storage temperature

-20 °C to +55 °C

IP rating

Designed for outdoor applications (all modules IP 66-certified).

IP rating is not part of the CSA certification

Degree of contamination

2

Installation category (overvoltage category)

II

Installation height

2000 m

Air humidity

0 to 95 %

Electrical data

Power supply

Power supply unit (input)

85 to 264 V AC, 50 / 60 Hz

Power supply unit (output)

24 V DC, maximum 5 A

Transmitter unit (input)

18 to 32 V DC, maximum 20 W

Interfaces

Service interface

- RS232 according to EIA/TIA-232 and V.28/V.24
- Level: max. ± 15 V.
- Current (short-circuit): max. ± 60 mA

Ethernet interface

- Protocol 10/100Base-T
- Max. voltage: ± 2.5 V

Safety instructions

DANGER

Explosion hazard

Failure to follow safety instructions may cause ignition of hazardous atmosphere resulting in serious personal injury and/or property damage.

WARNING

Loss of Ex-approval!

Loss of Ex approval due to replacement of components in devices for use in potentially explosive atmospheres.

- Devices for use in potentially explosive atmospheres may be serviced and repaired by qualified ABB personnel only.
- For measuring devices for potentially explosive atmospheres, observe the relevant operator guidelines.

Electrical connections

Safety instructions

Myers hub cable glands

- The Myers Hubs cable glands to connect the connection cable for the transmitter and the receiver unit to the terminal box are included with the analyzer.
- The Myers Hubs cable glands are not covered by the certification issued to ABB with regard to explosion protection.
- When handling the Myers Hubs cable glands and the connection cables, the provisions in the NEC standard and the local regulations must be observed. In addition, the instructions of the manufacturer of the cable glands and the conduit system including the instructions for handling the sealing compound must be observed.
- The Myers Hubs cable glands which are not used must be closed in accordance with the instructions of the manufacturer and the relevant standard applicable in the country of installation.

Power supply unit

- The power supply unit is described in **Connecting the power supply** on page 41.

Configuration / parameterization of the device

- The PC with the software for service communication with the analyzer must be placed in an explosion safe area.
- For long distance communication it is recommended to use the optional Ethernet connection.

Cable glands (Myers-Hubs) on the transmitter unit

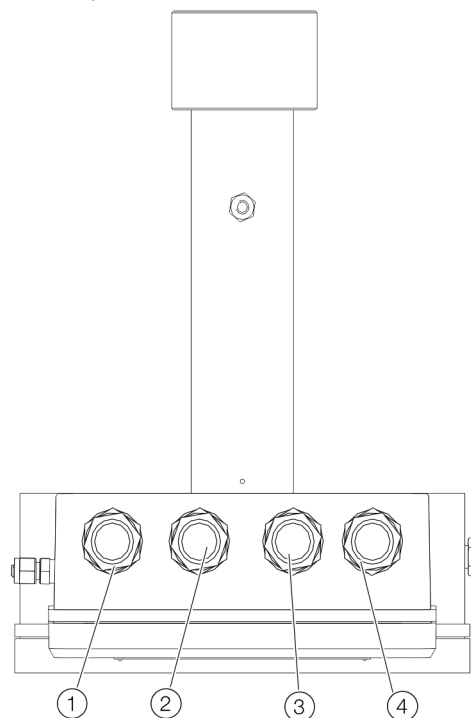


Figure 8: Cable glands (Myers-Hubs) on the transmitter unit (view from below)

| Pos. | Description |
|------|---|
| ① | 3/4" Myers Hub cable gland for cable to receiver unit Power supply and signals from and to the receiver unit. Connection assignment, see Receiver unit – signal cable on page 23. |
| ② | Not assigned |
| ③ | 3/4" Myers Hub cable gland for network cable and service connection 10 or 10/100 Base-T Ethernet (RJ45). Connection assignment, see Transmitter unit – network interface (Ethernet) on page 23. RS232 interface (galvanically isolated). Connection assignment, see Transmitter unit – service interface (RS232) on page 23. |
| ④ | 3/4" Myers Hub cable gland for power supply and analog inputs Power supply and signals from the external sensors. Connection assignment, see Transmitter unit – power supply / analog inputs on page 23. |

The connections to the transmitter unit are made in the transmitter connection box.

... 3 Use in hazardous areas in accordance with CSA

... Electrical connections

Cable connections

Preliminary remarks

The transmitter and receiver units are connected with a cable (signal cable).

This cable should not be exchanged without ABB's permission nor should the cable length be modified with more than 20 m (65.6 ft) as this may influence calibration or the device's accuracy.

- The max. length of the signal cable (transmitter to receiver unit) is 150 m (492 ft).
- The max. length of the power cable (power supply to transmitter unit) is 100 m (328 ft).
- The max. length of the (optional) Ethernet cable is 100 m (328 ft) or more (depending on configuration of local network).
- The service PC cable is 3 m (9.8 ft) long, but can be extended to approx. 10 m (32.8 ft).

Notes for installation

- If not pre-assembled at the factory, connect the power cable and signal cable to the transmitter unit terminal box, see **Transmitter unit – signal cable to receiver unit** on page 22 and **Transmitter unit – power supply / analog inputs** on page 23.
- If not pre-assembled at the factory, connect the signal cable to the receiver unit, see **Receiver unit – signal cable** on page 23.
- The input signals (such as external temperature and pressure sensors) are connected to the corresponding terminals in the transmitter unit, see **Transmitter unit – power supply / analog inputs** on page 23.

Use the cable gland for power supply and analog inputs, see **Cable glands (Myers-Hubs) on the transmitter unit** on page 21.

If connected to the terminals in the transmitter the factory-mounted wires should be removed from the terminals in question.

- The supplied power supply unit may only be installed outside the hazardous area.

Note

- In the table columns labeled "Signal", the indicated polarities of the items are for naming only and do not necessarily reflect the polarity of real voltages.
- All potentials are floating and none of them should be grounded to box. This applies to all connection tables.

Terminal layout

Transmitter unit – signal cable to receiver unit

| Terminal | Wire pair | Color | Signal | |
|----------|-----------|-------|--------------|---------------|
| J7 | 1 | — | — | |
| | 2 | 3 | Pink | RU Temp – |
| | 3 | 3 | Grey | RU Temp + |
| | 4 | 4 | Red | MODSQ – |
| | 5 | 4 | Blue | MODSQ + |
| | 6 | 5 | Black | RU PWR + |
| | 7 | 5 | Violet | RU GND + |
| | 8 | 7 | Green/White* | Servo Sig* |
| J8 | 9 | 6 | Grey/Pink | RU GND – |
| | 10 | 6 | Blue/Red | RU PWR – |
| | 11 | 1 | Brown | Direct – |
| | 12 | 1 | White | Direct + |
| | 13 | 2 | Yellow | 2. Harmonic – |
| | 14 | 2 | Green | 2. Harmonic + |
| | 15 | 7 | Green/Brown* | Servo +5 V* |

Table 13: Transmitter unit – signal cable connection assignment

* Only connected for devices equipped with option "Span check with internal sealed cell". This option is only available on request.

| Signal | Description |
|-------------|--|
| RU Temp | Signal from embedded receiver temperature sensor |
| MODSQ | Modulation signal from transmitter to receiver (used for detection of 2. harmonic) |
| RU PWR | Power supply to receiver unit |
| Direct | Direct laser transmission signal from receiver detector |
| 2. Harmonic | Detected second harmonic signal from receiver detector |
| Servo | Control of servomotor moving sealed cell |

Table 14: Description of signals

Note

The voltage for alignment purposes (see **Setting the maximum transmission** on page 45) is also available at plug J14.

Receiver unit – signal cable

| Terminal | Wire pair | Color | Signal |
|----------|-----------|--------------|---------------|
| 1 | 7 | Green/White* | Servo Sig* |
| 2 | — | — | — |
| 3 | — | — | — |
| 4 | 7 | Green/Brown* | Servo +5 V* |
| 5 | 3 | Grey | RU Temp + |
| 6 | 3 | Pink | RU Temp – |
| 7 | 4 | Blue | MODSQ + |
| 8 | 4 | Red | MODSQ – |
| 9 | 5 | Black | RU PWR + |
| 10 | 5 | Violet | RU GND + |
| 11 | 6 | Grey/Pink | RU GND – |
| 12 | 6 | Blue/Red | RU PWR – |
| 13 | 1 | White | Direct + |
| 14 | 1 | Brown | Direct – |
| 15 | 2 | Green | 2. Harmonic + |
| 16 | 2 | Yellow | 2. Harmonic – |

Table 15: Receiver unit – signal cable connection assignment

* Only connected for devices equipped with option “Span check with internal sealed cell”. This option is only available on request.

Transmitter unit – power supply / analog inputs

| Terminal | Color code | Description |
|----------|-------------|-------------|
| J5 | 1 | — |
| | 2 | — |
| | 3 | — |
| | 4 | — |
| | 5 | — |
| | 6 | — |
| | 7 | — |
| | 8 | — |
| J6 | +18-36 V in | White |
| | | Green |
| | | Grey |
| | 0 V in | Brown |
| | Yellow | |
| | Pink | |

Table 16: Transmitter unit – connection assignment for power supply / analog inputs

* Factory mounted cables may be replaced.

J6 – Power supply from power supply unit to transmitter unit. All 3 power pairs should be wired to ensure even current flow.

External temperature and pressure sensors can be connected inside the transmitter connection box to J5 terminals 1 to 8.

Transmitter unit – service interface (RS232)

| Terminal | Signal | Remark |
|----------|--------|---------------------|
| J13 | 1 | Data Carrier Detect |
| | 2 | Transmit Data |
| | 3 | Receive Data |
| | 4 | Data Terminal Ready |
| | 5 | Ground |
| | 6 | Data Set Ready |
| | 7 | Request To Send |
| | 8 | Clear To send |
| | 9 | Ring Indicator |

Table 17: Transmitter unit – RS232 connection

Alternatively connector J15 may be used (remember “Gender Changer”).

Transmitter unit – network interface (Ethernet)

| Terminal | Color code | Signal |
|---|------------|--------------|
| For straight-through connection (switch) | | |
| J2 | 1 | White/Orange |
| | 2 | Orange |
| | 3 | White/Green |
| | 4 | Green |
| For cross over connection (direct to PC) | | |
| J2 | 1 | White/Green |
| | 2 | Green |
| | 3 | White/Orange |
| | 4 | Orange |

Table 18: Transmitter unit – Ethernet connection

4 Design and function

Device description

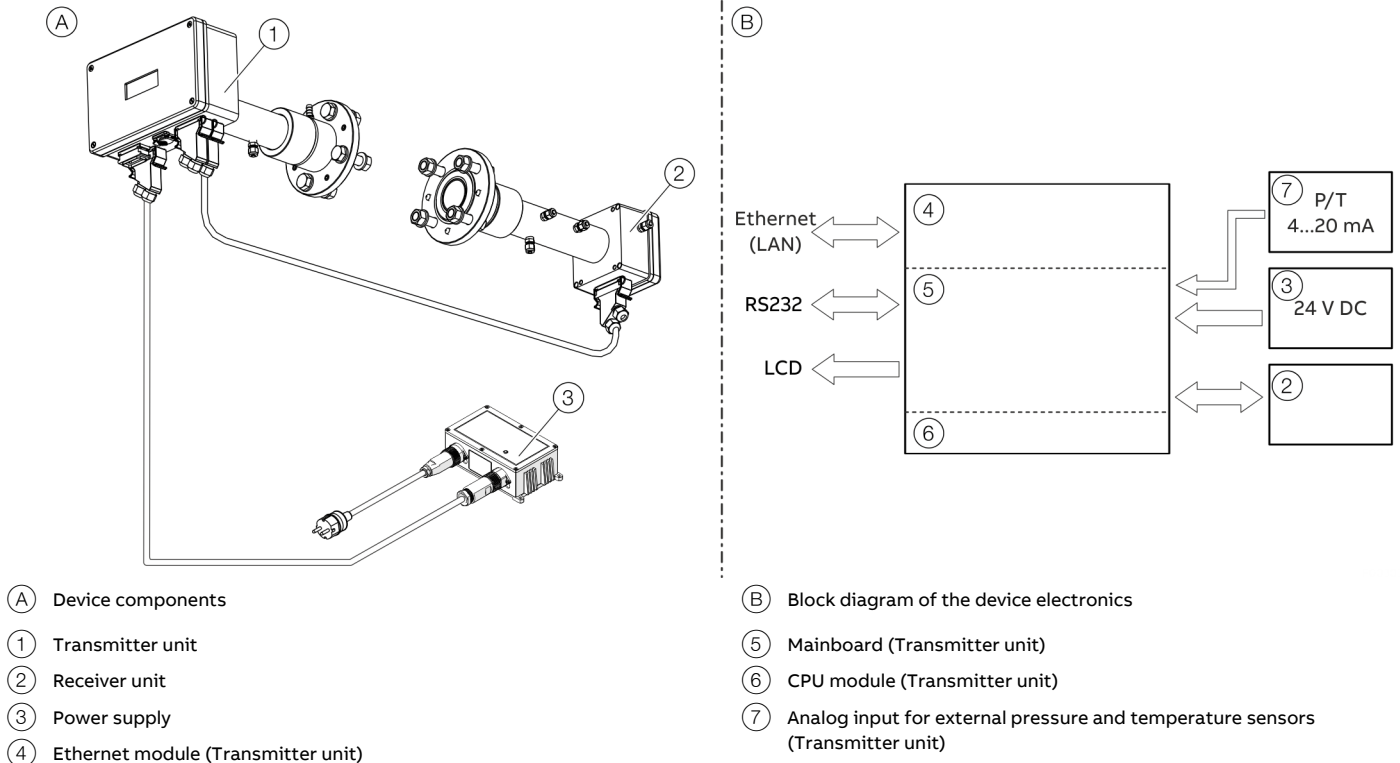


Figure 9: Overview of AO2000-LS25

The transmitter unit consists of the laser module with temperature stabilized diode laser, the collimating optics and the electronics in a coated aluminum housing.

The receiver unit consists of a focusing lens, the photodetector and the receiver electronics in a coated aluminum housing.

Transmitter and receiver units have housing protection IP 66.

The standard optical windows withstand pressures of up to 5 bar (absolute). The monitor is installed by assembling the transmitter and receiver units with the supplied purging and alignment units, which in turn are mounted onto the DN50 process flanges, see **Figure 20** on page 33.

The optical alignment is easy and reliable. The purging prevents dust and other contamination from settling on the optical windows.

The power supply unit transforms 85 to 264 V AC to 24 V DC (if 24 V DC is available the transmitter can be connected directly). The power supply box is connected to the transmitter unit with a cable.

The 4 to 20 mA input signals from the external temperature and / or pressure sensors are connected in the plug housing of the 24 V supply or, for Ex versions, to the screw terminals in the terminal box of the transmitter unit.

The receiver electronics is connected with the transmitter electronics with a cable. The detected absorption signal from the photodetector is amplified and transferred to the transmitter unit through this cable. The same cable transfers the required power from the transmitter unit to the receiver unit.

The aluminum housing of the transmitter unit contains the primary part of the electronics. The CPU board performs all device control and calculation of the gas concentration.

The main board incorporates all electronics required for device operation such as diode laser current and temperature control and analogue-to-digital signal conversion.

An LCD continuously shows the concentration of the gas, the laser beam transmission and the device status.

The RS-232 interface can be used for direct serial communication with a PC.

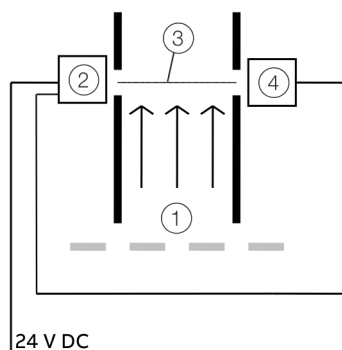
The Ethernet module provides TCP/IP communication over LAN (Local Area Network), which can be used instead of serial communication.

All plug connectors are Phoenix VARIOSUB type and waterproof.

Measuring principle

The analyzer is an optical instrument for continuous in-situ gas monitoring in stack, pipes, process chambers or similar and is based on tunable diode laser absorption spectroscopy (TDLAS).

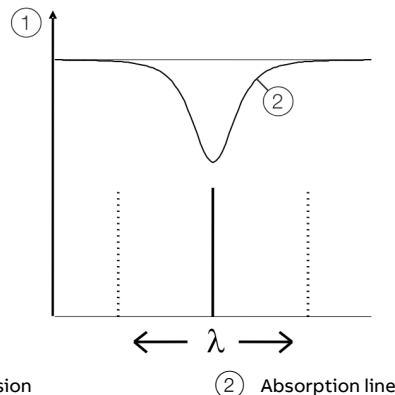
The analyzer utilizes a transmitter / receiver configuration (mounted diametrically opposite each other) to measure the average gas concentration along the line-of-sight path.



- | | |
|--------------------------|-----------------|
| ① Measuring medium (Gas) | ③ Optical path |
| ② Transmitter unit | ④ Receiver unit |

Figure 10: Measuring arrangement

The measuring principle is infrared single-line absorption spectroscopy, which is based on the fact that each gas has distinct absorption lines at specific wavelengths. The measuring principle is illustrated in **Figure 11**.



- | | |
|----------------|-------------------|
| ① Transmission | ② Absorption line |
|----------------|-------------------|

Figure 11: Absorption line of AO2000-LS25

The laser wavelength is scanned across a chosen absorption line of the gas to be measured. The absorption line is carefully selected to avoid cross interference from other (background) gases.

The detected light intensity varies as a function of the laser wavelength due to absorption of the targeted gas molecules in the optical path between transmitter and receiver.

In order to increase sensitivity the wavelength modulation technique is employed: the laser wavelength is slightly modulated while scanning the absorption line. The detector signal is spectrally decomposed into frequency components at harmonics of the laser modulation frequency.

The second harmonics of the signal is used to measure the concentration of the absorbing gas. The line amplitude and line width are both extracted from the second harmonics line shape, which makes the measured concentration insensitive to line shape variations (line broadening effect) caused by background gases.

