Embracing Challenge

In-situ Laser Analyzer ILA1-X000-EX

ILA1-A000-EX, ILA1-B000-EX

Instruction Manual
Version 1.00.00
Software version starting at 1.0

Dear customer,

Thank you for buying our product. In this instruction manual you will find all necessary information about this M&C product. The information in the instruction manual is fast and easy to find, so you can start using your M&C product right after you have read the manual.

If you have any questions regarding the product or the application, please don't hesitate to contact M&C or your M&C authorized distributor. You will find all the addresses in the appendix of this manual.

For additional information about our products and our company, please go to M&C's website http://www.mc-techgroup.com. There you will find the data sheets and manuals of our products in German and English.

With the release of this version all older manual versions will no longer be valid. The German instruction manual is the original instruction manual. In case of arbitration only the German wording shall be valid and binding.

Version: 1.00.00
Software version starting at 1.0

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1 General Information

The product described in this manual has been built and tested in our production facility.

All M&C products are packed to be shipped safely. To ensure the safe operation and to maintain the safe condition, all instructions and regulations stated in this manual need to be followed. This manual includes all information regarding proper transportation, storage, installation, operation and maintenance of this product by qualified personnel.

Follow all instructions and warnings closely.

Read this manual carefully before commissioning and operating the device. If you have any questions regarding the product or the application, please don't hesitate to contact M&C TechGroup Germany GmbH or your M&C authorized distributor.

2 Declaration of Conformity

CE - Certification

The product described in this operating manual complies with the following EU directives:

ATEX-Directive

The ATEX version of the product described in this manual is produced in accordance with the EU directive for devices and protection systems for appropriate use in hazardous areas 2014/34/EU appendix II.

EMC-Instruction

The requirements of the EU directive 2014/30/EU "Electromagnetic compatibility" are met.

RoHS Directive

The requirements of the RoHS2 ('Restriction of Hazardous Substances 2') Directive 2011/65/EU and its annexes are met.

Declaration of Conformity

The EU Declaration of conformity can be directly requested from **M&C**.

3 Warranty

In case of a device failure, please contact immediately M&C or your M&C authorized distributor.

We have a warranty period of 12 months from the delivery date. The warranty covers only appropriately used products and does not cover the consumable parts. Please find the complete warranty conditions in our terms and conditions.

The warranty includes a free-of-charge repair in our production facility or the free replacement of the device. If you return a device to M&C, please be sure that it is properly packaged and shipped with protective packaging. The repaired or replaced device will be shipped free of delivery charges to the point of use.

4 Important Safety Information

4.1 Warning Signs and Definitions

Danger

The 'Danger' warning sign indicates that death, serious injury and/or significant material damage will be the consequence, if the appropriate precautions should not be taken.

Warning

The 'Warning' warning sign indicates that death, serious injury or damage to property may occur if the relevant precautionary measures are not observed.

Caution

The 'Caution' warning sign indicates that slight personal injury can occur if the appropriate safety precautions are not observed.

Caution

'Caution' indicates that damage to property can occur if the appropriate safety precautions are not observed.

Attention

'Attention' indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

Note

'Note' indicates important information relating to the product or highlights parts of the documentation for special attention.

Qualified personnel

'Qualified personnel' are experts who are familiar with the installation, commissioning, maintenance and operation of these types of products. The following knowledge is at least required for the work:

- Instruction in EX-protection
- Training in the electrotechnical field
- Detailed knowledge of the manual and the applicable safety regulations

'Ex' indicates important information about the product or about the corresponding parts in the instruction manual, relating to usage in potentially explosive atmospheres.

Hot surface!

Contact may cause burn! Do not touch!

High voltages!

Protect yourself and others against damage which might be caused by high voltages.

Toxic!
Acute toxicity (oral, dermal, inhalation)! Toxic when in contact with skin, swallowed or inhaled.

Corrosive!
These substances destroy living tissue and equipment upon contact.
Do not breathe vapors; avoid contact with skin and eyes.

Contains gas under pressure. Do not open container!
Check pressure before opening container and adjust pressure to atmospheric pressure.

Caution laser beam!
Avoid eye or skin contact with the laser beam.
Only work on the laser analyzer and the clamps after the laser has been switched off.

Wear protective gloves!
Working with chemicals, sharp objects or extremely high temperatures requires wearing protective gloves.

Wear safety glasses!
Protect your eyes while working with chemicals or sharp objects. Wear safety glasses to avoid getting something in your eyes.

Wear protective clothes!
Working with chemicals, sharp objects or extremely high temperatures requires wearing protective clothes.

4.2 Correct Operation

Follow these safety precautions during installation, commissioning and operation of the device:

- Read this instruction manual before commissioning and operating the product. Make sure to follow all warnings and safety instructions.
- Installation and commissioning of electrical devices must be carried out only by qualified skilled personnel in compliance with the current regulations. All electrical connection work must only be carried out by suitably qualified electricians (IEC 60079-14).
- Attention should be paid to all relevant national and international regulations and standards regarding the usage of the device in potentially explosive atmospheres.
- Before connecting the device, please make sure to compare the supply voltage with the specified voltage on the product label.
- Operate the device only in the permitted temperature and pressure ranges. For details please refer to the technical data sheet or instruction manual.
- Install the device only in protected areas, sheltered from sun, rain and moisture. Avoid additional heat sources beside the connection flange.
- If an operation involves sample gases, which are toxic and hazardous to the health, protective measures need to be taken against any accidental leakage, e.g. unexpected damage of the wedged window, the related tubing or tube connections.
- The clearance and creepage distances acc. to IEC 60079-7, table 1, must be maintained for the customer´s connection to the terminals in the Ex e terminal box. For the nominal 24 V DC (< 32 V DC), a min. creep distance of 1.8 mm must be observed when connecting the individual wires to the terminal blocks.
- Only perform maintenance on the laser analyzer when it is de-energized.
- Opening the enclosure of an Ex-version In-situ Laser Analyzer and HMI is only permitted in an Ex-free environment.

Note

If you are unsure about the handling and commissioning of the system, contact M&C or the M&C representative for further information or assistance.

4.3 Wrong Operation

Make sure to install and operate the analyzer for the intended use described in this instruction manual only.

Incorrect installation and operation of the enclosures may result in the warranty becoming invalid.

Enclosures must not be damaged.

The device must be installed and used in such a way that electrostatic charges caused by operation, maintenance or cleaning are not occurring.

Warning

The materials of the laser analyzer, which are in contact with the process gas, need to be suitable for the application.

In order to operate the analyzer, it needs to be securely installed.

Do not install, maintain or dismantle the instrument with connected power cord.

Always wear personal protective equipment (PPE) in accordance with the risk assessment.

During the operation, the ambient temperature must not exceed the values stated in the specification.

In potentially explosive areas (zones) use only the In-situ Laser Analyzers, which are in the corresponding equipment category, explosive group and temperature class. The Ex markings are clearly stated on the product label.

Do not use the In-situ Laser Analyzer without Ex markings in potentially explosive atmospheres.

4.4 Safety Instructions for Using the Analyzer in Potentially Explosive Atmospheres

The Ex version of the In-situ Laser Analyzer is approved for installation in hazardous areas ATEX zones 1 and 21. The explosion protection marking of the ILA1-X000-EX is as follows:

$T_{ambient}$ -40 °C to +59 °C
EX II (1)2 G Ex db eb [op is Ga] IIC T6 Gb
EX II (1)2 D Ex tb [op is Da] IIIC T85 °C Db

$T_{ambient}$ -40 °C to +65 °C
EX II (1)2 G Ex db eb [op is Ga] IIC T5 Gb
EX II (1)2 D Ex tb [op is Da] IIIC T92 °C Db

The type examination certificate of the device is issued by IBExU Institut für Sicherheitstechnik GmbH, an affiliate institute of the TU Bergakademie Freiberg. You will find a copy of the type examination certificate IBExU24ATEX1007 X, IECEx IBE 24.0007X available in the corresponding editions, in the appendix of this instruction manual.

Qualified personnel

The In-situ Laser Analyzer may only be installed by qualified personnel. Qualified personnel must have at least the following knowledge:

- Instruction in EX-protection
- Training in the electrotechnical field
- Detailed knowledge of the operating instructions and the applicable safety regulations.

Do not install, maintain or repair the In-situ Laser Analyzer while explosive atmosphere is present.

Do not open the terminal box and the HMI in hazardous areas.

Warning

Do not open the aluminum enclosure of the laser head in a hazardous area. The capacitors are discharged after 4 s but there is a battery powering the RTC, which is loaded for several years!

An easily accessible main switch with appropriate labeling must be provided externally.