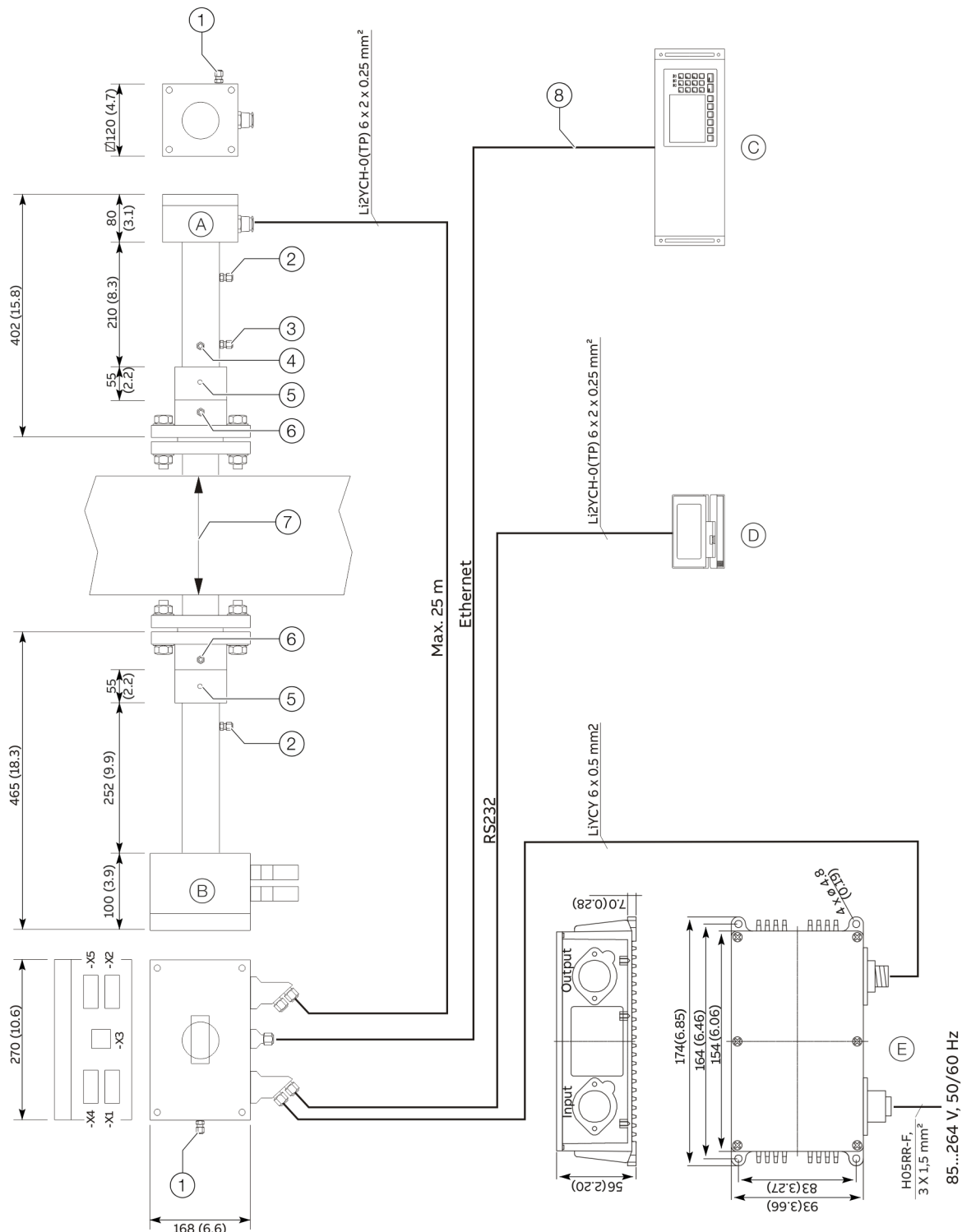
Note

The analyzer measures the concentration of only the FREE molecules of the specific gas, thus not being sensitive to the molecules bound with some other molecules into complexes and to the molecules attached to or dissolved in particles and droplets.

Care should be taken when comparing the measurements with the results from other measurement techniques.

... 4 Design and function

Dimensions, position of the purging connections and installation of cables



- (A) Receiver unit
- (B) Transmitter unit
- (C) AO2000 central unit
- (D) Service PC
- (E) Power supply unit
- (1) Purge gas outlet (housing purging), \varnothing 6 mm
- (2) Purge gas inlet (housing purging), \varnothing 6 mm
- (3) Calibration gas outlet, \varnothing 6 mm
- (4) Calibration gas outlet, \varnothing 6 mm
- (5) Tap hole M8
- (6) Purge gas inlet (flange purging), \varnothing 10 mm
- (7) Optical distance 0.5 to 6 m (1.6 to 19.7 ft)
- (8) CAT5 cable, for outdoor use or for direct earthing, with double PVC sheath

Figure 12: Block diagram of AO2000-LS25

Software

NOTICE

Impairment of the device function and warranty.

Impairment of the device function and warranty by using non-ABB-approved device firmware.

- The firmware may only be updated in coordination with ABB Service.
- Use of device firmware not approved by ABB will void the warranty.

Software for the analyzer consists of two programs:

- The device firmware hidden to the user and integrated in the CPU electronics runs the micro controller on the CPU card. The device firmware performs all necessary calculations and self-monitoring tasks.
- The service program for Windows® running on a standard PC connected through the RS-232 connection. The service program enables communication with the device during installation, service and calibration.

The operator will need to use the service program only during installation and calibration and not during normal operation of the device. See **Parameterization of the device** on page 48 for more details.

Laser classification and warnings

WARNING

Risk of injury

Eye injury due to invisible laser radiation.

The device contains diode lasers of class 1 and 1M.

- Do not open when energized!
- Do not view directly with optical instruments!

The diode lasers used in the analyzer operate in the near infrared (NIR) range between 700 and 2400 nm depending on the gas to be measured.

Laser classes according to IEC 60825-1

- Laser Class 1M for sample component O₂
- Laser Class 1 for all other sample components

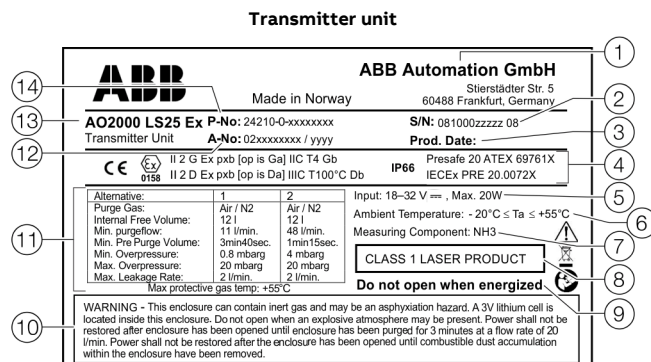
5 Product identification

Name plate

Note

The name plates displayed are examples. The device identification plates affixed to the device can differ from this representation.

Name plate ATEX / IECEx, Zone 1



Receiver unit

- | | |
|---------------------------------|--|
| ① Manufacturer | ⑨ Warning: do not open while energized. |
| ② Serial number | ⑩ Warning label, pressurized enclosure |
| ③ Production date | ⑪ Purge parameters, pressurized enclosure |
| ④ Ex marking | ⑫ Project number |
| ⑤ Power supply | ⑬ Type designation / model |
| ⑥ Ambient temperature | ⑭ Production number |
| ⑦ Sample component | |
| ⑧ Warning: laser class 1 | |

Figure 13: Name plate AO2000-LS25 (example, ATEX / IECEx version, Zone 1)

... 5 Product identification

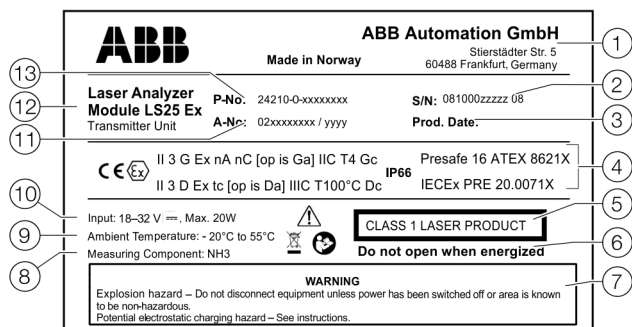
... Name plate

Warning label concerning pressurized enclosure

- This housing may contain inert gas and may pose a suffocation hazard.
- This housing contains a 3 V lithium battery.
- This housing must not be opened when a hazardous atmosphere may be present. After opening the housing, the power supply must not be restored until the housing has been purged for 3 minutes with a flow rate of 20 l/min.
- After opening the housing, the power supply must not be restored until the combustible dust accumulated in the housing has been removed.

Name plate ATEX / IECEx, Zone 2

Transmitter unit



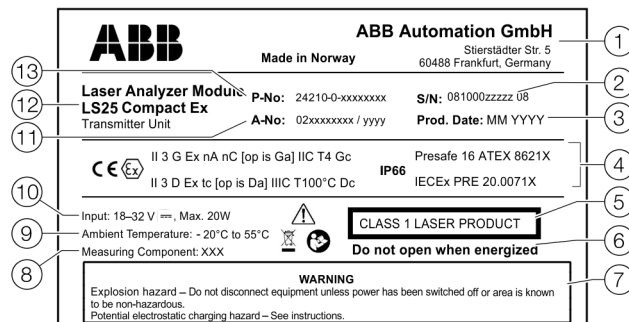
Receiver unit

- | | |
|---|----------------------------|
| ① Manufacturer | ⑧ Sample component |
| ② Serial number | ⑨ Ambient temperature |
| ③ Production date | ⑩ Power supply |
| ④ Ex marking | ⑪ Project number |
| ⑤ Warning: laser class 1 | ⑫ Type designation / model |
| ⑥ Warning: do not open while energized. | ⑬ Production number |
| ⑦ Warning – Risk of explosion: de-energize before opening. | |

Figure 14: Name plate AO2000-LS25 (example, ATEX / IECEx version, Zone 2)

LS25 Compact – name plate ATEX / IECEx, Zone 2

Transmitter unit



Receiver unit

- | | |
|---|----------------------------|
| ① Manufacturer | ⑧ Sample component |
| ② Serial number | ⑨ Ambient temperature |
| ③ Production date | ⑩ Power supply |
| ④ Ex marking | ⑪ Project number |
| ⑤ Warning: laser class 1 | ⑫ Type designation / model |
| ⑥ Warning: do not open while energized. | ⑬ Production number |
| ⑦ Warning – Risk of explosion: de-energize before opening. | |

Figure 15: Name plate AO2000-LS25 Compact (example, ATEX / IECEx Zone 2)

Scope of delivery

| Component / part | Quantity |
|--|-----------|
| Transmitter unit | 1 x |
| Receiver unit | 1 x |
| Connection cable (power supply unit transmitter, transmitter-receiver, Ethernet) | every 1 x |
| Power supply unit (optional) | 1 x |
| Purging flanges with gaskets (as per order) | 2 x |
| Commissioning Instruction | 1 x |
| Accessories included as per customer order | - |

Table 19: Scope of delivery AO2000-LS25

6 Transport and storage

Inspection

Verify that all delivered parts match the order, see **Scope of delivery** on page 28.

Check the devices immediately after unpacking for possible damage that may have occurred from improper transport. Details of any damage that has occurred in transit must be recorded on the transport documents.

All claims for damages must be submitted to the shipper without delay and before installation.

Transporting the device

Observe the following instructions:

- Do not expose the device to humidity during transport. Pack the device accordingly.
- Pack the device so that it is protected against vibrations during transport, for example, by using air-cushioned packing.

Storage conditions

Bear the following points in mind when storing devices:

- Store the device in its original packaging in a dry and dust-free location.
- Observe the permitted ambient conditions for transport and storage.
- Avoid storing the device in direct sunlight.
- In principle, the devices may be stored for an unlimited period. However, the warranty conditions stipulated in the order confirmation of the supplier apply.

Storage temperature range

-20 to 55 °C (-4 to 131 °F)

Returning devices

Use the original packaging or a secure transport container of an appropriate type if you need to return the device for repair or recalibration purposes.

Fill out the return form (see **Return form** on page 78) and include this with the device.

In accordance with the EU Directive governing hazardous materials, the owner of hazardous waste is responsible for its disposal or must observe the following regulations for shipping purposes:

All devices delivered to ABB must be free from any hazardous materials (acids, alkalis, solvents, etc.).

Address for the return:

ABB Automation GmbH

Service Analystechnik – Parts & Repair

Stierstädter Straße 5

60488 Frankfurt, Deutschland

Fax: +49 69 7930-4628

E-Mail: repair-analytical@de.abb.com

www.abb.de/prozessautomatisierung-service

7 Installation

Safety instructions

⚠ WARNING

Risk of injury due to process conditions.

The process conditions, for example high pressures and temperatures, toxic and aggressive measuring media, can give rise to hazards when working on the device.

- Before working on the device, make sure that the process conditions do not pose any hazards.
- If necessary, wear suited personal protective equipment when working on the device.
- Depressurize and empty the device / piping, allow to cool and purge if necessary.

⚠ WARNING

Risk of injury due to live parts.

Improper work on the electrical connections can result in electric shock.

- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

Requirements for the installation site

To ensure optimum measuring operation, the following things should be observed when choosing the measuring point or installation site:

- The installation of the flanges or analyzer should be carried out in one place with process pressure and process temperature variations that are as low as possible.
- The process gas flow should be as constant and homogeneous as possible (e.g. no measurement directly behind a line arc).
- The optical measuring path (optical path) should pass through the center of the pipe.
- The dust concentration should be as low and homogeneous as possible.

Flow conditions at measuring point

When deciding the placement of the analyzer in the process, we recommend a minimum of 5 stack diameters of straight duct before and 2 stack diameters of straight duct after the point of measure.

Installation of the measuring instrument

Both the transmitter and receiver units should be easily accessible. A person should be able to stand in front of either the transmitter unit or the receiver unit and adjust the M16 fixing bolts using two standard spanners.

For the receiver unit there should be at least 1 m free space measured from the flange fixed to the stack and outwards.

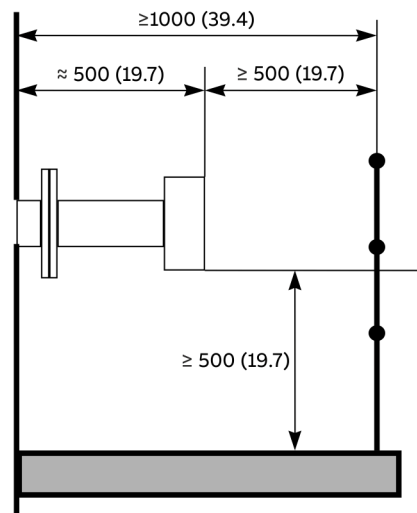


Figure 16: Transmitter and receiver installation tolerances

Flanges and stack hole requirements

The monitor requires two holes diametrically opposite to each other, at least 50 mm in diameter.

Standard flanges used for connection are e.g. of type DN 50 / PN 10 with an inner diameter of 50 mm and an outer diameter of 165 mm.

The flanges can either be welded directly to the process or optionally be part of a valve that is connected to the process for safety reasons. The two alternatives are illustrated in Figure 17.

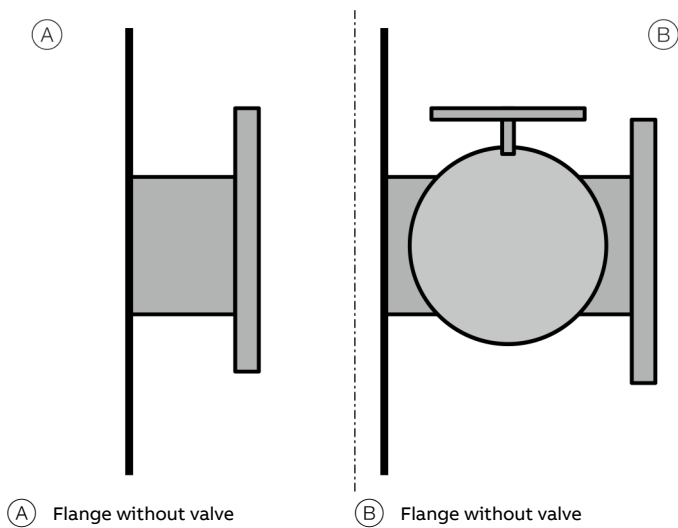
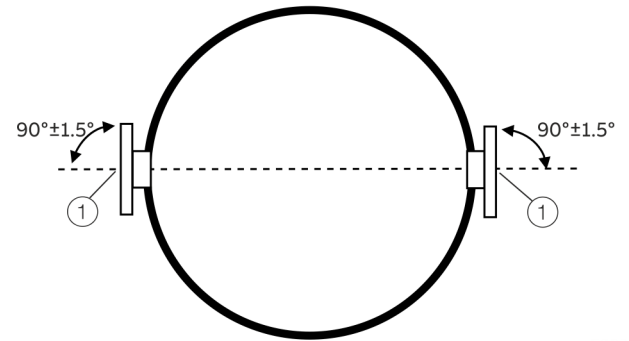


Figure 17: Flanges with and without valve

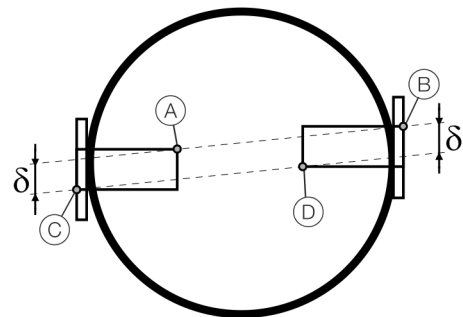
The analyzer is designed with an adjustment mechanism that can tilt the flanges. The flanges welded to the stack should, however, initially fulfil the specifications given in Figure 18 and Figure 19.



① Flange center

Figure 18: Flange angle alignment tolerances

The flange line-up should initially be better than 1.5° as specified in Figure 18. The distance between the thought parallel lines (A)–(B) und (C)–(D) (Figure 19) should fulfill the specifications in the table to ensure that the tubes do not shield the laser beam.



| Flange type | δ min |
|-------------|--------------|
| DN 50 | 40 mm |
| DN 80 | 55 mm |

Figure 19: Flange line-up tolerances

After correct adjustment and line-up of the device the maximum allowed drift in angle between laser beam and receiver unit center axis due to temperature effects or vibration, is $\pm 0.3^\circ$ without having effect on the measurements.

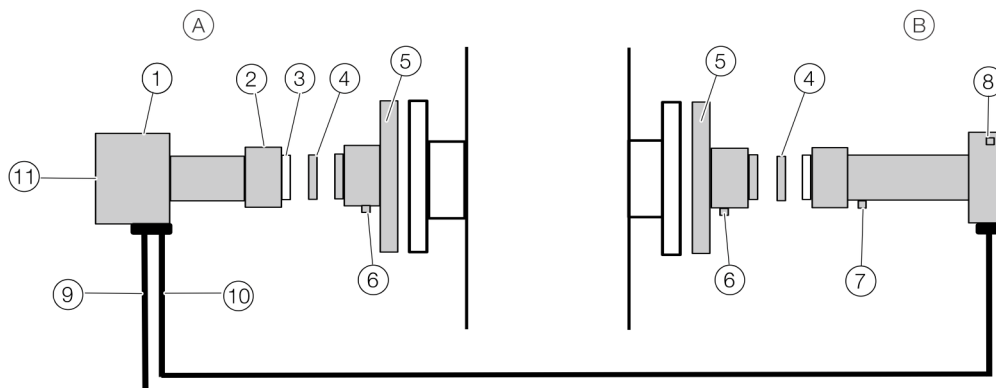
... 7 Installation

Necessary tools and other equipment

The following equipment is necessary to install and calibrate the equipment:

- 2 × open-end spanners for M16 bolts
- 1 × Allen key 5 mm for the locking screws on flanges
- 1 × PC (Windows 7® or higher) for installation and calibration
- 1 × flat-bladed screwdriver 2.5 mm for electrical connections

Mounting



- | | |
|--|--|
| Ⓐ Transmitter unit | Ⓔ Purge gas inlet |
| Ⓑ Receiver unit | Ⓕ Span cell inlet (non-corrosive gases, see also Validation on page 75) |
| ① Transmitter unit and housing electronics | Ⓖ Receiver electronics and housing |
| ② Union nut | ⑨ DC power cable |
| ③ Optical window | ⑩ Signal cable |
| ④ Adapter ring | ⓪ LCD |
| ⑤ Purging flange (e.g. DN 50 flange) | |

Figure 20: General view of AO2000-LS25

AO2000-LS25 installation

Note

- Read all instructions carefully before installation.
- All housing parts are made of stainless steel or aluminum.
- All threads must be greased using suitable grease before installation.
- Both receiver and transmitter units have optical windows installed by the factory. The optical windows should not be taken off and their angular positions should not be changed. This is important for successful alignment.
- Make sure that the mains cable is disconnected or that the power is disconnected before performing the electrical connection.
- Make sure that the power plug is the disconnecting device (no separate mains switch on device) and the power socket should be placed easily accessible for the operator.

Perform installation of the device as described in the following steps:

1. Install the purging flanges ⑤ on the stack flanges using 4 M16 × 60 screws each, see **Figure 20** on page 33. All 4 bolts on either side must be tightened firmly to compress the large O-ring. Adjust the 4 locking screws prior to mounting the unit, to assure good alignment of the unit and a uniform compression of the O-ring.
 - Install pressurized device purging as described in **Air purging of flanges** on page 34.
2. Turn on the purge gas, see **Air purging of flanges** on page 34 for details.
3. Place the window adapter ring ④ on the purging flange. Make sure that the O-ring is firmly connected to the purging flange and greased. The guiding pin on the purging flange must fit the hole in the adapter ring.