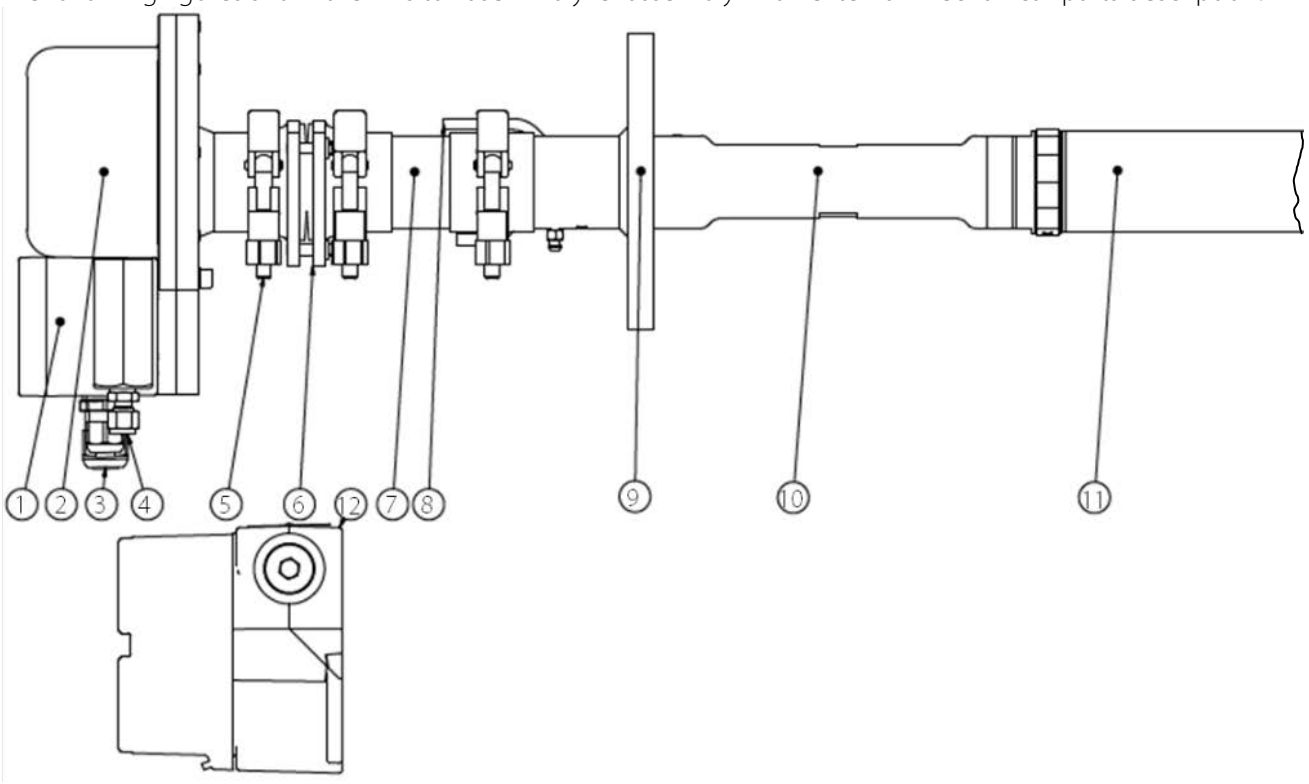
If the standard configuration is changed by using components or parts not specified and not authorized by M&C, the type examination certificate will no longer be valid. Repair and services with parts not specified by M&C will also lead to the cancellation of the EX certificate.

Note

If you have any questions or doubts about parts, components or repair and services, please don't hesitate to contact M&C or one of our official distributors.

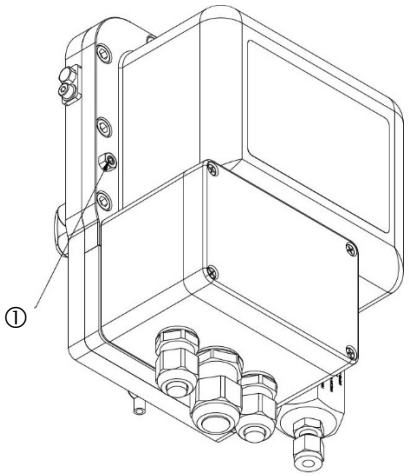
5 Product Overview

The following figures show the In-situ Laser Analyzer assembly with external mechanical parts description.



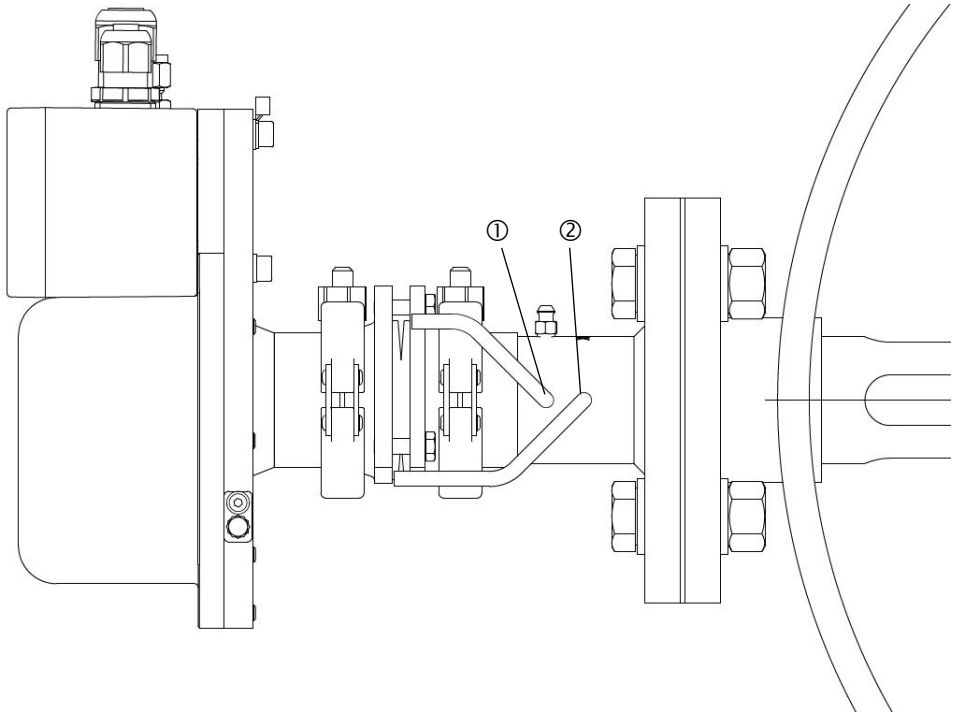
① Terminal box
② TDL laser head
③ Cable glands
④ Gas connector
⑤ Clamps
⑥ Alignment unit for laser head alignment
⑦ Insulation unit (optionally for hot processes)
⑧ Purge gas connection for the probe
⑨ Process flange
⑩ Probe extension to place the probe into the requested position (optionally)
⑪ Probe with assembled filter element (filter element optionally)
⑫ ILA HMI DCU10 EX for ILA1-X000-EX (optionally)

Figure 1 ILA1-X000-EX In-situ Laser Analyzer instrument assembly



① Threaded pin used for easier removal the device cover. For M&C maintenance purposes only.

Figure 2 Threaded pin used for maintenance purposes by M&C



① Purge gas connection for the probe (shown without Swagelok® connector)

② Purge gas connection for the buffer zone (shown without Swagelok® connector)

Figure 3 Purge connections for probe and buffer zone

5.1 Description

The In-situ Laser Analyzer ILA1-X000-EX is a high-performance analyzer for industrial and potential compliance applications.

The design of the In-situ Laser Analyzer ILA1-X000-EX consists of a laser head, a probe (includes a measuring section and probe flange) and a separate HMI unit (optionally). The transmitter and receiver are located in the laser head, the beam reflector is placed inside the tip of the probe in the measuring section.

The laser inside the laser head emits a laser beam which passes through the process gas. The beam reflector at the end of the measuring section reflects the beam back to the receiver inside the laser head. An integrated system for continuous N_2- and instrument-air-purge (instrument air not for ILA1-A000-EX) prevents dust and other contamination from coating the reflector and window. Either the external HMI (optionally) or a web interface can be used to operate, configure and perform diagnostics on the ILA1-X000-EX. Example applications are real-time measurements for combustion control, safety monitoring and process control. Industries that can benefit from this measurement technology include chemical and petrochemical plants, power plants, waste incinerators and the steel industry.

The ILA1-X000-EX is particularly suitable for controlling combustion processes, process optimization and control, ensuring facility and workplace safety, explosion protection, quality control and measurement in corrosive and toxic gases.

The outstanding properties are:

- Interference-free in-situ measurement technology
- 12-months inspection interval is recommended
- Highly flexible interface for process connections
- Various measuring path lengths available for different applications
- Wide range of materials for wetted parts (temperature and different medias)
- Simple installation with one process flange
- No pre-alignment of the flanges required
- Ex version approved for hazardous areas ATEX Zone 1