... 7 Installation

... Mounting

4. Attach an O-ring (ungreased) to the adapter ring and mount the transmitter unit to the balancing device. The guiding pin on the adapter ring must fit the hole in the transmitter unit window. Tighten the clamping nut on the transmitter unit.
 5. Repeat steps 2 to 4 for the receiver unit.
 6. Connect the transmitter and receiver units with the corresponding cable, see **Transmitter unit interface** on page 36.
All connectors are coded with small red pins on the inside.
 7. Optionally, external pressure and temperature sensors can be connected to the LS25 using 4 to 20 mA signals:
 - General purpose devices: Connect the signal lines of the sensors in the power supply connection plug to the transmitter unit, see **Power supply / analog inputs** on page 38.
 - Explosion-protected apparatuses: Connect the signal lines from the sensors to the corresponding terminals in the terminal box of the transmitter unit, see **Transmitter unit – power supply / analog inputs** on page 17 or **Transmitter unit – power supply / analog inputs** on page 23.
 8. Connect the power supply unit to the transmitter unit with the corresponding cable.
- * Ensure that the sensors used are suitable for process conditions and have a resolution suitable for the application.

The analyzer can now be switched on, see **Commissioning** on page 43.

Air purging of flanges

The instrument windows are kept clean by setting up a positive flow of air through the flanges and into the stack. This purging will prevent particles from settling on the optical windows and contaminating them.

The purge gas must be dried and cleaned. We recommend using instrument air for purging. If instrument air is not available a separate blower is needed.

A purge flow of approximately 20 to 50 l/min (process dependent) is sufficient for most installations.

Alternatively, the initial velocity of the purge flow in the flanges is set to $\frac{1}{10}$ of the gas velocity in the duct.

After completion of the installation the purge flow is optimized as described in **Optimizing purging gas flow of the flanges** on page 71.

The air quality should conform to standard set by ISO 8573.1, Class 2-3. This means particles down to 1 micron should be removed, including coalesced liquid water and oil, and a maximum allowed remaining oil aerosol content of 0.5 mg/m³ at 21°C (instrument air).

Note that some instruments require nitrogen purging, e.g. O₂ instruments for high temperature or pressure applications, some H₂O instruments etc.

Housing purging of the transmitter and receiver units

For applications (e.g. small measuring ranges of O₂, H₂O and CO₂) where purging of the transmitter and receiver units is required, the connection diagram in **Connection diagram flange - and housing purging** on page 35 must be observed.

Purge medium

To avoid contaminating the analyzer's optical windows, it must be purged with dry and oil-free instrument air (in accordance with ISO 8573.1 Class 2–3) or nitrogen depending on the application, see **Air purging of flanges** on page 34.

The purge gas flow must not be high to avoid pressure build-up inside the units.

ABB recommends reducing the purge gas flow to less than 0.5 l/min.

In the event of a purge gas supply failure, the transmitter and receiver units can maintain a purge gas level of more than 99.5 % for one hour.

Isolation flanges

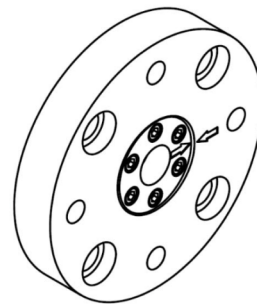


Figure 21: Isolation flange (Example)

For toxic gas and highly corrosive applications especially in combination with high pressure the first flange has to be an isolation flange which isolates the process from the analyzer.

In these cases a shut-off valve is always necessary in order to do maintenance on the flange.

The isolation flange has to be “custom tailored” for the individual process. The isolation flange may be purged if necessary (refer to **Connection diagram flange - and housing purging** on page 35). Due to the additional windows a certain loss of transmission is to be expected. The analyzer will be mounted on the isolation flange.

Before dismantling the isolation flange make sure the process is either turned off and safe or the volume between the nearly closed shut-off valve and the flange is purged thoroughly to make sure no harmful gas may leak out.

Connection diagram flange - and housing purging

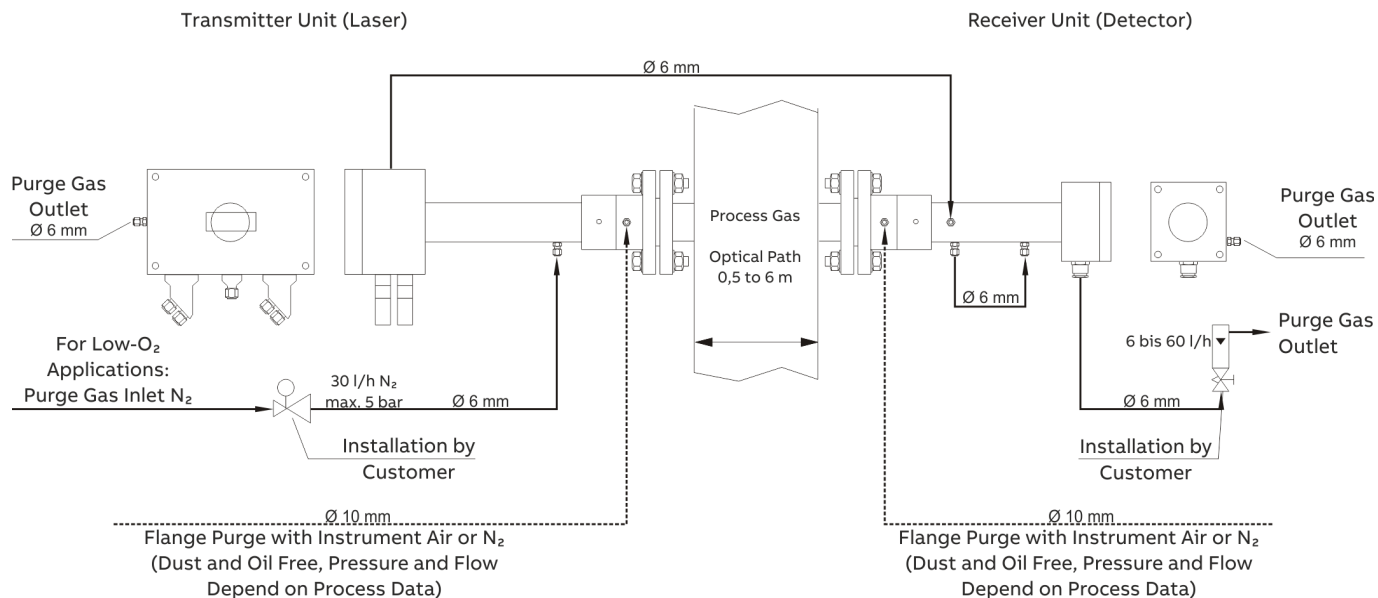


Figure 22: Purging of the transmitter and receiver units

8 Electrical connections

Safety instructions

⚠ WARNING

Risk of injury due to live parts.

Improper work on the electrical connections can result in electric shock.

- Connect the device only with the power supply switched off.
- Observe the applicable standards and regulations for the electrical connection.

Note

When using the device in potentially explosive atmospheres, note the additional data in **Use in potentially explosive atmospheres in accordance with ATEX and IECEx** on page 6 and **Use in hazardous areas in accordance with CSA** on page 19!

Note

- The polarities listed in the column “Description” are used for naming only and do not necessarily correspond to the polarities of the applied voltages.
- All potentials are floating and none of them should be grounded to box. This applies to all connection tables.

Transmitter unit interface

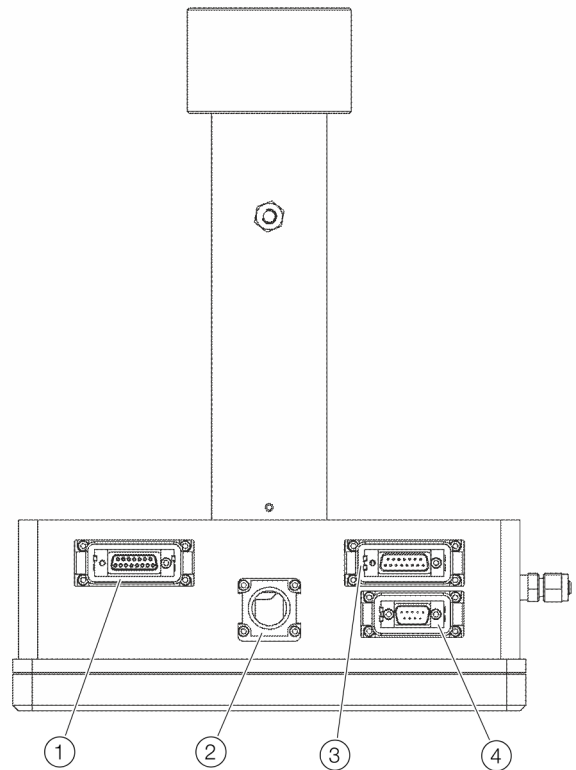


Figure 23: Electrical connections on the transmitter unit (viewed from below)

| Pos. | Description |
|------|--|
| ① | Connector for receiver unit (signal cable) Power supply and signals from and to the receiver unit. Connection assignment, see Signal cable on page 37. |
| ② | Network connection 10 or 10/100 Base-T Ethernet (RJ45). Connection assignment, see Service interface (RS232) on page 38. |
| ③ | Connection plug for power supply and analog inputs Power supply and signals from the external sensors. Connection assignment, see Power supply / analog inputs on page 38. |
| ④ | Service connection RS232 interface (galvanically isolated). Connection assignment, see Service interface (RS232) on page 38. |

Terminal assignment

Signal cable

Devices with Phoenix connectors

Table 20 shows the connection assignment of the signal cable connectors.

This connection assignment applies to both cable ends and only to devices **without** explosion protection.

| Terminal | Wire pair | Color | Signal |
|---|-----------|-----------------------|--------------------|
| Standard Version | | | |
| 1 | | Red* | Lineup + |
| 2 | 3 | Pink | RU Temp - |
| 3 | 3 | Gray | RU Temp + |
| 4 | 4 | Red | MODSQ - |
| 5 | 4 | Blue | MODSQ + |
| 6 | 5 | Black | RU PWR + |
| 7 | 5 | Violet | RU GND + |
| 8 | | NC | |
| 9 | 6 | Gray/Pink | RU GND - |
| 10 | 6 | Blue/Red | RU PWR - |
| 11 | 1 | Brown | Direct - |
| 12 | 1 | White | Direct+ |
| 13 | 2 | Yellow | 2. Harmonic - |
| 14 | 2 | Green | 2. Harmonic + |
| 15 | | Black * | Lineup - |
| Design with integrated validation cell | | | |
| 1 | | Red* | Lineup+ |
| 2 | 3 | Pink | RU Temp- |
| 3 | 3 | Gray | RU Temp+ |
| 4 | 4 | Red | MODSQ- |
| 5 | 4 | Blue | MODSQ+ |
| 6 | 5 | Black | RU PWR + |
| 7 | 5 | Violet | RU GND + |
| 8 | 7 | Green/White | Servo Sig |
| 9 | 6 | Gray/Pink + Black* | RU GND - / Lineup- |
| 10 | 6 | Blue/Red | RU PWR - |
| 11 | 1 | Brown | Direct - |
| 12 | 1 | White | Direct+ |
| 13 | 2 | Yellow | 2. Harmonic - |
| 14 | 2 | Green | 2. Harmonic + |
| 15 | 7 | Green/Brown | Servo +5V |

Table 20: Pin assignment of the receiver unit (Phoenix plug)

* Internally connected to the alignment jack.

| Signal | Description |
|-------------|--|
| Lineup | Alignment voltage |
| RU Temp | Signal from embedded receiver temperature sensor |
| MODSQ | Modulation signal from transmitter to receiver (used for detection of 2. harmonic) |
| RU PWR | Power supply to receiver unit |
| Direct | Direct laser transmission signal from receiver detector |
| 2. Harmonic | Detected second harmonic signal from receiver detector |
| Servo | Control of servomotor moving sealed cell |

Table 21: Description of signals

Devices with cable glands

For some devices the receiver unit is supplied without detachable Phoenix contact but with cable gland. This connection assignment applies to devices **with** explosion protection.

| Terminal | Wire pair | Color | Signal |
|----------|-----------|--------------|-----------------|
| 1 | 7 | Green/White | Optional 1 / NC |
| 2 | 7 | Brown/Green | Optional 2 / NC |
| 3 | 8 | Yellow/White | Optional 3 / NC |
| 4 | 8 | Yellow/Brown | Optional 4 / NC |
| 5 | 3 | Gray | RU Temp + |
| 6 | 3 | Pink | RU Temp - |
| 7 | 4 | Blue | MODSQ + |
| 8 | 4 | Red | MODSQ - |
| 9 | 5 | Black | RU PWR + |
| 10 | 5 | Violet | RU GND + |
| 11 | 6 | Gray | RU GND - |
| 12 | 6 | Blue/Red | RU PWR - |
| 13 | 1 | White | Direct+ |
| 14 | 1 | Brown | Direct - |
| 15 | 2 | Green | 2. Harmonic + |
| 16 | 2 | Yellow | 2. Harmonic - |

Table 22: Terminal assignment of the receiver unit (cable gland)

... 8 Electrical connections

... Terminal assignment

Power supply / analog inputs

Table 23 shows the connection assignment of the power supply connectors and the analog inputs (4 to 20 mA). This connection assignment applies only to the connector on the cable for the transmitter unit and only to devices **without** explosion protection.

| Terminal | Color | Signal |
|----------|---------------|----------------------|
| 1 | Blue* | Temperature sensor - |
| 2 | Red* | Temperature sensor + |
| 3 | Black* | Pressure sensor - |
| 4 | Violet* | Pressure sensor + |
| 5 | White/Green* | Flow sensor - |
| 6 | Brown/Green* | Flow sensor + |
| 7 | Gray/Pink* | Sensors +24V |
| 8 | Blue/Red* | Sensors AGND |
| 9 | White/Yellow* | Sensors +24V |
| 10 | White | PWR+ (+18 to 36 V) |
| 11 | Green | PWR+ (+18 to 36 V) |
| 12 | Gray | PWR+ (+18 to 36 V) |
| 13 | Brown | PWR - (0V) |
| 14 | Yellow | PWR - (0V) |
| 15 | Pink | PWR - (0V) |

Table 23: Power cable connections (Phoenix connectors)

(*) Cables may be replaced at the transmitter end of the cable (see **Connecting analog inputs (option)** on page 42).

Note

- All 3 power pairs (PWR+/PWR-) should be wired to ensure even current flow through the connector.
- External temperature and pressure sensors are connected to the connector of the transmitter end of the cable, see **Connecting analog inputs (option)** on page 42.

Service interface (RS232)

| Terminal | Signal | Comments |
|----------|---------------------|-------------------------|
| 1 | Data Carrier Detect | Connected to terminal 4 |
| 2 | Transmit Data | — |
| 3 | Receive Data | — |
| 4 | Data Terminal Ready | — |
| 5 | Ground | — |
| 6 | Data Set Ready | Connected to terminal 4 |
| 7 | Request To Send | Connected to terminal 8 |
| 8 | Clear To send | Connected to terminal 7 |
| 9 | Ring Indicator | Not assigned |

Table 24: Service interface connection assignment

Network interface (Ethernet)

| Terminal | Signal | |
|----------|--------|--------------|
| 1 | TX+ | |
| 2 | TX- | |
| 3 | RX+ | |
| 4 | — | Not assigned |
| 5 | — | Not assigned |
| 6 | RX- | |
| 7 | — | Not assigned |
| 8 | — | Not assigned |

Table 25: Connection assignment of the network interface RJ-45

Ethernet connection to AO2000

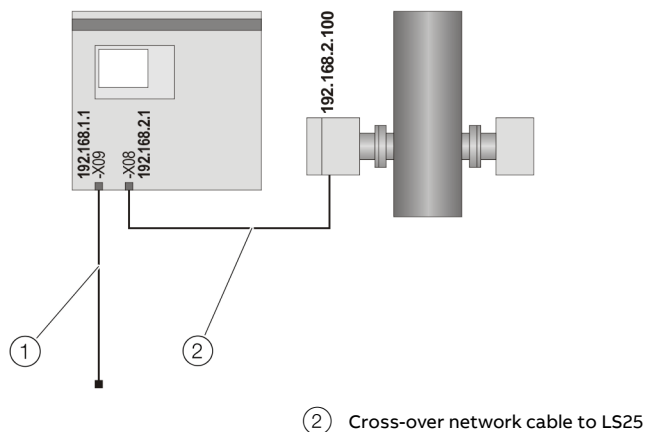
The transmitter unit is connected to the AO2000 central unit via an Ethernet cable (for outdoor use, acid and UV resistant).

Note

The LS25 Ethernet port is switched off when the LS25 service interface is in use.

AO2000 with software version ≥5.0.0

AO2000 with one laser analyzer



① Customer network

② Cross-over network cable to LS25

Figure 24: Ethernet connection – AO2000 with one laser analyzer

In the event of integration of the AO2000 into a customer network, the 1st Ethernet interface **-X09** must be used for connection to the customer network, whereas the 2nd Ethernet interface **-X08** must be used for connection of the analyzer to the central unit of the AO2000.

The advantage of this configuration is that the plant network communication is not conducted through the laser analyzer – AO2000 CU network.

Example of set IP addresses:

| | | |
|--------|-----------------------------|---------------|
| AO2000 | 1. Ethernet interface -X09: | 192.168.1.1 |
| | 2. Ethernet interface -X08: | 192.168.2.1 |
| LS25 | Example: | 192.168.2.100 |

... 8 Electrical connections

... Ethernet connection to AO2000

AO2000 with two or three laser analyzers

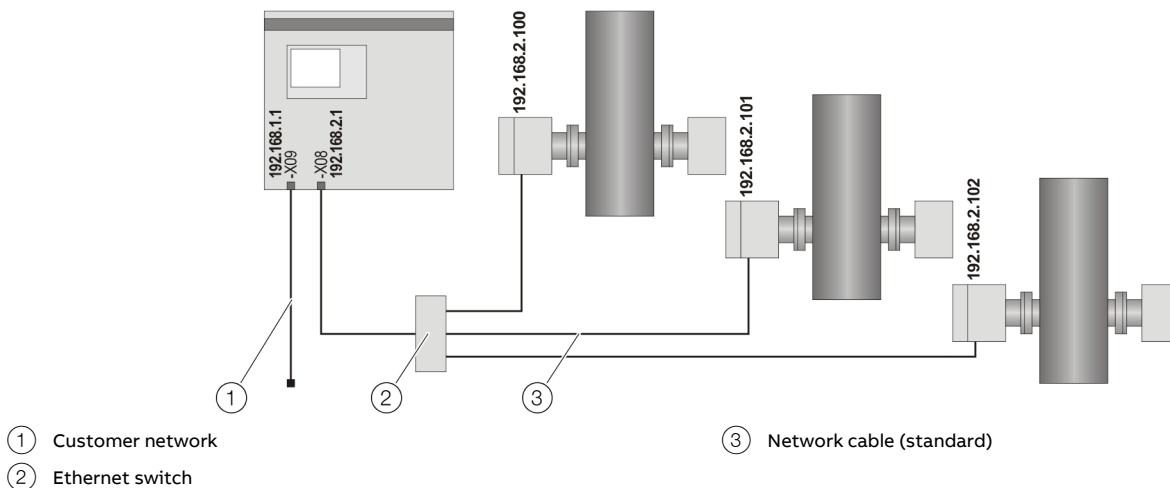


Figure 25: Ethernet connection – AO2000 with two or three laser analyzers

The laser analyzers are connected to a switch which is connected to the 2nd Ethernet interface **-X08** via its uplink port.

For the connection between the laser analyzer and the switch a standard network cable is necessary.