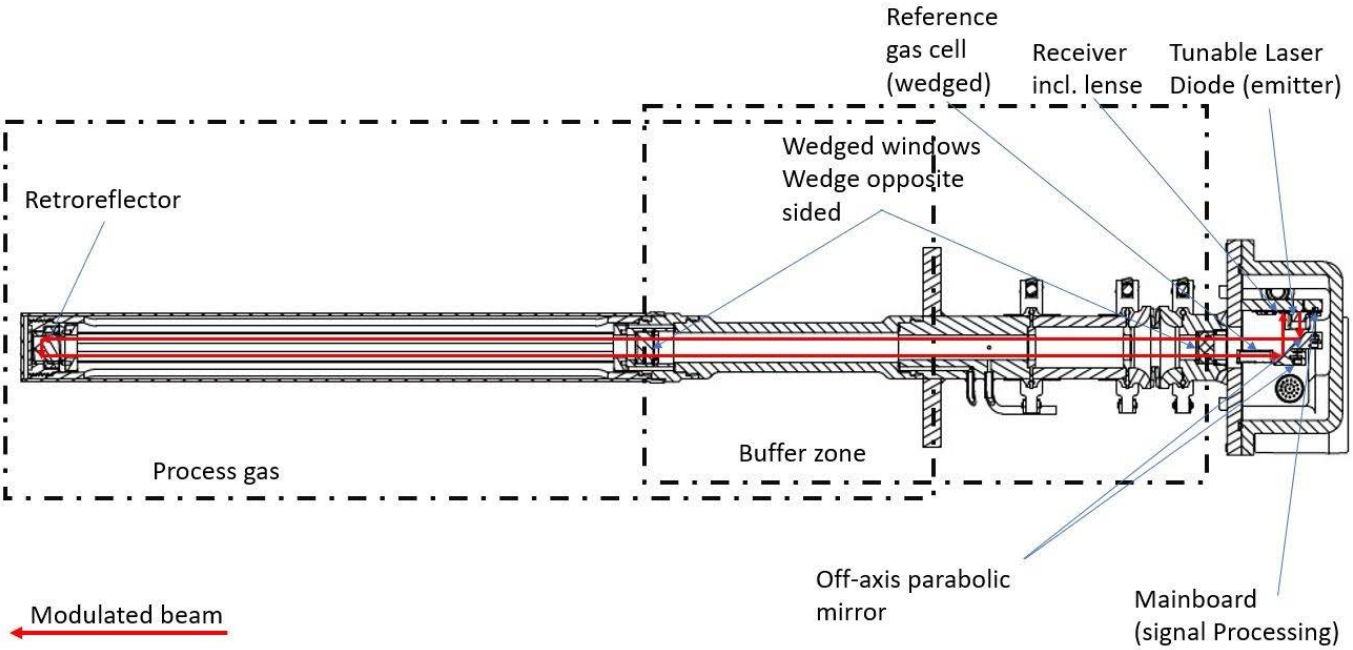


Figure 4 Typical setup of the ILA1-X000-EX In-situ Laser Analyzer

5.2 Operating Principle

The In-situ Laser Analyzer uses a principle called Tunable Diode Laser Absorption Spectroscopy (TDLAS) to analyze the molecular concentration of a specific gas. The principle is based on the light absorption of gas molecules. Specific gas molecules absorb certain colors in a narrow frequency range, this narrow frequency range is called an absorption spectrum line. A selected semiconductor laser source is tuned to continuously scan the absorption spectrum line of the gas molecule to be measured.
The amount of laser light which is absorbed by the specific gas can be used to determine the concentration of this gas. The following figure shows the laser line scanning an absorption line of a gas molecule.

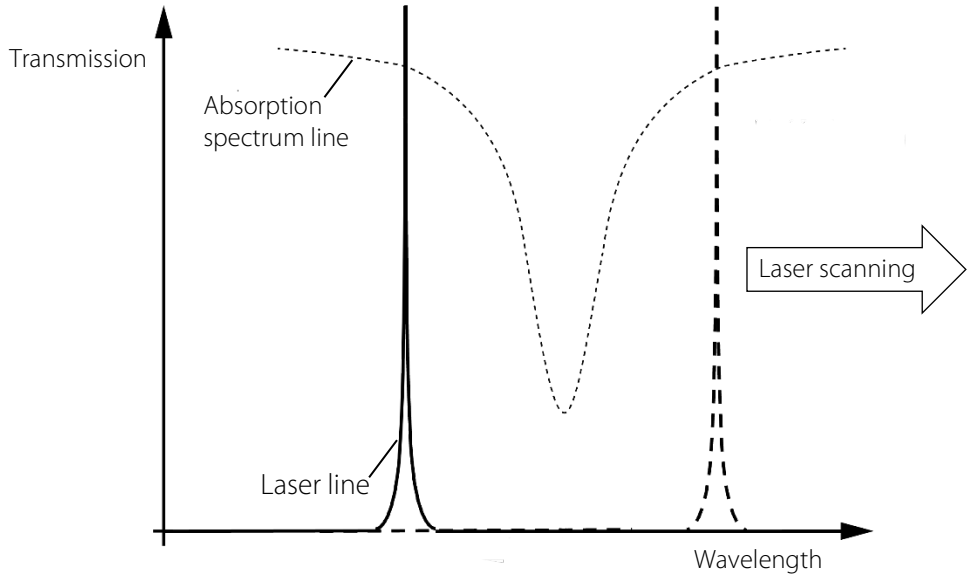


Figure 5 Wavelength scanning process

5.3 Measurement Influences

The measurement might be influenced by temperature, pressure, a high amount of dust load or other gases present.

The influences of temperature, pressure, dust load and other gases are normally compensated by the analyzer. However, typical constraints at the pressure sensor are:

Influence of the sample gas pressure: ±0.4 % of range
e.g. max process gas pressure: 5 bar(a)

- 10 mbar are equal to a deviation of 0.25 % at the TDL
- => Min. quality: ±16 mbar at 5 bar(a)
  ⇒ ±0.32 % at a 5 bar (a) sensor;

Usually the tolerance is given by a percentage of full scale; in case pressure gradation is e.g. 10 bar(a), it will halve the allowable tolerance of the pressure sensor
⇒ ±0.16 % at a 10 bar (a) sensor

5.3.1 Flow Conditions at the Measuring Point

When selecting the measuring point for the ILA1-X000-EX, we recommend that a straight section with a length of at least 5 times tube diameter before the measuring point and at least 3 times tube diameter behind it. This is how laminar flow conditions can appear that are a prerequisite for stable measurement conditions.