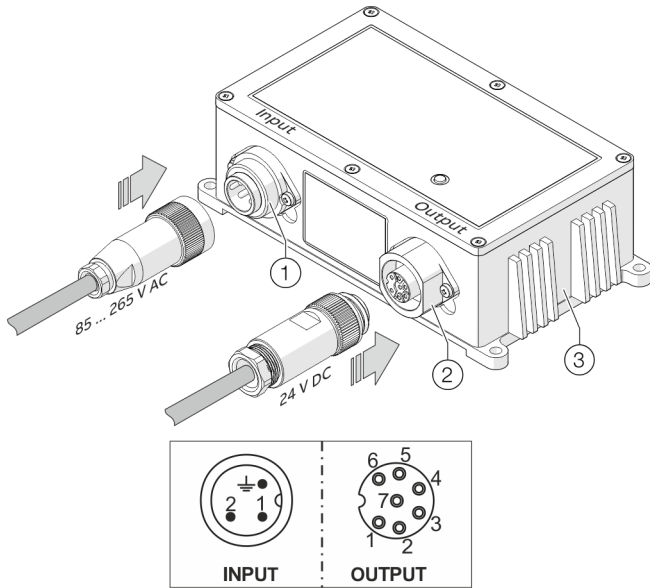
Each laser analyzer must have a unique IP address within the same network group as the Ethernet interface.

The 1st Ethernet interface **-X09** is used e.g. to connect AO2000 to the customer network.

Example of set IP addresses:

| | | |
|---------------|-----------------------------|---------------|
| AO2000 | 1. Ethernet interface -X09: | 192.168.1.1 |
| | 2. Ethernet interface -X08: | 192.168.2.1 |
| LS25 | 1. Analyzer: | 192.168.2.100 |
| | 2. Analyzer: | 192.168.2.101 |
| | 3. Analyzer: | 192.168.2.102 |

Connecting the power supply



- ① Input 85 to 264 V AC, 50/60 Hz (cable box binder series 693, 3-pole)
- ② Output 24 V DC, max. 5 A (cable connector binder series 693, 7-pole)

Figure 26: Power supply unit

1. Connect the power supply to the “Input” connector as shown in Table 26.
2. Connect the line to the analyzer to the “Output” connector as shown in Table 27.
3. Connect and screw the connectors to the power supply.

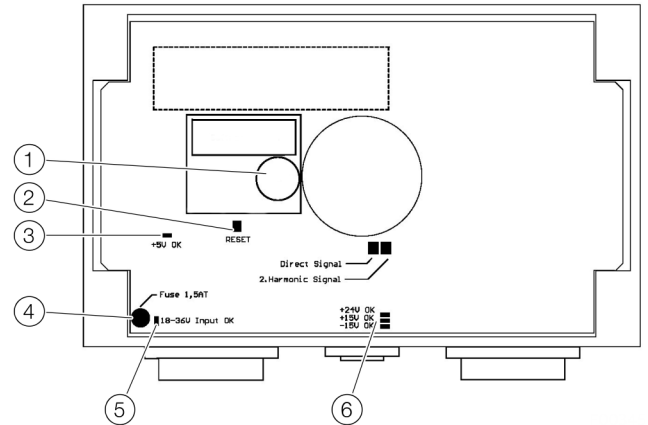
| Pin | Description |
|-----|-------------|
| 1 | L |
| 2 | N |
| ⊕ | PE |

Table 26: Pin assignment input 100 to 240 V AC

| Pin | Description |
|-----|---------------------------------------|
| 1 | GND (-) |
| 2 | GND (-) |
| 3 | GND (-) |
| 4 | 24 V DC |
| 5 | 24 V DC |
| 6 | 24 V DC |
| 7 | Connected to the power supply housing |

Table 27: Pin assignment output 24 V DC

Transmitter unit – Fuses and LEDs



- ① Buffer battery
- ② Reset key
- ③ Control LED voltage +5V OK
- ④ Fuse
- ⑤ Control LED power supply 18 to 36V OK
- ⑥ Control LED voltages +24 V, +15 V, -15 V OK

Figure 27: Mainboard card fuses and LED layout

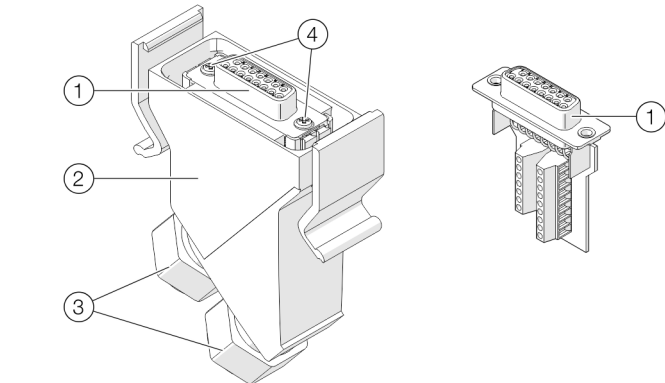
The main transmitter unit board has one main fuse and some LEDs to indicate status of different supply voltages:

- If the LED next to the main fuse (“18–36V Input OK”) is lit but the other LEDs are not, the fuse must be checked.
- If all LEDs are dark, check the 24 V supply to the device.
- If some LEDs are lit and others are not, note the status of the LEDs and contact ABB Service. The main board may need to be replaced.

... 8 Electrical connections

Connecting analog inputs (option)

Active (with separate power supply) or passive (power supply from the LS25) sensors can be connected.



- ① Plug insert
- ② Connector housing
- ③ Cable glands
- ④ Fixing screws plug insert

Figure 28: Power supply / analog inputs connector

1. Switch off the power supply.
2. Disconnect the power supply / analog inputs connector from the transmitter unit.
3. Loosen the cable glands and the plug insert and pull it out of the plug housing.
4. Feed the wire for the external sensors into the plug housing through the free cable gland.
5. Connect the cables to the screw terminals of the plug insert according to Figure 29 “Active sensor” or Figure 30 “Passive sensor”.
 - Connection assignment, see **Transmitter unit – power supply / analog inputs** on page 17.
 - To connect the sensors, use cables with a cross-section of 0.14 to 0.5 mm² (AWG 26 to 20) (ABB recommends 0.25 mm²).
 - The outer cable diameter (1× per cable gland) must be in the 3 to 9 mm range.
 - The internal burden of the analog input is 100 Ω.
 - For passive sensors, a 24 V power supply with a maximum current load capacity of 80 mA is available (terminals +24 V/AGND).
6. Reinstall the plug insert in the plug housing and tighten it. Tighten the cable glands.
7. Attach the power supply / analog inputs connector to the transmitter unit.

Note

- The connection examples show the connection of a temperature sensor. Pressure and flow sensors are connected to the corresponding inputs (Press / Flow).
- The connection examples show the connection with plug, devices with terminal blocks are connected according to the corresponding connection assignments.

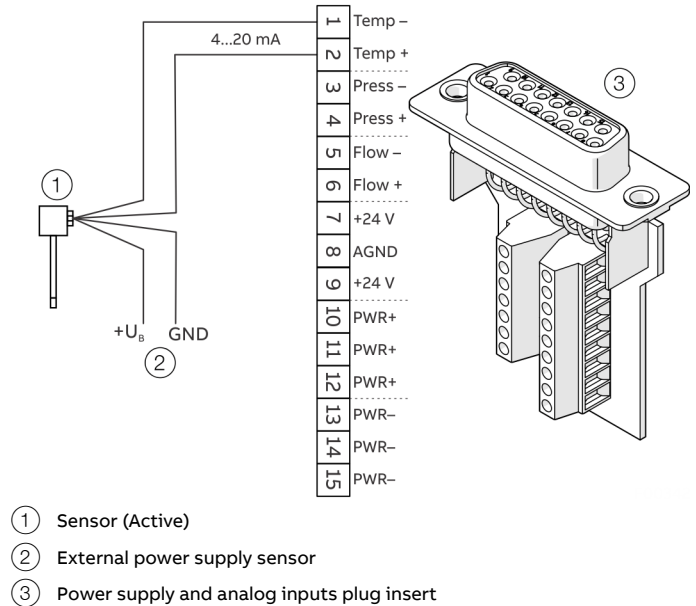


Figure 29: Connection example for analog input, active (example, temperature sensor)

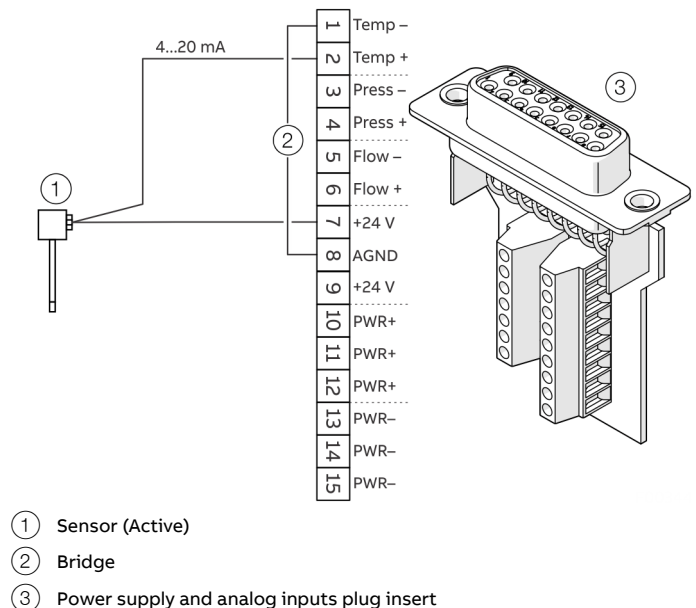


Figure 30: Connection example for analog input, passive (example, temperature sensor)

9 Commissioning

Introduction

Having completed the installation of the transmitter and receiver according to the previous sections the analyzer is ready for start-up.

The start-up of the system consists of 3 main activities:

1. Start-up of electronics.
2. Alignment of transmitter.
3. Alignment of receiver.

Switching on the power supply

- Switch on the electronics.

The LCD in the transmitter unit will enter start-up mode showing:

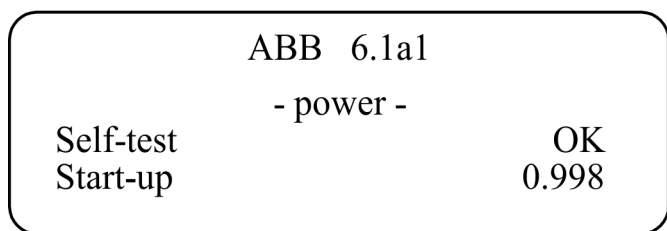


Figure 31: Start-up sequence

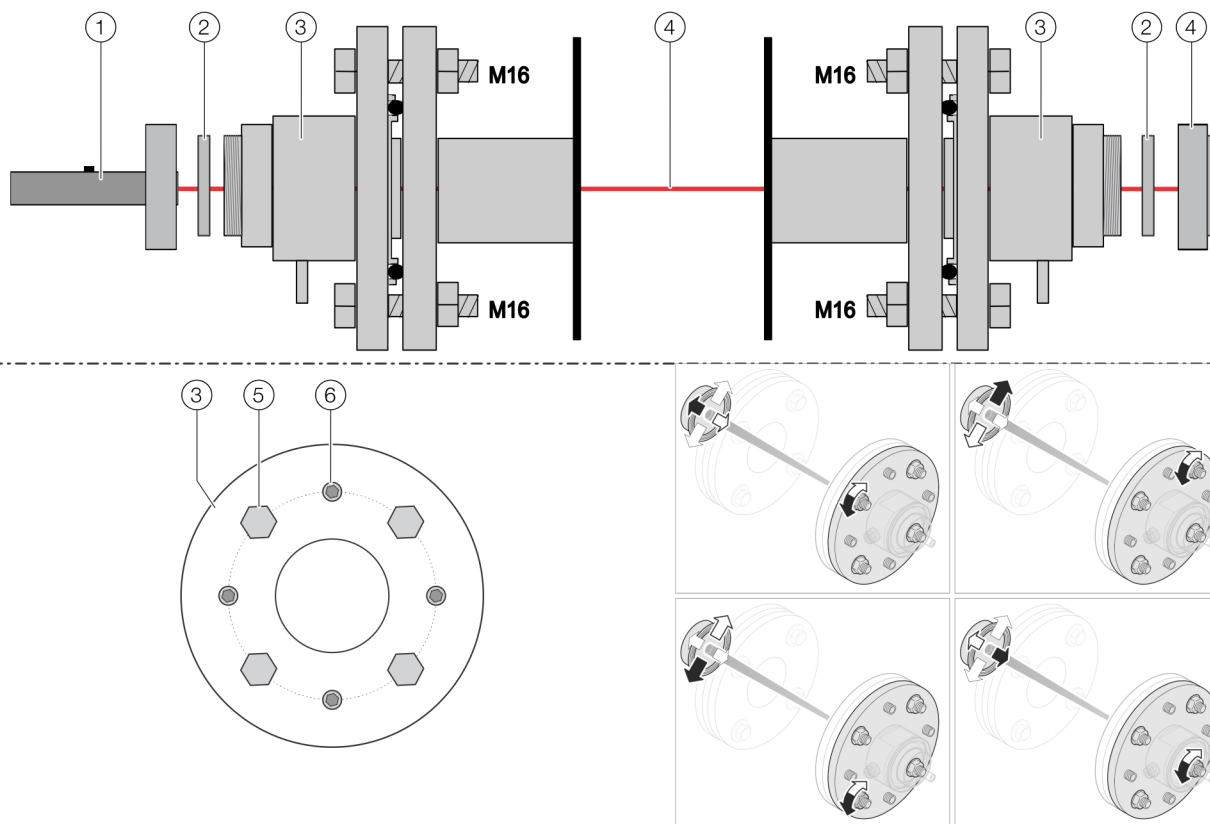
The start-up sequence will make sure the laser is tuned to the correct temperature before it is switched on, and the instrument performs a self-test on all systems. Allow about 5 minutes for the instrument to start the laser.

The LCD will probably show 'Laser line-up error' and 'Low transmission' when the laser has started up. This is normal and indicates misalignment of the receiver and transmitter units, i.e. the laser beam does not hit the detector inside the receiver unit.

If you use a red laser alignment jig for alignment of the transmitter/receiver refer to **Align analyzer with laser alignment device** on page 44.

... 9 Commissioning

Align analyzer with laser alignment device



- ① Laser pointer
- ② Adapter ring
- ③ Purging flange

- ④ Focusing screen
- ⑤ Fixing screws M16 (adjusting screws)
- ⑥ Stud screws (locking screws)

Figure 32: Installing the laser alignment tool and aligning the flanges

Principle of rough pre-alignment

During pre-alignment, the purging flanges installed opposite to one another are aligned coaxially to one another using the laser alignment aid.

Necessary tools and other equipment for the adjustment procedure:

- 1 × laser alignment device (laser pointer and focusing screen)
- 2 × spanners to adjust the flanges with (M 16)
- 1 × Allen key (5 mm) for the stud screws

Mounting the adjustment device

1. Leave the device switched on and disassemble transmitter and receiver units from the relevant purging flange.
2. Remove the adapter ring (item ② in **Figure 32**) from the purging flange.
3. Fix the laser pointer to the transmitter-side purging flange with the union nut.
4. Fasten the focusing screen to the receiver-side purging flange with the union nut.

⚠ WARNING

Risk of injury

Eye injury due to invisible laser radiation.

The device contains class 1 and 1M diode lasers.

- Do not open when energized.
- Do not look into the optical path with optical instruments.

Pre-aligning the purging flanges

Pre-alignment is carried out in three steps:

1. Mount the laser pointer on the transmitter unit purging flange and the focusing screen on the receiver unit purging flange. Perform pre-alignment as described below.
 2. Mount the laser pointer on the receiver unit purging flange and the focusing screen on the transmitter unit purging flange. Perform pre-alignment as described below.
 3. Re-mount the laser pointer on the transmitter unit purging flange and the focusing screen on the receiver unit purging flange. Perform pre-alignment as described below.
- After completion of the pre-alignment, refit the transmitter and receiver units and perform fine-tuning according to **Setting the maximum transmission** on page 45.

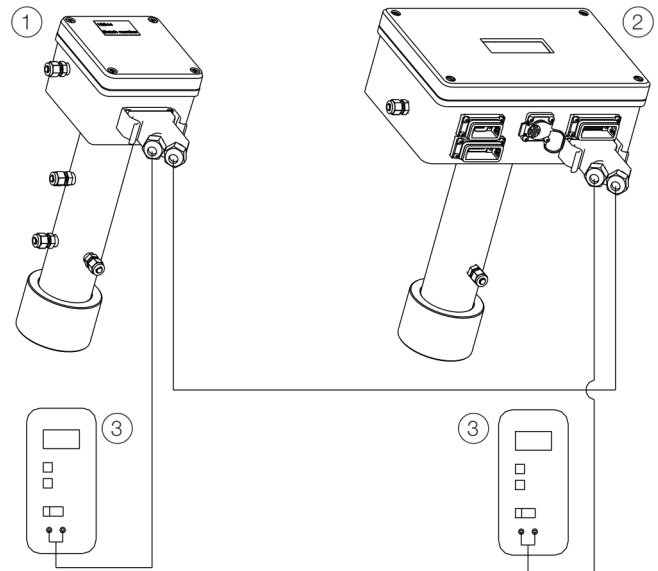
Performing pre-alignment

1. Unscrew the 6 stud screws (item ⑥ in **Figure 32**) until the ends of the screws no longer stick out of the holes.
2. Switch on the laser pointer.
3. Align the purging flanges by adjusting the 4 screws (item ⑤ in **Figure 32**) until the laser beam hits the center of the focusing screen.
4. Screw in the 4 stud screws until they stop so that the setting is fixed.
5. Switch off the laser pointer.
6. Remove the laser pointer and focusing screen.

Setting the maximum transmission

Fine-tuning of the transmitter and receiver units is performed by measuring the adjustment voltage at the connectors of the signal cable to ensure that a maximum signal (transmission) is achieved.

The adjustment voltage varies from 0 V at 0 % transmission to -3V (typically) at 100 % transmission.



① Receiver unit
② Transmitter unit
③ Voltmeter

Figure 33: Measurement of adjustment voltage

As shown in Figure 33, by connecting a voltmeter to the adjustment connector, the adjustment voltage (Lineup+/Lineup-) is measured in the connector housing of the signal cable of the transmitter and receiver units.

| Pin | Color | Signal |
|---------|-------|---------|
| 1 | Red | Lineup+ |
| 15 / 9* | Black | Lineup- |

Table 28: Pin assignment adjustment voltage

* Design with integrated validation cell

... 9 Commissioning

... Setting the maximum transmission

The fine-tuning procedure is as follows:

1. Connect a voltmeter with a potential-free input (battery operation) and measure the adjustment voltage of the receiver unit.
2. Unscrew the 6 stud screws (item ⑥ in **Figure 32**) until the ends of the screws no longer stick out of the holes.
3. Carefully adjust the voltmeter display to the maximum value using the receiver-side adjustment screws (item ⑤ in **Figure 32**).
4. Connect a voltmeter with a potential-free input (battery operation) and measure the adjustment voltage of the transmitter unit.
5. Carefully adjust the voltmeter display to the maximum value using the receiver-side adjustment screws (item ⑤ in **Figure 32**).
6. Repeat steps 1. to 2. and 3. to 4. until there are no further improvements in the display of the voltmeter.
7. Tighten the stud screws and check that the alignment has not changed.
8. Disconnect the voltmeter.

Having completed the previously described operations successfully, the installation and process parameters need to be set using a PC to enable correct measurements.

For parameter descriptions, see **Configuration, parameterization** on page 48.

Connecting a PC

The software for service communication with the analyzer is supplied with the instrument and will run under Microsoft Windows®. The software does not require any installation.