5.3.2 Purging

The flow rate during purging affects the effective length of the optical path and therefore the measured value. It is recommended to start with a high flow rate of purge gas and decrease it gradually, especially when there is a lot of humidity in the process gas, to avoid condensation on the wedged windows. The reading is initially very small and increases with decreasing purge gas flow. At a certain point it will level off and remain constant for a while until it starts to increase again. Choose a purge gas flow rate in the middle of this constant area. This effect is more pronounced with short probes than with long probes.

Attention

If the process gas flow remains constant, a good purge gas flow is yielded. However, the effective length of the optical path always remains a function of the process gas flow and must therefore always be taken into account.

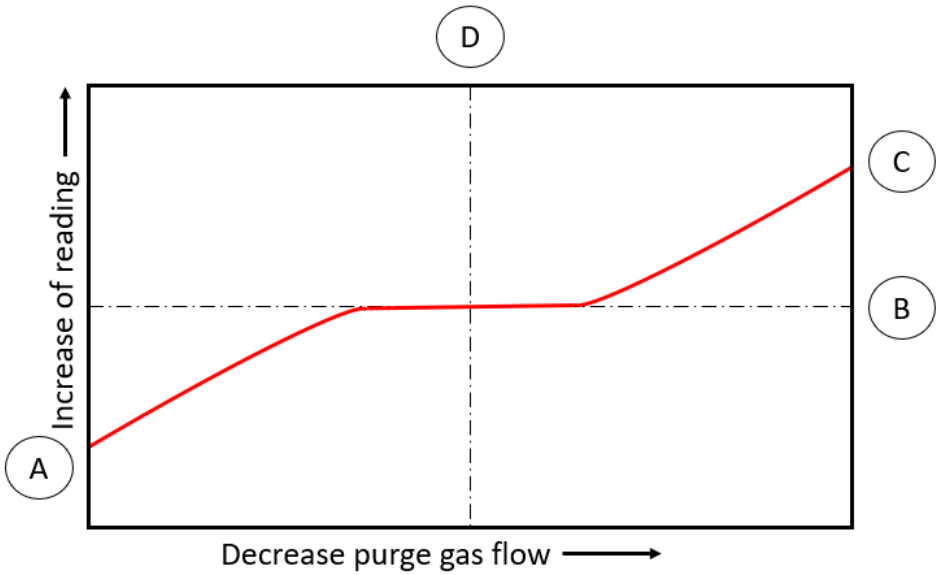


Figure 6 Adjusting purge gas flow

On the x-axis the purge gas flow is shown and on the y-axis the reading of the device for the concentration.

(A) Concentration reading at high purge gas flow. The length of the path here is shorter than the effective length of the optical path because the purge gas lines are completely filled with purge gas and the purge gas flows into the measuring path.

(B) Measured value for the concentration with optimized purge gas flow. The length of the path here is equal to the length of the effective optical path because the purge gas lines are completely filled with purge gas.

(C) Concentration reading with no purge gas flow. The length of the path is the same here as the length of the optical path because the sensor is completely filled with process gas.

(D) Adjustment of optimized purge gas flow.

6 Technical Data

6.1 Interfaces

Interfaces of the ILA1-X000-EX	
Analog outputs	2 x 4-20 mA, active (for concentration and transmission)
Analog inputs	2 x 4-20 mA (for pressure and temperature), active or passive
Relay output	Error status 60 V AC/60 V DC, max. 500 mA, NO (normally open)
Relay input	Maintenance status min. 6 V DC, max. 60 V DC, NO (normally open)
Digital interfaces	CAN (connection to HMI), RS485, Modbus TCP/IP
Customer interface	Ethernet (RJ-45) and RS485 WebServer based software for real-time logging of the gas concentration and optical transmission

Caution

Swapping active and passive analog outputs
The function of the In-situ Laser Analyzer is impaired when these analog output types are swapped. Check the different power requirements for active and passive analog outputs: For details see chapters 10.3.1 and 10.3.2.

6.2 Dimensions and Weights (Example Probes)

Note

For information about the immersion length of the probe see dimension "PL" in Table 4 Typical minimum diameters for the probe.

In-situ Laser Analyzer ILA1-X000-EX	20 cm path length	40 cm path length	80 cm path length
Laser head and probe (probe flange and measuring section): dimensions (W x H x L)	185 x 238.6 x 460 mm [≈ 7.3" x 9.4" x 18"]	185 x 238.6 x 560 mm [≈ 7.3" x 9.4" x 22"]	185 x 238.6 x 760 mm [≈ 7.3" x 9.4" x 30"]
Laser head and probe (probe flange and measuring section): weight	Approx. 14.9 kg [≈ 32.8 lbs]	Approx. 10.6 kg [≈ 23.4 lbs]	Approx. 16 kg [≈ 35.3 lbs]
Laser head	Material: Aluminum, weight: 5.4 kg, dimensions (W x H): 185 x 139 mm, length: see dimension "A" in Table 3 Typical lengths of dimension A (In-situ Laser-Analyzer head)		
Probe flange: material	Stainless steel 316		
Probe flange: dimensions	ANSI-flanges: 2" Class 150, 2.5" or 3" Class 150 or higher, DN 80 PN 40, DN 65 PN 6		

6.3 Material Selection

The materials used for the ILA1-X000-EX depend on the application. You can choose between different thermal packages and different materials for the process flange, probe extension (optional) and measuring tube.

A thermal package consists of an insulation unit and a set of gaskets. The insulation unit is used to insulate the laser head from the process flange at high temperatures. The following table shows the max. temperatures for the different thermal packages.

Code	Material: insulation unit	Material: gasket	Max. process gas temperature
N	-	Gylon® Style 3522	65 °C
D	Durobest DB250R	Gylon® Style 3522	250 °C
Z	ZrO_2	ThermA-Pur® Style 4122	900 °C*

*Temperature due to heat conduction to the laser head

GYLON® is a registered trademark for a high-performance PTFE material by Garlock Sealing Technologies LLC, USA.
THERMa-PUR® Style 4122 is a registered trademark for non-metallic gaskets for use in extreme temperature applications by Garlock Sealing Technologies LLC, USA.

The material of the process flange, the probe extension (optional) and the measuring tube depends on the max. temperature of the application and the corrosion resistance needed. You can choose from the following materials:

Code	Material: process flange, probe extension (optional) and measuring tube	Max. process gas temperature	Corrosion resistance
-S	Stainless steel 316Ti (standard)	500 °C	Corrosion-resistant
-R	Stainless steel F51	250 °C	Increased corrosion resistance
-V	Stainless steel 904L	400 °C	Increased corrosion resistance
-T	Stainless steel 321H (temperature range increased)	600 °C	Reduced corrosion resistance
-H	Nickel-based alloy, e.g. Hastelloy® (high temperature)	900 °C	High corrosion resistance

Hastelloy® is a registered trademark for a nickel-chromium-molybdenum alloy by Haynes International, USA.

Note

For information regarding the codes see chapter 7.2 Type designation.

6.4 Technical Data of the Overall System

Technical data for ILA1-A000-EX	
Gas measured	O_2
Measuring range	0 to 100 %
Detection limit* (depending on optical path length)	ILA1-A000-EX-PXX20: 500 ppm ILA1-A000-EX-PXX40: 250 ppm ILA1-A000-EX-PXX60: 170 ppm ILA1-A000-EX-PXX80: 125 ppm
Max. process gas temperature	Depends on the selected thermal package and process flange, probe extension (optional) and measuring section material, see chapter 6.3. The max. process gas temperature is determined by the component with the lowest temperature approval.
Max. process gas pressure	7 bar abs.
Length of optical path (optical path = 2 x measuring section)	Measuring sections with 200 [≈ 7.9"], 400 [≈ 15.7"], 600 [≈ 23.6"] and 800 mm [≈ 31.5"] optical path length available
Repeatability deviation	ILA1-A000-EX-PXX20: ±1 % of measured value or ±500 ppm O_2, whichever is higher ILA1-A000-EX-PXX40: ±1 % of measured value or ±250 ppm O_2, whichever is higher ILA1-A000-EX-PXX60: ±1 % of measured value or ±170 ppm O_2, whichever is higher ILA1-A000-EX-PXX80: ±1 % of measured value or ±125 ppm O_2, whichever is higher
Linearity error	< 1 %
Drift	< 2 % measuring range every 12 months
Measuring repetition rate	1 second
Purging of windows	Nitrogen
Recommended purging gas flow	0 - 10 Nl/min, depending on the application
Purging gas flow for housing	Only slight overpressure of 20 mbar is needed; flow approx. 5 ml/min
Wetted material	Depends on the selected process flange, probe extension (optional) and measuring section material
Process windows	UVFS (UV Fused Silica), leak tested and certified in accordance to EN1779:1999 norm
Retroreflector	UVFS (UV Fused Silica)
Power supply	24 V DC ±10 % 6 W, fused with max. 20 A (short-circuit current)
Power consumption	< 6 VA
Process gas speed	1 m/s, recommended: over 5 m/s
EMC immunity	In accordance with EN 61326-1
Warm-up time	It takes approximately 3 minutes for the system to be fully operational
Housing screws	Metric stainless steel bolts class A4-70
Alignment unit	To align measuring section and laser head, weight: 1 kg [≈ 2.2 lbs]

* The limit of detection (LOD) was measured under constant ambient conditions in the compensated temperature and pressure range (±0.015 %/mbar) and with a measurement time of 10 seconds and a moving average of 10 points. Additionally, the limit of detection is depending on sample gas and the selected measuring range.