1. Copy the software supplied to a separate directory named e.g. "AO2000-LS25" on the hard disk.
2. Connect the PC serial port to the RS-232 connection on the transmitter unit, see **Transmitter unit interface** on page 36. using the supplied serial cable and "gender changer" adapter. Optionally, a waterproof Phoenix connection cable can be used instead.
 - The service program uses the serial port configured as 9600 baud, no parity, 8 bits and 1 stop bit.
 - If network communication is used, connect the network cable to the Base-T connector on the transmitter unit, see **Transmitter unit interface** on page 36. Make sure that the serial cable must be disconnected from the device.
3. Compare the following parameters with the installation specifications and set with the software, see **Configuration, parameterization** on page 48:
 - Process gas pressure and temperature, see **Gas pressure and temperature** on page 55.
 - Concentration averaging, see **Concentration averaging** on page 56.
 - Instrument time, see **Instrument time** on page 57.
 - Gas concentration unit, see **Unit (Unit)** on page 58.
 - Optical path parameters, see **Optical path through gas (m)** on page 56.

Having completed the setting of all necessary parameters, the device is in normal operation mode and should indicate this by updating the gas concentration on the LCD periodically.

Setting the IP address on AO2000-LS25

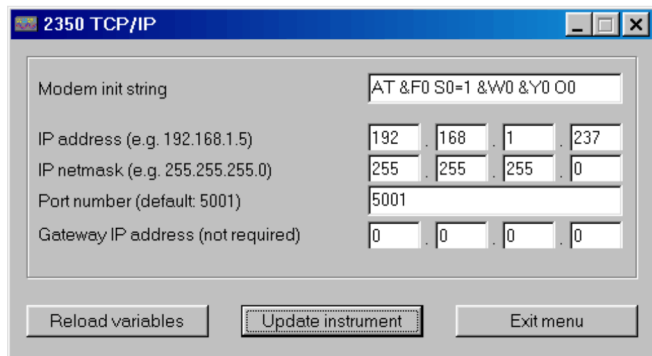
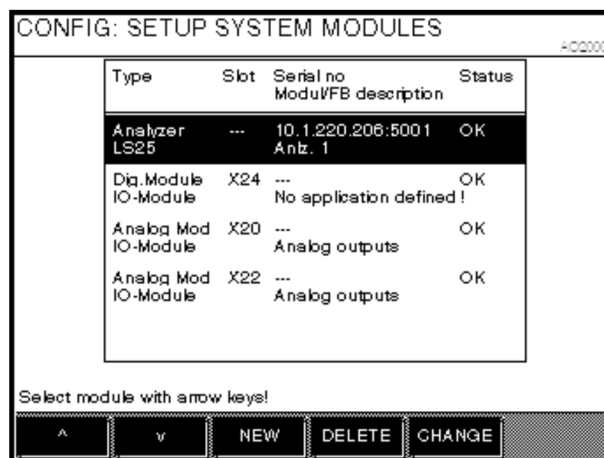


Figure 34: Menu "TCP/IP"

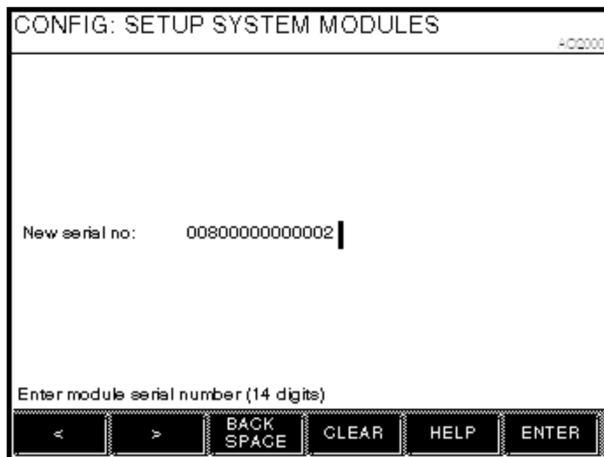
The analyzer's IP address is set in the "TCP/IP & modem configuration" menu in the service program, see **TCP/IP and modem configuration <TCP/IP & modem configuration>** on page 61.

Setting up the laser analyzer in AO2000

1. Call up the "MENU / Configure / System / Setup system modules" menu and press the <NEW> key.
 - The IP address shown in the picture is an example.



2. Enter the 14-digit serial number of the analyzer (located on the back of the transmitter housing on the name plate). The first three digits must be "008" and the serial number is specific to each LS25 laser analyzer.

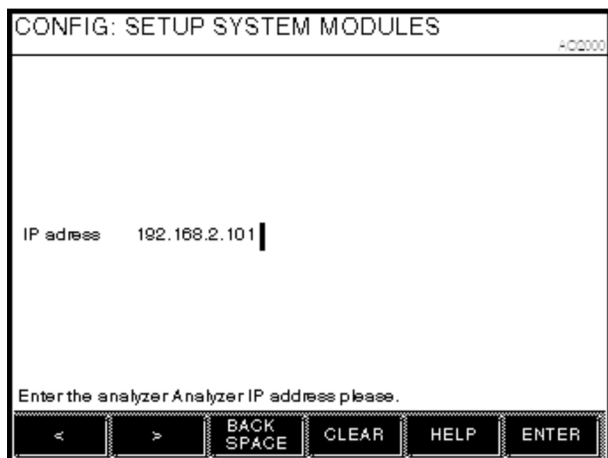


3. Confirm the entry by pressing <ENTER>.

... 9 Commissioning

... Setting up the laser analyzer in AO2000

4. Enter the IP address of the laser analyzer and press <ENTER> to confirm. The factory-set IP address is 192.168.1.237.
 - In the system modules list the laser analyzer will be shown with a “New” status.



10 Configuration, parameterization

Parameterization of the device

The instrument calculates the gas concentration from the measured signal, which depends on several process parameters. The instrument must therefore be configured for the specific installation.

With the service program the user communicates with the instrument and changes installation or process relevant settings.

With a PC connected to the instrument via a standard serial communication port the operator can perform the following major tasks:

- Monitor the measured concentration and the laser beam transmission;
- Plot the measured concentration as a function of time;
- Log the concentration and other control parameters to a file;
- Display the measured signal;
- Save the measured signal and other control parameters to a file;
- Observe and erase the instrument error logging;
- Configure the 4 to 20 mA process temperature and pressure inputs;
- Change the measurement averaging time;
- Set the optical path parameters;
- Change the concentration unit;
- Change the format of the displayed concentration;
- Change the instrument clock time;
- Calibrate the instrument;
- Save all instrument parameters to a file;
- Restore the instrument parameters from a file.
- Configure the Ethernet connection

Through different menus the necessary installation parameters may be set.

After setting the necessary parameters the PC is no longer needed. The analyzer has all the parameters stored in the internal memory.

The PC can therefore be disconnected and the analyzer can be turned off and on without resetting the parameters.

Software start-up

After starting the program, a dialog for selecting the communication link is shown:

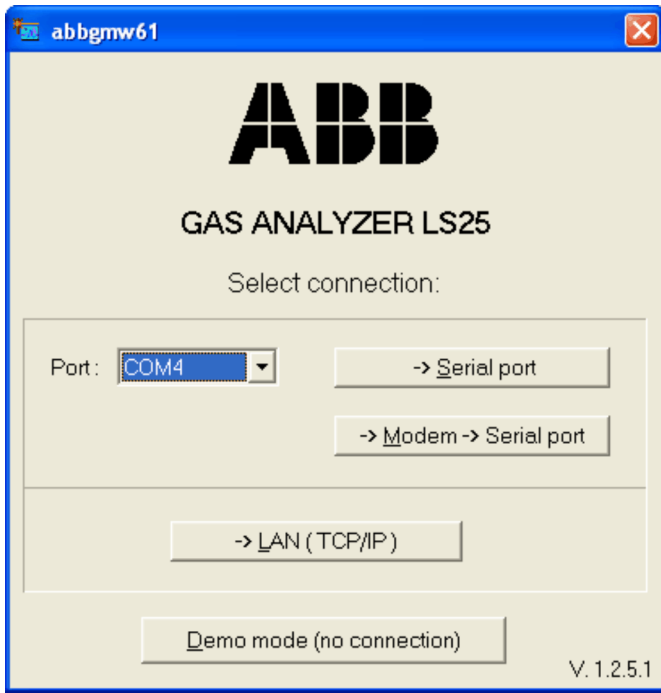


Figure 35: Interface selection

The version of the service program is printed in the right bottom corner (in the example above V.1.2.5.1).

Serial connection

For direct serial or modem connection, select the PC serial port from the dropdown list of available ports and press the corresponding button.

Modem connection

For a modem connection, the phone number to be dialed must be entered.

If the first digit in this phone number is a "0", the software will pause after dialing the zero before dialing the rest of the digits. If additional pausing is needed, apply "," between the digits.

LAN connection

If the communication is used via LAN, the IP address and port number must be entered.

- The IP address and port number are preset to 192.168.1.237 and 5001 at the factory.

If the IP address and port number are to be changed, the gas analyzer must be connected via the serial connection and the TCP/IP parameters must be configured according to **TCP/IP and modem configuration <TCP/IP & modem configuration>** on page 61.

Selecting configuration mode

After connecting to the device, the configuration mode must be selected:

- <User mode> (User mode)
- <Advanced mode> (Advanced mode, unrestricted access to all device parameters)
- <Demo mode> (No connection to device)

Note

- If another LS25 gas analyzer is to be configured, the service program must be closed and opened again.
- It is possible to open several program windows simultaneously to communicate with different devices with one PC.

<User mode> (User mode)

This User mode provides a simplified interface with limited access to the device setting parameters and should be used during installation and normal operation of the device.

<Advanced mode> (Advanced mode)

A password is only required for Advanced mode that enables full access to all the instrument setting parameters. Extended mode should be used during service adjustment of the device. For the necessary password, please contact ABB Service.

<Demo mode> (Demo mode)

The service program can also be started without a connection to a device by pressing <Demo mode>. This is for demonstration purposes of the service program.

Two special files are required for this purpose:

- *.dmp, or *.rea and *.set, or *.stt

These files can be created using the service program when the PC is connected to a device.

The files are created by downloading the device readings to *.rea and settings to *.set (see **File download / upload <File download / upload>** on page 62).

Alternatively, the files supplied on the data storage medium can be used. These files were downloaded from the instrument at the factory prior to shipment.

... 10 Configuration, parameterization

Description of menus and parameters

Main menu

After pressing the <User mode> button the program opens the “Measurements” menu. The example below is for a device measuring oxygen.

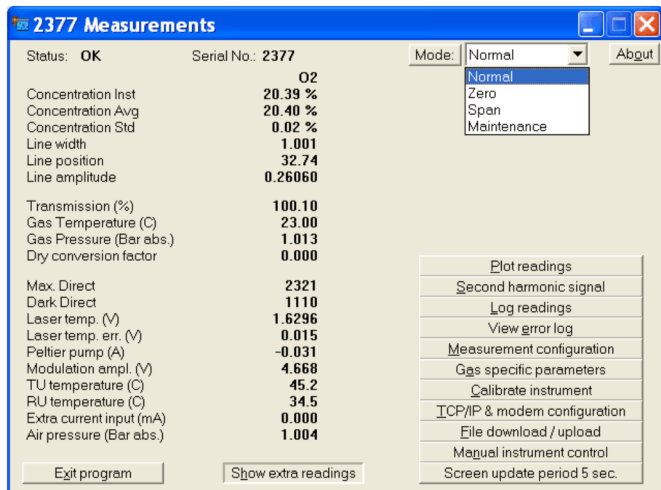


Figure 36: Menu “Measurements” (example)

The serial number of the device is shown in the title line of the menu. The bottom right of the screen shows different menus which can be accessed either by pressing the buttons or by pressing the underlined shortcut letters (e.g. <S> for Second harmonic signal (Second harmonic signal)). By pressing <Exit menu> one can always go back to the previous menu. The description of each menu will follow.

The rest of the screen is used to display different readings parameters. By default only the main readings parameters are displayed. All parameters are displayed by pressing <Show extra readings>.

Note

<Show extra readings> is activated in the above example.

The device readings update period is set by pressing <Screen update period>, which is 5 seconds by default. This time should not be shorter than the time required to calculate the concentration (the update time of the LCD).

The parameters are explained in detail below:

Status:

The device status can be SLEEPMODE / STARTUP / OK / WARNING / ERROR.

Refer to **Operating mode** on page 65.

Serial No.

Serial number of the analyzer.

Mode:

The measuring mode of the device. This is optional and only for devices with zero / span check. 3 different measuring modes can be selected by clicking the <Mode:> button.

Refer to **Operating mode** on page 65.

Note

Maintenance mode “Maintenance” is not available for the LS25.

Concentration Instant:

Displays the last value calculated by the analyzer with no averaging. This is in the following called a primary measurement.

Concentration Average:

Displays the running average calculated by the analyzer (not by the service program) from the last N values, where N is the averaging count specified in menu <Measurement configuration>.

A description of the averaging method will be given in that subsection.

Concentration Standard:

Gives an estimate of the running standard deviation also calculated by the analyzer.

This number indicates how much the calculated gas concentration fluctuates from its average value. If the gas concentration is truly constant it will provide a measure of the instrument precision.

Line width:

Relative measure of the width of the absorption line. In combination with the line amplitude it determines the integrated absorption, which in turn is used to calculate the gas concentration.

The reference line width parameter is equal to 1.000 at T = 23 °C and P= 1.013 bar (1 atm.) and when the gas composition is equal to those used when calibrating the instrument.

The line width increases with gas pressure and decreases with gas temperature. It also depends on the gas composition, e.g. water vapor broadens the absorption lines significantly.

Line position:

The position of the line peak (maximum absorption) in samples of the AD converter [0–63]. The value should be close to the reference line position, which is given in the menu <Gas specific parameters> for the corresponding line. The instrument automatically tracks the line, i.e. if it deviates more from the reference position than a given value, the instrument adjusts the laser temperature and thereby the wavelength.

Line amplitude:

Relative measure of the peak of the absorption line of the second harmonic signal. If this value approaches 0.5 to 1.0 the absorption is strong and saturation of the AD converter may be very close (actual saturation initiates the ERROR). In the region from 0.01 to 0.1 the signal is good.

Below 0.01 the signal is approaching the low level below which line width cannot be measured and line tracking is off.

Transmission (%):

Indicates how much light the receiver detects in % of the maximum value. If the optical windows are covered with dust and the transmission drops below a pre-set level, a warning will appear on the display of the transmitter unit.

The optical windows of the instrument should then be cleaned. The warning will also appear for improper alignment of the transmitter and receiver.

Gas temperature (C):

The temperature currently used to calculate the gas concentration.

It may be a fixed value set by the user, the value measured by a 4 to 20 mA current temperature probe or the value measured by the device itself optically or electrically.

Optically measured temperature is called Spectral temperature.

Electrically measured temperature is the temperature measured by the embedded temperature sensors (only used when the gas temperature is equal to ambient temperature) offset-corrected to be equal the ambient air temperature. In the example above the gas temperature is set equal to the Spectral temperature. These settings can be configured in the <Measurement configuration> menu.

Gas Pressure (Bar abs.):

The current absolute pressure used to calculate the gas concentration. It may be a fixed value set by the user, the value measured by a 4 to 20 mA pressure sensor or the value measured by the device itself using the embedded pressure sensor (mainly for O₂ devices and only used when the gas pressure is equal to the ambient air pressure). This is configured in the <Measurement configuration> menu.

Dry conversion factor:

Factor currently used to multiply the gas concentration if dry basis conversion is selected (see **Dry basis conversion** on page 57).

The initial (wet) concentration reading may be converted to dry reading if the H₂O concentration is known. If dry basis conversion is not activated the factor is always 1.0.

Max. Direct:

Maximum value of the direct signal in the levels of AD converter [0–4096]. This value together with Dark Direct determines the value of the light transmission.

Dark Direct:

Optical zero of the direct signal measured when the laser is switched off for a short period. The unit is the same as for “Max. Direct”.

Laser temp. (V):

The voltage across the thermistor located in the vicinity of the diode laser. Higher voltages indicate lower laser temperature. Changing laser temperature changes the laser wavelength.

Laser temp. error:

The amplified difference in Volts between the measured Laser Temp and the reference value. Should be around 0.000. It indicates the quality of the laser temperature regulation and thus the quality of the wavelength stabilization.

... 10 Configuration, parameterization

... Description of menus and parameters

Peltier pump (A):

The current drawn by the Peltier element.

Modulation ampl. (V):

Amplitude of the high frequency modulation voltage to the laser.

TU/RU temp.:

The temperatures measured by the embedded thermistors located inside the transmitter and receiver units.

Extra current input (mA):

Current measured at the analog input (flow 4 to 20 mA input).

Air pressure (Bar):

The ambient pressure measured by the embedded pressure sensor located inside the transmitter unit.

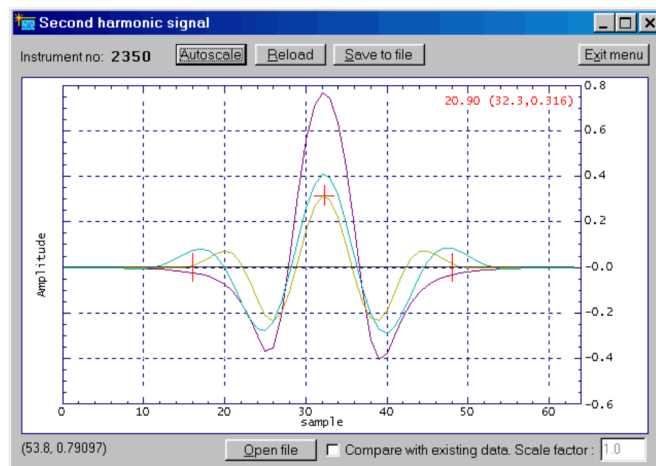
<Plot readings>

<Plot readings> plots the measured average and instant concentration of gases, transmission and spectral temperature (if measured).

Two different plots can be shown simultaneously. Clicking on the axis labels modifies the scale of the plot.

Second harmonic signal <Second harmonic signal>

<Second harmonic signal> displays signals recorded by the device for calculation of the gas concentration.



Yellow: 2. Harmonics filtered

Pink: 2. Harmonics detected

Figure 37: Menu Second harmonic signal (example)

This signal is also useful for inspection and analysis of the absorption spectra, verification of proper laser function, and fault diagnostics.

In total three curves are displayed: the normalized second harmonic signal as detected (pink curve) and the same signal after filtering with two different filters (yellow and blue curves). For some instruments only one filter is applied to the signal.

The example given in Figure 37 displays the signal from an oxygen absorption line.

The peak of the yellow curve is marked with a red cross.

The current gas concentration measured according to this line, the sample number and the position of the peak are displayed at the top right of the diagram.

The latter are also referred to as “Line position” and “Line amplitude” and are described in **Main menu** on page 50.

The line position must be within the acceptance window marked by the two vertical red lines. For some instruments such as dual gas instruments more than one absorption line is plotted.

With the <Reload> button the second harmonics signal is updated. The data can be saved to file (<Save to file>) for later analysis.

This is equivalent to the function <Download readings> in the “File download/upload” menu, see **File download / upload <File download / upload>** on page 62. The scale of the axes is modified by clicking on the axes labels.

It is possible to open a previously saved signal and scale it to compare with existing signal. Two curves are shown for each signal.

Log readings <Custom logging>

With <Custom Logging> all data displayed in the Measurements menu can be logged to an ASCII file at specified regular intervals.

The sampling period (logging interval), file directory, and the filename are user defined (default filename is “gmYYMMDD.log”).

If <New file at midnight> is selected the program will create a new logging file at every midnight with the default filename reflecting the new date.

Before logging <Select Parameters> should be pressed and the parameters of interest should be marked.

The selected parameters are automatically arranged in columns in the logging file.

The first column is always seconds after the last midnight (PC time) and the last two columns are always the instrument status (-4 (sleep mode)/ -1 (startup)/ 0 (ok)/ 1 (warning)/ 2 (error)) and the measurement mode (0 (ok)/ 1 (zero)/ 2 (span)).

Parameters can be added to or deleted from the logging file without interrupting the logging process. The configuration of the logging file may be modified (e.g. specify text qualifier, data separator, add comment on top etc.).

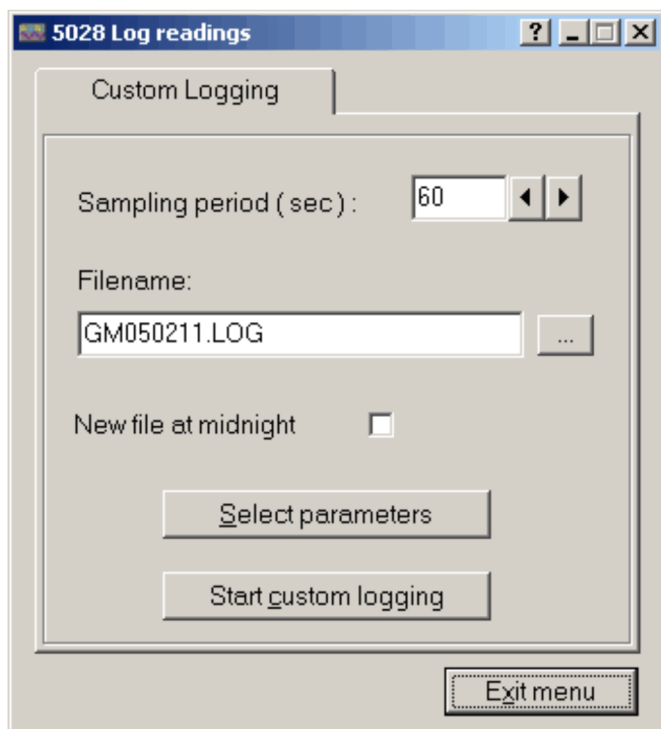


Figure 38: Menu ‘Custom Logging’

... 10 Configuration, parameterization

... Description of menus and parameters

<View error log>

After pressing <View error log> the program downloads the log of the instrument's errors and warnings (see **Diagnosis / Troubleshooting** on page 67) including the date and time of their last activation and deactivation.

The currently active errors and warnings are marked with a cross (x), while the inactive errors are marked with a dash (-).

- <Save error log> saves the current list of errors to a text file.
- <Clear error log> clears all the errors and warnings from the instrument's internal memory.

The instrument also stores the log (System log) of internal status and self-test information.

This information is useful for advanced diagnostics and faultfinding and downloaded to a text file by pressing <Save system log>.

Older system information may be downloaded by pressing <Rewind system log 100 lines> and subsequently <Save system log>.

In case of instrument failure it is always useful to download the error log and the system log and send both files to ABB for diagnostics.

Measurement configuration <Measurement configuration>

In this menu the most important parameters can be set:

- Gas pressure (page 55)
- Gas temperature (page 55)
- Pressure / temperature input method (page 55)
- Pressure / temperature PLC input range (page 55)
- Concentration averaging (page 56)
- Optical path variables (page 56)
- Instrument time (page 57)

Note that the parameters are modified in the program but the device is not updated with the new values until the button <Update instrument> is pressed.

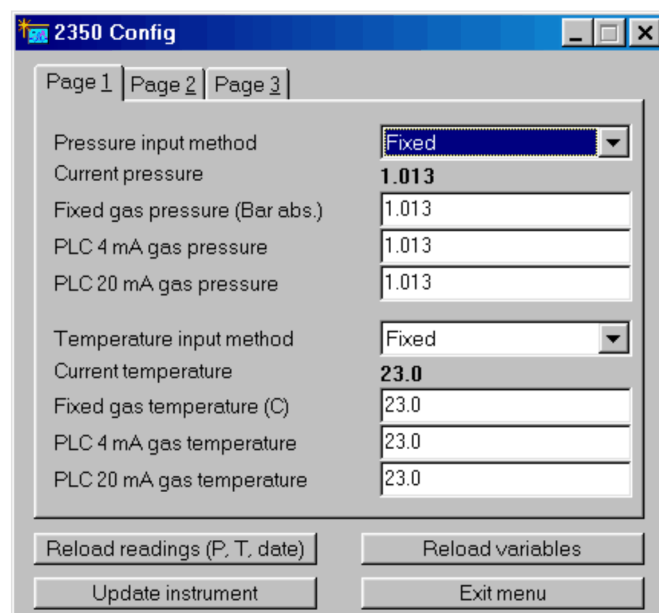


Figure 39: Menu "Config", page 1

Gas pressure and temperature

The strength of the absorption line and line width are pressure and temperature dependent. This is compensated for by calculating a correction factor based on deviation of pressure and temperature from the standard atmosphere ($P = 1,013$ bar, $T = 23$ °C).

For relative concentration units (ppm, %, mg/Nm^3 , g/Nm^3) the gas pressure and temperature are in addition directly involved in calculation of the concentration through the ideal gas law. Therefore, correct setting of gas pressure and temperature is important for the accuracy of the measurement.

“Current pressure” and “Current temperature” are the values for calculating the current state. These values are only downloaded from the device after an update of parameters or explicitly after pressing <Reload readings (P, T, date)>.

The gas pressure is always given in bar absolute.

- To convert pressure from Psig to bar absolute, use the following formula:
 $P(\text{bara}) = 1,013 + P(\text{barg})$
- To convert pressure from Psig to bar absolute, use the following formula:
 $P(\text{bara}) = 1,013 + P(\text{psig})/14,5$

The gas temperature is always given in Celsius.

- To convert temperature from Fahrenheit to Celsius, use the following formula:
 $T(\text{C}) = (T(\text{F}) - 32)/1,8$
- To convert temperature from Kelvin to Celsius, use the following formula:
 $T(\text{C}) = T(\text{K}) - 273$

Pressure and temperature input method

The <Pressure/Temperature input method> specifies whether the values are fixed or are read using any of the following methods:

- If method “Current loop” is activated the values are input from the corresponding current 4 to 20 mA values. In this case, the parameters “PLC 4 mA” and “SPS 20 mA” must be specified.
- Method “Internal” sets the gas pressure equal to the ambient pressure measured by the internal pressure sensor (Air pressure in “Measurements” menu). The gas temperature is set equal to the average of the measured temperatures inside the RU and TU (*TU* and *RU Temp* in “Measurements” menu), which are offset corrected to be approximately equal to the ambient temperature.
- Method “Spectral” (only for temperature) sets the gas temperature equal to the temperature measured spectroscopically. This method is only applicable for devices measuring gas temperature like the O_2 +Temperature monitor.
- Method “Serial”: Pressure and temperature input through RS-232 or Ethernet connector (requires special data packet, please contact ABB Service).

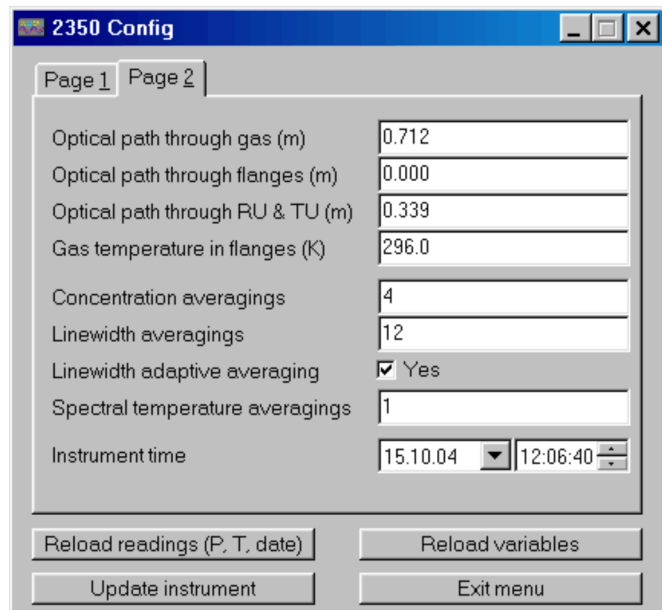


Figure 40: Menu “Config”, page 2

... 10 Configuration, parameterization

... Description of menus and parameters

Optical path through gas (m)

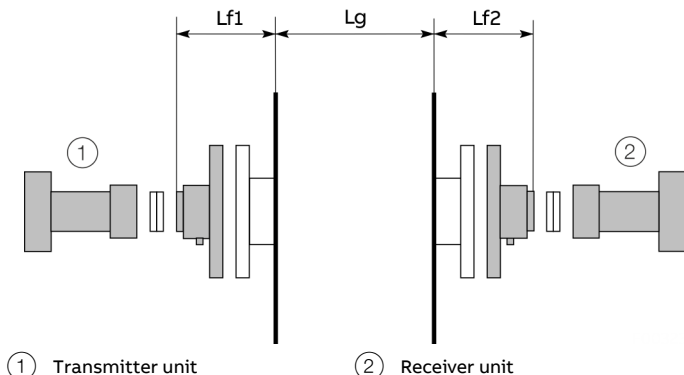


Figure 41: Optical lengths needed for setting initial parameters

The length (in meters) of the optical path through the gas to be measured (L_g in Figure 41). It is normally equal to the stack diameter or the free space between insertion tubes. In case of installations with a measurement cell it is equal to the length of the cell.

Optical path through flanges (m)

The combined length of the flanges ($L_{f1}+L_{f2}$ in Figure 41).

This parameter is important only if the measured gas is present in the flange region and the instrument must compensate for this extra gas absorption. This is usually the case for O_2 , H_2O , CO_2 , CH_4 monitors, e.g. devices for measuring atmospheric gases.

Note

For this compensation to work, the gas concentration in the flanges must be specified in the “Gas specific parameters” menu (**Gas specific parameters <Gas specific parameters>** on page 58).

Optical path through RU & TU (m)

The optical path through the transmitter and receiver units (TU + RU). This is the internal optical path of the instrument. The value is set by the factory.

If this parameter is changed, the original value should be noted down in order to be able to restore the original setting when required.

This parameter is only important if the measured gas is present in the internal device volume so that the additional gas absorption must be compensated for.

Note

For this compensation to work, the gas concentration in the RU and TU must be specified in the “Gas specific parameters” menu (**Gas specific parameters <Gas specific parameters>** on page 58).

Gas temperature in flanges (C)

The average temperature of the gas in the flanges is stated in degrees Celsius. If the measured gas is not present in the flanges, the flange temperature is irrelevant.

Note

Proper setting of the optical path parameters is important for correct measurements.

Concentration averaging

The amount of primary measurements used to calculate the averaged concentration (“Concentration Avg” parameter in “Measurements” menu).

The instrument measures and calculates the gas concentration at regular intervals.

A primary measurement (“Concentration Instant” parameter in “Measurements” menu) takes approximately 1 to 4 seconds depending on the gas type.

The instrument calculates a “running” average of the primary measurements, which is then output in the following ways:

- On the LCD of the electronic unit
- By means of the desired or ordered outputs of the AO2000 system (e. g. 4 to 20 mA analog, PROFIBUS®, Ethernet, etc.).

All output types use the averaged gas concentration. The amount of averaging is specified by the averaging count ($T_{av} = N \times T_{prim}$).

Line width averaging:

Specifies the number of line width averaging.

Line width adaptive averaging:

Switched OFF = the rolling average (as for concentration) applies.

Switched ON = the number of averaging depends on the signal strength i.e. weak signals are averaged longer. NB: This will only be effective if line width averaging is specified > 10.

Spectral temperature averaging:

Specifies the number of spectral temperature averaging.

Instrument time

The device has a built-in clock, which also runs when power is off.

Using this menu the instrument time should be set equal to the local time. The current device time is only downloaded from the device after an update of parameters or explicitly after pressing <Reload readings (P, T, date)>.

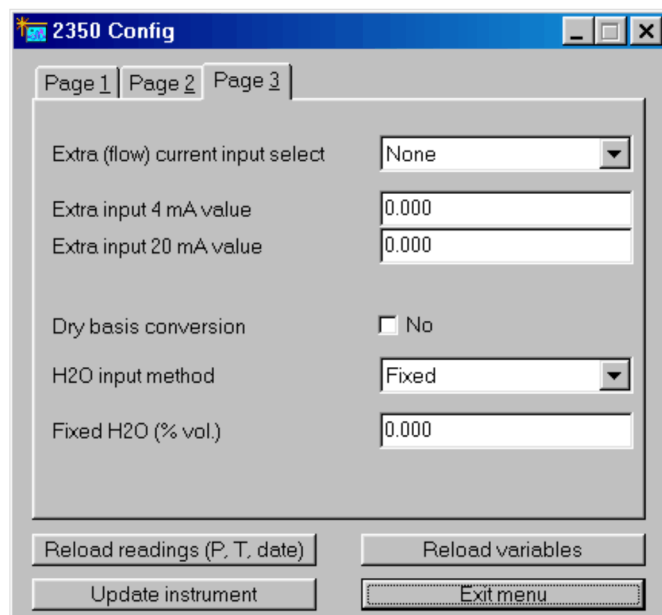


Figure 42: Menu "Config", page 3

Selecting extra (flow) current input

Configures the extra (denoted as "Flow") current input to the instrument. This can be set to "None", "Gas -%vol", "Gas - g/Nm³", "Gas - g/m³", and "Flow".

Input "None" simply deactivates the extra current input. For all other inputs the 4 mA and 20 mA values must be specified. The current input can be used to connect an external gas sensor (typically an H₂O sensor for dry basis conversion) to the device. In this case "Gas" input with the corresponding concentration unit should be selected. The measured input current can be monitored in the "Measurements" menu. Input "Flow" is currently not implemented.

Dry basis conversion

The primary measurements of the gas concentration are always on wet basis. The device can also present the results on dry basis if the H₂O concentration is known.

If <Dry basis conversion> is selected the device converts the measured concentrations according to the following simple equation:

$$N(\text{dry}) = N * 100 / (100 - \text{H}_2\text{O}(\%))$$

where N represents the original sample gas concentration of the damp reference condition and H₂O (%) represents the H₂O concentration in vol.%.

The parameter "Dry conversion factor" multiplies N and can be monitored in the "Measurements" menu.

... 10 Configuration, parameterization

... Description of menus and parameters

Input methods for H₂O

The following input methods for the H₂O concentration are available:

- Method “Fixed” sets the H₂O concentration equal to the manually specified value.
- With method “Current loop” the H₂O concentration is input from an external H₂O sensor via the Extra (Flow) current input. In this case, the parameter “Extra (flow) current input select” should be set to “Gas-unit”, where “unit” equals the unit of the external H₂O sensor output concentration. The 4 mA and 20 mA values must be specified.
- Method “Measured” can be used when the analyzer is configured to measure several gases and one of them is H₂O. Even if the measured concentration exceeds this value that is used to convert it to a dry reference state, 50 vol.% is still valid.
- If the method “Calculated” is enabled, the device calculates the saturated water vapor concentration, which is based on the input values of the gas temperature and the gas pressure.

The calculated H₂O concentration is then used for dry basis conversion.

The maximum gas temperature for this method is approximately 90 °C, the calculated max. H₂O concentration being limited to 70 vol.%. The same H₂O restriction is used for the methods “Fixed” and “Current loop”.

Gas specific parameters <Gas specific parameters>

If the instrument monitors more than one absorption line a selection menu with the relevant gases appears first.

Upon selection of the gas the following menu is displayed:

The screenshot shows a configuration window titled '2377 Gas-1' with a 'Page 1' tab. The window contains the following parameters and values:

| | | |
|--------------------------------|--|-------|
| Measured gas | 02 | |
| Unit | % | |
| Output format | %6.2f | |
| Gas conc. alarm level | 20.00 | % |
| Gas conc. at 4 mA current out | 0.00 | % |
| Gas conc. at 20 mA current out | 3.00 | % |
| Gas concentration in flanges | 0 | |
| Gas concentration in RU & TU | 298.6 | g/Nm3 |
| Min line position [0-63] | 16 | |
| Max line position [0-63] | 48 | |
| Reference line position | 32.00 | |
| Max line position deviation | 1.00 | |
| Calibration constant | 486.91 | |
| Linewidth constant | -0.2478 | |
| Linewidth measurements | <input checked="" type="checkbox"/> On | |

At the bottom of the window are three buttons: 'Reload parameters', 'Update instrument', and 'Exit menu'.

Figure 43: Menu 'Gas specific parameters'

Sample gas (Measured gas)

Displays the gas type. Cannot be modified if the program runs in User mode.

Unit (Unit)

Select the appropriate unit for output of the gas concentration from the dropdown list.

The units can be grouped into two different categories.

Absolute units: g/m³, mg/m³ and µg/m³ and relative units: %, ppm, ppb, g/Nm³, mg/Nm³ and µg/Nm³.

Some more specific units are also available such as %*m, ppm*m and ppb*m. These units are often used for open path analyzers and represent the concentration recalculated to 1 m optical path length.

Make sure that the actual optical path length is set to the correct value in the “Measurement configuration” menu.

The primary unit used by the device to calculate the gas concentration from the absorption line is the absolute unit g/m^3 . All other units are calculated from this primary unit assuming the ideal gas law is applicable.

The relative units g/Nm^3 , mg/Nm^3 and $\mu\text{g}/\text{Nm}^3$ are the values obtained from the conversion of the absolute units (g/m^3 , mg/m^3 and $\mu\text{g}/\text{m}^3$) to standard pressure and temperature assuming the ideal gas law. According to the European standard that applies to the analyzer, these are the values $P = 1.013 \text{ bar}$ and $T = 0 \text{ }^\circ\text{C}$.

Note that the US standard for the relative units g/Nm^3 and mg/Nm^3 differs in respect of the standard temperature and is $25 \text{ }^\circ\text{C}$.

Note that the gas concentration is always measured on “wet basis”, i.e. no correction is done for water vapor present in the process gas.

Output format

The numerical format of the gas concentration on the LCD and in most parts of the service program.

The format is presented according to the programming language C (%6.2f means that the floating number will be presented with 2 decimals and 6 digits including the decimal point, e.g. 123.45).

Gas concentration in flanges, RU and TU

The gas concentrations in the flanges and in the RU & TU. The unit can be chosen between g/Nm^3 , % or ppm from the dropdown list. If the measured gas is not present inside RU and TU and/or in the flanges the corresponding gas concentration must be set to zero.

Make sure that the appropriate optical path lengths are specified in the “Measurement configuration” menu.

Min/Max line position [0-63]

These values define the acceptance window (in samples) for the line position in the second harmonic signal (see **Second harmonic signal <Second harmonic signal>** on page 52). The values cannot be modified if the program runs in User mode.

Reference line position

Specifies the position of the absorption line (in samples) in the second harmonic signal. The value cannot be modified if the program runs in User mode.

Max line position deviation

Specifies the maximum deviation of the line position (in samples) from the reference line position. In case the deviation is larger than the specified value the instrument will adjust the laser temperature to bring the line back to the reference position. The value cannot be modified if the program runs in User mode.

Calibration constant

The constant used in calculation of the gas concentration. The calibration constant is modified after calibration (see **Calibrating the device <Calibrate instrument>** on page 60). The value cannot be modified manually in this menu if the program runs in User mode.

Line width constant

The constant used to calculate the line width, which in turn is used to calculate the gas concentration. The line width constant can be modified together with the calibration constant after calibration (see **Calibrating the device <Calibrate instrument>** on page 60). The value cannot be modified manually in this menu if the program runs in User mode.

Line width measurement

This parameter switches the line width measurement function ON and OFF. If switched OFF the theoretical line width for the given gas pressure and temperature is used.

If switched ON the line width is measured from the shape of the second harmonic absorption line. The value cannot be modified manually in this menu if the program runs in User mode.

... 10 Configuration, parameterization

... Description of menus and parameters

Calibrating the device <Calibrate instrument>

Calibration of all gases and the spectral temperature (if applicable) is carried out in this menu. The example below is for a device measuring two gases.

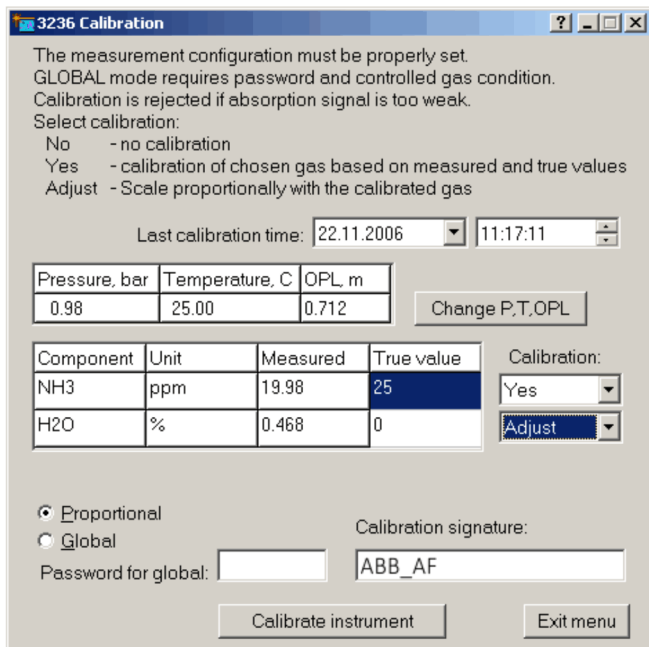


Figure 44: "Calibration" menu

There are two available calibration modes: "PROPORTIONAL" and "GLOBAL", which can be toggled.

Calibration mode "Proportional"

The default calibration mode is "PROPORTIONAL". In this mode the device performs proportional adjustment of the calibration constant based on the measured and supplied concentrations. There are no special requirements for the gas parameters and signal quality. The PROPORTIONAL calibration may be done whenever it appears necessary to the user that the device measurements should be adjusted, e.g. during measurement of process gas.

Observe the following:

All gases can be calibrated individually. The true gas value is specified and "Calibration" is set to "Yes" from the corresponding dropdown list.

For gases that are not to be calibrated, "Calibration" is set to "No" from the corresponding dropdown list.

It is also possible to auto-calibrate gases.

Gas A is calibrated by filling in the true value and selecting "yes".

Gas B is auto-calibrated by setting the correct value to zero and select "adjust". In this case the calibration constants for line amplitude and line width for gas B are adjusted according to the calibration of gas A. This is useful when only one calibration gas is present or when the reference ratio of the measured concentrations is maintained even after the calibration.

In Figure 44, NH₃ is calibrated to 25 ppm. The calibration constants for H₂O will be adjusted accordingly.

A signature for identifying the calibration can be entered in the "Calibration signature" field

Press <Calibrate instrument> to update the device with the new calibration. The device will use the currently measured average concentration to perform all necessary calculations. The new calibration will be stored permanently. The calibration time will be updated automatically.

ABB calibrates all instruments under controlled conditions using certified gas. This calibration is then verified for the specified range of temperature and pressure. There is no need to calibrate the instrument upon reception. However, if the measured concentration does not match an expected value or wet chemical control measurements, the user may wish to recalibrate the instrument directly on the process.

Note

In this case, after such a calibration ABB is relieved of responsibility for correct device calibration in the specified range of gas temperature and pressure.

An O₂ analyzer can measure incorrect zero level after such a calibration. This can happen if the new calibration constant does not correspond to the background oxygen absorption in the receiver and transmitter units and/or in the flanges.

Calibration mode “Global”

In the “GLOBAL” calibration mode the device performs reference measurements of the absorption line width in addition to the line amplitude.

The calibration constant and reference line width are then adjusted based on these measurements.

This calibration procedure requires stable and controlled conditions of the reference gas. It should be performed using a test cell and a certified mixture of measured gas with nitrogen and only if it was verified that the current calibration is not valid.

The procedure requires technical skills and some experience in handling gas mixtures.

Note

As a rule only qualified personnel should perform GLOBAL calibration after major services. See also **Calibration of the device** on page 72.

To calibrate the device proceed in the same way as described above for PROPORTIONAL calibration mode. The only difference is that the program will ask for a password that is available from ABB Service.

The GLOBAL calibration, if performed correctly, guarantees the validity of the calibration parameters in the specified pressure and temperature range.

Calibration mode PROPORTIONAL/GLOBAL is common for all gases. Nevertheless, it is possible to calibrate one gas in global mode and another in proportional mode.

In this case the mode is set to GLOBAL and the line width measurements for the gas, which should be calibrated proportionally, must be switched OFF in the <Gas specific parameters> menu (only for the program running in Advanced mode).

It can be switched back ON after the calibration. Calibration mode is not applicable to the spectral temperature.

TCP/IP and modem configuration <TCP/IP & modem configuration>

TCP/IP parameters of the embedded Ethernet board and the initializing string of a modem can be configured in this menu.

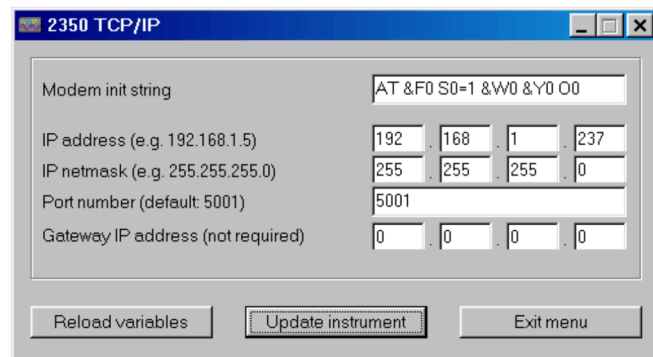


Figure 45: Menu 'TCP/IP'

IP address

IP address assigned to the Ethernet board of the device. Default IP address is typically set to 192.168.1.237 for LAN communication.

The user can assign any free local IP address or a valid global IP address for direct Ethernet connection.

IP netmask

Subnet mask for the LAN connection. Default net mask is 255.255.255.0.

Port number

Port number for TCP/IP communication. Default port number is 5001, but the user can assign any free port number.

Gateway IP address

The address of a server used to route TCP/IP traffic to/from the Ethernet board to another network. This is normally not needed for local communication, but may be needed when the Ethernet board is setup for Internet connection.

... 10 Configuration, parameterization

... Description of menus and parameters

File download / upload <File download / upload>

The menu allows to save/restore device data to/from file.

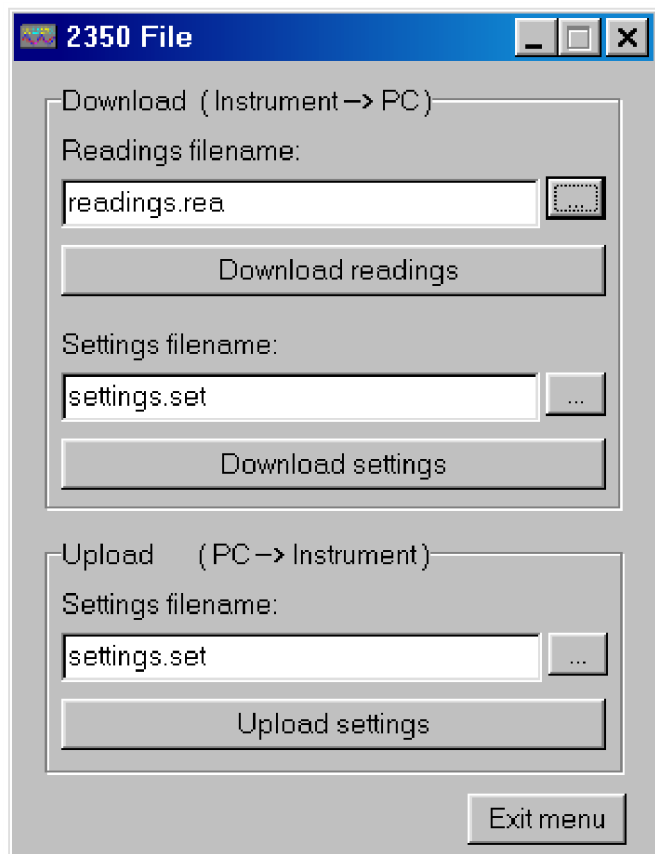


Figure 46: Menu 'File'

Two different types of data can be downloaded from the device to a PC and saved into ASCII text files: the device readings and the device settings.

The readings file contains the measured data shown in the "Measurements" menu. The settings file contains all static parameters of the device including those in the different menus described above.

The filenames can be edited.

ABB recommends using the file extension .rea or .dmp for the device views and .set or .stt for the device settings.

If an existing file name is chosen the new data are appended to this file.

After pressing <Download readings> the readings data are downloaded and written to a file with the specified name. The data can be viewed and analyzed. Alternatively, in the "Second harmonic signal" menu you can download all instrument displays (see **Second harmonic signal** <**Second harmonic signal**> on page 52).

After pressing <Download settings> the device setting parameters are downloaded and written to a file with the specified name.

The setting file is useful as backup of the device settings. It is useful to save the current device settings before making any changes to the device parameters. The same also applies before and after each calibration.

It is possible to upload instrument settings from a PC, thus updating the instrument with new settings or restoring a previously saved instrument configuration.

It is important to ensure that the settings file is correct and actually belongs to this analyzer. The settings file can be edited with any text editor. Parameters that are not to be uploaded can be removed.

NOTICE

Damage to the device

Damage to the device due to improper device settings.

- Updating the device with incorrect settings, such as laser current and laser temperature, can damage the laser.

<Manual instrument control>**Enter Sleep mode**

The instrument will be forced into Sleep mode.

Reset Microcontroller

Microcontroller is reset.

Collect AD statistics

For service purpose only.

Current loops and digital i/o

This menu is for testing the 4 to 20 mA inputs or outputs mainly during installation of the analyzer.

Note that the instrument will be set into sleep mode for these tests.

Save system log

See **<View error log>** on page 54.

Rewind system log 100 lines

See **<View error log>** on page 54.

... 10 Configuration, parameterization

Configuration via AO2000 central unit

Those parameters which are used to fit the laser analyzer to the measuring point can also be configured via the AO2000 display and control unit. This configuration method has the same effect as that using the service software.

The following overview briefly explains the parameters and their possible settings (refer to **Measurement configuration** <Measurement configuration> on page 54 und **Gas specific parameters** <Gas specific parameters> on page 58).

| Menu | |
|--------------------------|---|
| Maintenance/Test | |
| ... | |
| Analyzer spec. adjustm. | |
| ... | |
| LS25 basic configuration | |
| Serial number | for information only |
| Unit | unit of gas concentration: |
| Meas. range | g/m3, mg/m3, %, ppm, g/Nm3, mg/Nm3 |
| Neg. concentration | display of negative measured values: on or off |
| Temperature | input method: fixed value, 4–20 mA, internal sensor, AO2000 correction |
| Value | fixed temperature value in K |
| Value at 4 mA | temperature value for 4 mA at current input |
| Value at 20 mA | temperature value for 20 mA at current input |
| Pressure | input method: fixed value, 4–20 mA, internal sensor, AO2000 correction |
| Value | fixed pressure value in hPa |
| Value at 4 mA | pressure value for 4 mA at current input |
| Value at 20 mA | pressure value for 20 mA at current input |
| Advanced settings | |
| Optical path gas | optical path length through gas |
| Optical path flanges | optical path length through both flanges |
| Gas temperature flanges | gas temperature in flanges in K |
| Concentration flanges | gas concentration in flanges in g/Nm3 |
| Concentration TU & RU | gas concentration in transmitter and in receiver unit in g/Nm3 |

11 Operation

Safety instructions

If there is a chance that safe operation is no longer possible, take the device out of operation and secure it against unintended startup.

Operating mode

After having set all necessary device parameters as described in **Configuration, parameterization** on page 48, the device is ready for operation.

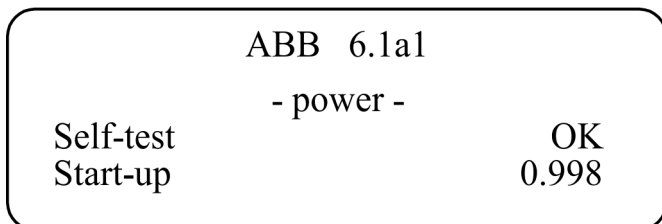
During operation, the analyzer may be in any of these three modes:

- Start-up mode
- Measuring mode (or normal mode)
- Fault mode (or Sleep mode)

Start-up mode

After turning on the power the device runs through initializing, self-test and start-up before starting measurements. This is indicated by appropriate texts in the LCD.

The instrument stays in start-up mode until the laser temperature stabilizes within acceptable limits. The LCD typically shows the following:



In the upper right corner of the LCD the firmware version used by the instrument is printed. In this case the version is 6.1a1.

The next row shows the cause for the instrument being in start-up mode. Normally it will show -power- indicating that the power has recently been switched on. In the event of a restart due to unexpected software or hardware conditions the word - watchdog- would be printed instead.

If the self-test has passed successfully, a number appears in the lower right corner of the LCD. This number decreases as the laser temperature stabilizes. When the number is below 0.3, the instrument slowly powers up the laser.

The start-up mode normally lasts less than 3 minutes.

Measuring mode

While the operating mode is «measuring», the device can be in one of the following three modes:

- «Normal»: Measuring mode,
- «Zero»: Zero point measurement.
- «Span»: Span measurement (with span cell).

Note

Maintenance mode "Maintenance" is not available for the LS25.

The measuring mode is selected through digital communication (see **Software start-up** on page 49).

Mode «Normal»

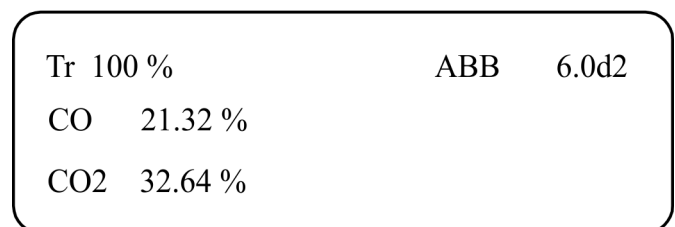
In «Normal» mode, the sample gas concentration is regularly displayed in the LCD and is output via the outputs configured with the AO2000.

The measurement results are transferred to the AO2000 via the Ethernet cable.

In addition, measurements can be monitored with the service program via a serial cable (RS-232) for service purposes.

The measured gas concentration is updated every 1 to 5 seconds depending on factory settings which are optimized for the application.

If the device can measure two gases the LCD might look as follows:



The LCD shows the measured average gas concentration(s) in the chosen unit and the laser beam transmission, which indicates how much light hits the detector relative to the maximum value (calibrated by the factory).

In case of a warning, the instrument continues to measure the gas concentration while displaying the message in the bottom line.

In the event of an error, the LCD shows <Instr. ERROR> instead of the concentration, and displays the message in the bottom line.

For information on the possible error messages, see **Diagnosis / Troubleshooting** on page 67.

... 11 Operation

... Operating mode

Mode «Zero» / «Span»

Zero (Zero) and span check (Span) functionality are optional features of the analyzer.

Refer to **Calibrating the device <Calibrate instrument>** on page 60.

Fault mode «Instrument Off»

Fault mode is entered when the device has detected a severe failure during the self-test or normal operation, which might permanently damage the device.

In this case the instrument stops measuring the gas concentration and most instrument functions are turned off. This operating mode is indicated on the LCD with <Instrument Off>, no gas concentration is displayed, and the bottom line of the display indicates the nature of the fault, see **Diagnosis / Troubleshooting** on page 67.

The instrument automatically attempts a restart after one hour.

12 Diagnosis / Troubleshooting

Error messages

During operation essential status information about the device is displayed on the LCD mounted in the transmitter / AO2000 main unit. The instrument messages and their possible explanations and actions to be taken are given in the table below.

If no messages are displayed on the LCD, see **Transmitter unit – Fuses and LEDs** on page 41.

Error messages in the LCD of the transmitter unit

| Fault message | Description | Troubleshooting instructions |
|----------------------|--|--|
| Low transmission | WARNING The optical transmission has dropped below the limit for reliable measurements. This might indicate misalignment of the optical units or contamination of the optical windows. | Clean the optical windows and check the alignment of the flanges. |
| Laser line-up error | ERROR The laser beam does not reach the detector. | Clean the optical windows and check the alignment of the flanges. Check the optical path for obstacles. |
| PLC T-read error | ERROR Error while reading the temperature via the 4 to 20 mA analog input. The input current from the temperature sensor is either above 23.7 mA or below 0.3 mA. | Check the electrical connection of the external temperature sensor. Alternatively, use the fixed temperature setting in the analyzer. |
| PLC P-read error | ERROR Failure reading pressure through 4 to 20 mA analog input. The input current from the pressure sensor is either above 23.7 mA or below 0.3 mA. | Check the electrical connection of the external pressure sensor. Alternatively, use the fixed pressure setting in the analyzer. |
| T-read out of range | WARNING Input current from temperature sensor is either above 22 mA or below 3.2 mA. The measured gas temperature may be wrong. | Check the electrical connection of the external temperature sensor. Alternatively, use the fixed temperature setting in the analyzer. |
| P-read out of range | WARNING Input current from pressure sensor is either above 22 mA or below 3.2 mA. The measured gas pressure may be wrong. | Check the electrical connection of the external temperature sensor. Alternatively, use the fixed temperature setting in the analyzer. |
| P/T out of range | WARNING Pressure and temperature compensation is outside acceptable range. The accuracy of the measured gas concentration may be reduced. | If supplied values are correct, the device is operating outside specifications. |
| Ex-read out of range | WARNING Input current from external gas sensor is either above 22 mA or below 3.2 mA. | Check the electrical connection of the external flowmeter. |
| Voltage supply fail | The power supply voltage input to the device (transmitter unit) is exceeding acceptable range (for standard device; 18 to 36 V). | Check and correct input voltage. If the error persists, contact ABB Service. |

... 12 Diagnosis / Troubleshooting

... Error messages

| Fault message | Explanations and actions | Troubleshooting instructions |
|---|--|--|
| Low laser temp. High laser temp. | ERROR The laser temperature regulation has failed and the laser is too cold/warm. The instrument has entered FAULT mode and attempts automatic restart after one hour. | Allow the transmitter unit to cool. Improve ventilation, provide heat shielding if necessary. If transmitter is not overheated, the error might indicate a bad electrical contact or other hardware failure. If the error persists, contact ABB Service. |
| Low box temp. High box temp. | ERROR Internal temperature of transmitter or receiver is exceeding the operating limit. The instrument has entered FAULT mode and attempts automatic restart after one hour. | Check the ambient temperature of the transmitter and receiver units. Improve ventilation, provide heat shielding if necessary. If the error persists, contact ABB Service. |
| EEPROM error | ERROR Failure of the internal memory of the device. | Upload a backup settings file (with the original settings) to the device. If the error persists, contact ABB Service. |
| Self-test fail | ERROR The device has detected a self-test error during start-up. | Restart the device. If the error persists, note the messages on the LCD, download the error record and system log and contact ABB Service. |
| Low line position High line position No absorption line | ERROR The device has detected a spectroscopic fault. This can have several causes: Unknown interference gas in process, incorrect laser temperature (wavelength), transmitter unit is operating outside acceptable temperature range, or laser malfunction. | Check the device with the calibration cell with a gas concentration suitable for calibration, run the device continuously for more than 70 minutes. If the error persists or if the calibration is significantly incorrect, contact ABB Service. |
| Saturation of direct | ERROR The photodetector is saturating or transmission is > 130%. If the error remains when the receiver window is obscured, this is an electronic fault. Otherwise the error may occur after replacement of laser module or receiver electronics. | Reduce receiver amplification (if possible) or transmission. If the error persists, contact ABB Service. |
| Saturation of harm. | ERROR A second harmonic signal is saturating. This may be for one of the following reasons: The gas concentration is too high or the length of the optical path for measurement is too long. | Reduce the amplification for the second harmonic signal in the receiver (contact service personnel for details), or use a shorter measurement length for high gas concentrations. If the error remains when the receiver window is obscured, this is an electronic fault. Contact ABB Service. |
| All other error messages | – | Note all LCD messages and contact ABB Service. |

Error messages at the AO2000 central unit

| No. | Text | O | E | M | F | Corresponds to LCD error message |
|-----|---|---|---|---|---|--|
| 366 | The LS25 analyzer has a global error. | x | x | | | |
| 367 | The LS25 analyzer has a maintenance request. | x | | x | | |
| 368 | The LS25 analyzer starts measurement. | x | x | | | |
| 369 | LS25 analyzer detector error # | x | x | | | |
| 370 | The beam transmission exceeds the permissible range. | | | x | | Low transmission |
| 371 | The temperature input signal exceeds the permissible range. | | | x | | T out of range |
| 372 | The pressure input signal exceeds the permissible range. | | | x | | P out of range |
| 374 | No measurement. The detector signal is too low. | x | x | | | Laser line-up error |
| 375 | The input current loop (4–20mA) has an error. | x | x | | | T-read error, P-read error |
| 376 | This LS25 module is under maintenance. | | | | x | (Communication with service software via RS232. No measured values are transferred.) |

- O** X = Status message sets the overall status
- E** X = Message sets the “Failure” individual status
- M** X = Message sets the “Maintenance Request” individual status
- F** X = Message sets the “Function Check” individual status

13 Maintenance

The analyzer is designed to reduce the maintenance required to a minimum.

Experience has shown that maintenance interval of more than three months are acceptable for most applications.

The maintenance operations described in this section will secure a continuous and safe operation of the monitor.

Maintenance plan

ABB gas monitors have no moving parts and require no consumables.

For best performance, however, routinely carrying out the follows steps is recommended:

- Check optical transmission regularly (daily). This can be done automatically by use of instrument output (if ordered).
- Clean windows and adjust alignment when necessary, see **Cleaning of optical windows** on page 70.
- For applications whose concentration of the sample gas is usually zero (“zero point gas” application):
 - Check the device reaction by supplying a sample gas. Ensure that a sufficient amount or concentration is applied in order to detect a device reaction or measured value change for at least 10 minutes.
 - No warnings or errors should be displayed during the test.
 - For certain devices this procedure is not necessary as the laser is tracking on another absorption line than the “zero gas” line (e.g. H₂O line for an HF device). Contact ABB Service if you are in doubt about your device.
- Check calibration every 3 to 12 months (depending on the required accuracy). Recalibrate if necessary, see **Calibration of the device** on page 72.
- After each calibration check, save device settings and measurement data recorded with some gas, see **File download / upload <File download / upload>** on page 62. This is for tracking purposes in case of future service issues.

Carry out maintenance activities

Cleaning of optical windows

Dust, soot or other contamination on the optical windows will reduce the signal level.

The LS25 is designed to allow a considerable reduction of transmission (down to 10 to 30 %) without influencing the quality of the measurements.

However, if the transmission falls below the level for reliable measurements, the LCD shows “Low transmission.”

The optical windows must then be cleaned:

- The optical windows can be cleaned with nonabrasive detergents or solvents.
- If there are cracks in or damage to the optical window, the optical window should be replaced.
Since the optical windows are wedge-shaped, the new optical window must be aligned in the same way as the old optical window in order to maintain optical adjustment of the system.

In order to reduce dust accumulations on the optical windows, the device is equipped with purging connections on the transmitter and receiver units as well as on the flanges. A check of the optical windows should also be done in connection with purging failures.

Alignment of the device

The alignment of the receiver and transmitter units may change due to outer strains.

The transmission can, therefore, decrease with time.

The LCD shows the messages «Laser line-up error» and «Low transmission» alternately.

In this case, realign the transmitter and receiver units, see **Align analyzer with laser alignment device** on page 44 and **Setting the maximum transmission** on page 45.

Optimizing purging gas flow of the flanges

It is generally difficult to give a recommendation of what purge gas quantity is needed for certain applications. The required purge gas volume depends on the flow velocity of the gas in the sample gas path (e.g. stack, boiler or process line), as well as on the length and diameter of the flanges, etc.

From experience, it can be assumed that the flow rate of the purge gas in the flanges corresponds to $\frac{1}{10}$ of the flow rate of the purge gas in the pipe.

If the gas concentration to be measured is fairly constant (and non-zero) over a few minutes one can try one of the following procedures to measure the required purge flow:

Alternative 1:

1. Connect the service PC, and with the menu <Custom logging> selected, start the 2-second sampling period with "Concentration Instant", see **Log readings <Custom logging>** on page 53.
Alternatively, the instantaneous concentration can be noted down from the "Measurements" menu.
2. Quickly turn off the purge gas flow for 30 to 60 seconds and then back on.
 - The flanges will be filled with sample gas path gas a few seconds after the purge gas is turned off.
3. Repeat step 2. a few times to be sure to have good repeatability of the change in the measured gas concentration, as opposed to true fluctuations in the process.

4. From the data in the log file calculate the ratio of measured gas concentration without and with flange purge gas.
 - Compare the result with the ratio of the length RU-to-TU-window to the length flange-tip-to-flange-tip. From this one can estimate the "fill-fraction" of purge gas in the flanges.
 - If the ratios are equal the flanges are completely filled with purge gas.
 - If the gas-ratio is less than the length-ratio the flanges are only partly filled with purge gas.
5. Adjust the amount of purge gas and repeat the test until the flanges are filled with purge gas.

Alternative 2:

1. Set the measuring length of the device so that the window distance between RU and TU is the same, see **Optical path through gas (m)** on page 56.
2. Turn off the purge gas flow for sufficiently long until the flanges are filled with gas from the sample gas path and the concentration can be measured.
3. Reset the measurement length equal to the distance from flange tip to flange tip.
4. Increase the purge gas flow until it measures the same as in step 2.

If the windows have become dirty during the tests, remember to clean them. If the required amount of purge gas is difficult to obtain, alternatively the parameter "Optical path through gas" can subsequently be adjusted on the basis of the test results, see **Optical path through gas (m)** on page 56.

... 13 Maintenance

Calibration of the device

Note

The analyzer is calibrated ex works with a certified gas mixture. A calibration certificate is supplied with the device. There is therefore no need for the user to calibrate the instrument upon reception.

After some period of operation the device parameters may change due to aging of the diode laser. In this case a new calibration might be necessary.

ABB recommends verifying calibration of the device once a year using a certified sample gas and the supplied calibration cell. The certified sample gas should in most cases be a mixture of nitrogen with the measured gas.

The O₂ analyzer can be tested and calibrated using dried air.

Percent level H₂O analyzers are normally calibrated using calibration gas generators (e.g. type HovaCAL) to generate defined moisture concentrations. If any other method is desired, please contact ABB Service.

Since the calibration of the instrument affects all subsequent measurements, the user should verify the need for a new calibration.

We do not recommend performing a calibration if the device readings deviate less than 2 to 3 % from the nominal value within the recommended concentration levels indicated below.

This is the typical absolute accuracy for calibration gas mixtures. The precision of the analyzer should also be taken into account: this is about 1 % of the measured value if pressure and temperature are correctly set in the device.

The second harmonic technique used in the analyzer is intrinsically a baseline-free technique. Therefore, a calibration of the zero level is never done.

If an attempt is made to calibrate the zero level, the service program will display an error message. The monitor can only be calibrated if it detects an absorption signal amplitude above a predefined level.

This level is factory set and is typically 20 times the detection limit for an optical path length of 1 m.

To obtain the optimal signal-to-noise ratio with one of the optional calibration cells (accessory available from ABB), the gas concentrations in Table Recommended gas concentrations for calibration should be used for our standard monitors (contact ABB Service for non-standard monitors).

Note

The hydrogen fluoride (HF) measurement is calibrated using a special 0.1 to 0.15 m long PTFE cell with sapphire windows. The PTFE cell can be supplied by ABB.

If only one sample gas with high gas concentration is available, the sample gas must be diluted with nitrogen using a calibrated gas mixing system. Dilution must be made up to the values specified in the table Recommended gas concentrations for calibration.

Significantly lower concentrations should not be used because the measurements might be influenced by noise as well as by adsorption and de-sorption processes in the cell and the tubes.

Recommended gas concentrations for calibration

| Measured gas | Concentration range |
|--|---------------------------|
| HF | 50 to 500 ppm (PTFE cell) |
| HCl | 15 to 200 ppm |
| NH ₃ | 30 to 400 ppm |
| H ₂ O (low conc.), HCN, CH ₄ | 50 to 500 ppm |
| H ₂ S | 300 to 2000 ppm |
| CO, CO ₂ | 0.5 to 5 Vol.-% |
| CO, CO ₂ (low conc.) | 50 to 500 ppm |
| NO | 500 to 5000 ppm |

NOTICE

Impairment of calibration

Impairment of calibration due to unsuitable sample gases.

- Only use certified sample gases (e.g. in accordance with DIN ISO 6141 or DIN ISO/IEC 17025).

Calibration instructions

- When gas is flushed through the cell, the cell pressure is higher than the ambient pressure. The pressure difference depends on the flow rate and the diameter and length of the outlet tubes.
 - It is therefore highly recommended to measure the gas pressure close to the cell, using an absolute pressure sensor in order to provide the device with correct gas pressure during the verification and calibration procedure.
 - If only the ambient pressure is known or the pressure sensor is located far away from the cell, one can switch off the gas flow before calibration, wait 1 minute for the measurement readings to stabilize and subsequently perform calibration. In this case the gas pressure is equal to the ambient pressure.
- Special care should be taken for reactive and “sticky” gases such as HF, NH₃, H₂O, HCl and H₂S. Because of the nature of these gases, it is difficult to obtain the required concentration in the calibration cell due to adsorption and de-sorption in the connection tubes and within the cell itself.
- For H₂O or gas mixtures with H₂O component, a heated measuring cell and a connection lead of at least 180 °C is required. The heated line should be connected directly to the gas mixing system, e.g. HOVACAL.
- Use cells made of stainless steel or PTFE for HF.
- Use connecting tubes made of PTFE.
- Use connections that are as short as possible between the calibration gas cylinder and the calibration cell.
- Flush the cell with calibration gas with a high flow rate of 5 to 7 l/min.
- Wait until the concentration in the cell has stabilized.
- Switch off the flow and observe how fast the concentration degrades.
 - If it degrades rapidly, the cell needs to be passivated.
- Check that the measured concentration remains the same with increasing flow rate. If it does, the concentration in the cell most likely has reached the expected value.

Performing the calibration

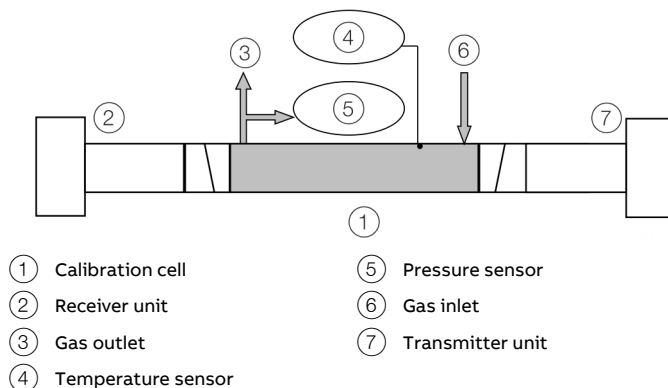


Figure 47: Calibration set

Perform the following steps to verify and calibrate:

- Remove the transmitter and receiver units at the measuring point.
- Install the transmitter and receiver units on the test cell, see Figure 47.
 - Check the calibration set for leak tightness. e.g. by testing with slight overpressure.
- Connect the calibration cell temperature and pressure sensors to the AO2000-LS25, see **Connecting analog inputs (option)** on page 42.
- Switch on the device, the device must be operational for at least 1 hour before performing the verification and/or calibration.
- Start the service program, see **Software start-up** on page 49.
- Make sure that the measurement configuration parameters are set correctly, see **Measurement configuration <Measurement configuration>** on page 54.
 - The flange length or concentration should be set to zero.
 - Check that the manually set temperature and pressure are correct, or that the PLC inputs for the gas temperature and pressure are correct.

... 13 Maintenance

... Calibration of the device

7. Pressurize the cell with the calibration gas and set a constant flow rate of 5 to 7 l/min.
 - Wait until the system reaches stable levels.
8. Check if the reading is in agreement with the concentration of the certified gas.
 - Perform a PROPORTIONAL or GLOBAL calibration if necessary, see **Calibrating the device <Calibrate instrument>** on page 60 and **PROPORTIONAL and GLOBAL calibration** on page 74.
9. Save the device settings to a file, see **File download / upload <File download / upload>** on page 62.
10. Adjust the optical path parameters, pressure and temperature again according to the measuring point process parameters, see **Measurement configuration <Measurement configuration>** on page 54.
11. Reinstall and commission the transmitter and receiver units at the measuring point.

PROPORTIONAL and GLOBAL calibration

Line broadening compensation requires a large number of parameters to be measured. These parameters are critical for accuracy, but only when line broadening compensation is used. Most of the parameters seldom or never need to be adjusted.

PROPORTIONAL calibration:

This calibrates the span of the gas concentration by adjusting the proportionality between the peak amplitude of the absorption line and the gas concentration. Only the proportional calibration constant is affected by PROPORTIONAL calibration.

GLOBAL calibration:

Calibrates both the gas concentration span and line width parameters. It is important to follow the calibration procedure carefully and specify to the instrument the exact pressure and temperature of the calibration cell.

The pressure (P) and temperature (T) values can be set permanently using the service program.

However, the 4 to 20 mA inputs can also be used if these sensors are connected to the calibration cell.

One can also use the readings of the internal sensors if these are close to the values for the calibration cell. It is also important to use dry gas mixed with nitrogen. For O₂, dry air can be used.

Use GLOBAL calibration:

- If spectral properties of the laser seem to have drifted. This can be evaluated by qualified service personnel from readings files recorded with the device when it was measuring on a calibration gas.
- After major device services such as replacement of laser module, main board or receiver board. (Qualified service personnel only!)
- After adjustment of laser parameters (laser temperature, modulation amplitude or phase, or other laser currents). (Qualified service personnel only!)

DO NOT use GLOBAL calibration when:

- The device is measuring on the process (with process gas).
- The concentration of the calibration is low or the path length of calibration cell is short such that the signal-to-noise ratio is not good.
- If the above mentioned GLOBAL calibration conditions are not fulfilled, but a recalibration is required, use PROPORTIONAL calibration instead.

Validation

The AO2000-LS25 analyzer may be fitted with different options to carry out span and zero checks for validation on the process.

The following options are available:

- Span check for non-corrosive gases (e.g. O₂, NO, CO, CO₂) with internal flow through cell inside receiver unit.
- Span check for corrosive gases (e.g. HCl, NH₃, H₂S) with additional span flow through cell mounted between receiver unit and process
- Span and zero check with internal sealed span cell.

Contact your local distributor for more information about these options.

Span check with flow through cell

Span checks to validate analyzer performance may be carried out with the instrument installed on the process.

For non-corrosive gases the internal 100 mm volume between receiver window and receiver lens is used to this end.

For corrosive gases a dedicated span cell (accessory available from ABB) mounted between receiver unit and process applies.

The span gas is measured in parallel with the process gas; therefore it is important that during normal operation this internal or span cell is empty for span gas.

The span mode is initiated by input through digital communication, see **Mode** on page 50.

The instrument calculates and stores the absorption signal for the gas concentration measured in normal mode just before the span check.

The absorption signal is continuously subtracted from the measured signal during span check operation. The resulting signal, therefore, corresponds to the signal from the internal cell (or span cell) providing that the signal from the process remains stable.

The ambient temperature and pressure recorded with the internal temperature and pressure sensors located inside the receiver unit is used to calculate the concentration of the span gas.

... 13 Maintenance

... Validation

The default concentration relates to a optical path length of 1 m. This means that for an span gas concentration of e.g. 1 %, the span is 0.1 vol.%.

(The span can be scaled to a different optical path length. Contact ABB for details.)

Span check procedure:

1. Initiate span check through one of the channels described above. The device is forced to span check operation. After few seconds the message "SPAN" appears on the transmitter LCD. The measured concentration should come to zero, which indicates that the process absorption signal is properly subtracted.
2. Start flushing the internal cell with the span gas. Use moderate flow rates (approximately 1 to 2 l/min) to avoid pressure build-up in the cell.
3. Measure span concentration.
4. Remove any residual span gas from the flow through span cell by flushing it with Nitrogen or air.
5. Set the device back to normal.

Span and zero check with internal sealed span cell

Note that this option also includes zero check functionality.

Span and zero checks may be carried out with the device installed on the process. The receiver unit includes a small sealed gas cell containing the gas to be measured. This cell is moved into the laser optical path by a compact servomotor.

The span and zero mode is initiated by input through digital communication, see **Mode** on page 50.

The instrument calculates and stores the absorption signal for the gas concentration measured in normal mode just before the span check.

This absorption signal is continuously subtracted from the measured signal during span check operation.

The resulting signal, therefore, corresponds to the signal from the internal cell providing that the signal from the process remains stable during span procedure (typically 15 seconds). The ambient temperature and pressure recorded with the internal temperature and pressure sensors located inside the receiver unit is used to calculate the concentration of the span gas.

By default the internal span cell is calibrated to give a 75 to 80 % of full-scale reading.

(Alternative calibration is possible, contact ABB or your local distributor.)

14 Recycling and disposal

Note



Products that are marked with the adjacent symbol may **not** be disposed of as unsorted municipal waste (domestic waste).

They should be disposed of through separate collection of electric and electronic devices.

This product and its packaging are manufactured from materials that can be recycled by specialist recycling companies.

Bear the following points in mind when disposing of them:

- As of 8/15/2018, this product will be under the open scope of the WEEE Directive 2012/19/EU and relevant national laws (for example, ElektroG - Electrical Equipment Act - in Germany).
- The product must be supplied to a specialist recycling company. Do not use municipal waste collection points. These may be used for privately used products only in accordance with WEEE Directive 2012/19/EU.
- If there is no possibility to dispose of the old equipment properly, our Service can take care of its pick-up and disposal for a fee.

15 Specification

Note

The device data sheet is available in the ABB download area at www.abb.com/analytical.

16 Additional documents

Note

All documentation, declarations of conformity and certificates are available in ABB's download area.

www.abb.com/analytical

| Title | Doc. ID |
|--|-----------|
| Advance Optima AO2000 Series Continuous Gas Analyzers – Data Sheet | DS/AO2000 |
| Advance Optima AO2000 Series Continuous Gas Analyzers – Operating Instruction | OI/AO2000 |
| Advance Optima Function Blocks; Descriptions and Configuration – Technical Information | 30/24-200 |
| AO-HMI Remote Control Interface – Technical Information | 30/24-311 |
| AO2000 Series PROFIBUS DP/PA Interface – Technical Information | 30/24-315 |
| AO2000 Modbus and AO-MDDE – Technical Information | 30/24-316 |

Table 29: Additional documentation

Trademarks

Windows is a registered trademark of Microsoft Corporation.

17 Appendix

Return form

Statement on the contamination of devices and components

Repair and/or maintenance work will only be performed on devices and components if a statement form has been completed and submitted.

Otherwise, the device/component returned may be rejected. This statement form may only be completed and signed by authorized specialist personnel employed by the operator.

Customer details:

Company: _____

Address: _____

Contact person: _____

Telephone: _____

Fax: _____

Email: _____

Device details:

Type: _____

Serial no.: _____

Reason for the return/description of the defect: _____

Was this device used in conjunction with substances which pose a threat or risk to health?

Yes No

If yes, which type of contamination (please place an X next to the applicable items):

biological

corrosive / irritating

combustible (highly / extremely combustible)

toxic

explosive

other toxic substances

radioactive

Which substances have come into contact with the device?

1. _____

2. _____

3. _____

We hereby state that the devices/components shipped have been cleaned and are free from any dangerous or poisonous substances.

Town/city, date

Signature and company stamp

Notes

ABB Measurement & Analytics

For your local ABB contact, visit:
www.abb.com/contacts

For more product information, visit:
www.abb.com/analytical

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