Technical data for ILA1-B000-EX	
Gas measured	SO_2
Measuring range (depending on optical path length)	ILA1-B000-EX-PXX20: 0 to 2 % ILA1-B000-EX-PXX40: 0 to 1 % ILA1-B000-EX-PXX60: 0 to 0.7 % ILA1-B000-EX-PXX80: 0 to 0.5 %
Detection limit* (depending on optical path length)	ILA1-B000-EX-PXX20: 100 ppm ILA1-B000-EX-PXX40: 50 ppm ILA1-B000-EX-PXX60: 33 ppm ILA1-B000-EX-PXX80: 25 ppm
Max. process gas pressure	7 bar abs.
Max. process gas temperature	Depends on the selected thermal package and process flange, probe extension (optional) and measuring tube material, see chapter 6.3. The max. process gas temperature is determined by the component with the lowest temperature approval.
Length of optical path (optical path = 2 x measuring section)	Measuring sections with 200 [≈ 7.9"], 400 [≈ 15.7"], 600 [≈ 23.6"] and 800 mm [≈ 31.5"] optical path length available
Repeatability deviation	ILA1-B000-EX-PXX20: ±1 % of measured value or ±100 ppm SO_2, whichever is higher ILA1-B000-EX-PXX40: ±1 % of measured value or ±50 ppm SO_2, whichever is higher ILA1-B000-EX-PXX60: ±1 % of measured value or ±33 ppm SO_2, whichever is higher ILA1-B000-EX-PXX80: ±1 % of measured value or ±25 ppm SO_2, whichever is higher
Linearity error	< 1 %
Drift	< 2 % measuring range every 12 months
Measuring repetition rate	1 second
Purging of windows	Nitrogen or instrument air
Recommended purging gas flow	0 - 10 l/min, depending on the application
Purging gas flow for housing	Only slight overpressure of 20 mbar is needed; flow approx. 5ml/min
Wetted material	Depends on the selected process flange, probe extension (optional) and measuring section material
Process windows	Sapphire, leak tested and certified in accordance to EN1779:1999 standard
Retroreflector	Crystalline material similar to Sapphire
Power supply	24 V DC ±10 % 6 W, fused with max. 20 A (short-circuit current)
Power consumption	< 6 VA
Process gas speed	1 m/s, recommended: over 5 m/s
EMC immunity	In accordance with EN 61326-1
Warm-up time	It takes approximately 3 minutes for the system to be fully operational
Housing screws	Metric stainless steel bolt class A4-70
Alignment unit	To align measuring section and laser head, weight: 1 kg [≈ 2.2 lbs]

* The limit of detection (LOD) was measured under constant ambient conditions in the compensated temperature and pressure range (±0.015 %/mbar) and with a measurement time of 10 seconds and a moving average of 10 points. Additionally, the limit of detection is depending on sample gas and the selected measuring range.

6.5 Laser Safety

Laser information for ILA1-X000-EX	
Laser class for laser head with mounted probe	Class 1 according to IEC 60825-1, eye safe
 **Warning**	Danger due to laser radiation! Laser class of the laser head without probe: **O_2 laser:** Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam **SO_2 laser:** Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments. Switch off the power supply before any assembly, maintenance or disassembly.

6.6 Ex Safety

ATEX certificate for ILA1-X000-EX	
ATEX Directive 2014/34/EU	$T_{ambient}$ -40 °C to +59 °C EX II (1)2 G Ex db eb [op is Ga] IIC T6 Gb EX II (1)2 D Ex tb [op is Da] IIIC T85 °C Db $T_{ambient}$ -40 °C to +65 °C EX II (1)2 G Ex db eb [op is Ga] IIC T5 Gb EX II (1)2 D Ex tb [op is Da] IIIC T92 °C Db
Cable glands on Ex e terminal box	**2 x M16** brand: Pflitsch, type: bg216msHTex, clamping range: 7-11 mm, torque: 8 N m **1 x M20** brand: Pflitsch, type: bg220msHTex, clamping range: 9-14 mm, torque: 10 N m
EU Directives	IEC 60079-0:2017 Ed. 7 IEC 60079-1:2014 Ed. 7 IEC 60079-7:2015/A1:2017 Ed. 5.1 IEC 60079-14:2014 Ed. 6 IEC 60079-28:2015 Ed. 2 IEC 60079-31:Ed. 3 EN 60079-0:2018/AC:2020 EN 60079-1:2014/AC:2018 EN 60079-7:2015/AC:2017 EN 60079-14:2014/AC:2016 EN 60079-28:2015 EN 60079-31:2014

6.7 Ambient Conditions

Ambient conditions for ILA1-X000-EX	
Ambient pressure	700 to 1200 hPa

Ambient conditions for ILA1-X000-EX	
Ambient humidity	RH < 99 %, non-condensing
Ambient temperature	-40 to +59 °C [-40 to +138.2 °F] for T6 -40 to +65 °C [-40 to +149 °F] for T5
Storage temperature	-40 to +70 °C [-40 to +158 °F]
Degree of protection	In accordance with IP65

6.8 Options

Options for ILA1-X000-EX:	
ILA HMI DCU10 EX	HMI to operate, configure or perform diagnostics on the ILA1-A000-EX In-situ Laser Analyzer. ▪ LCD display: 128 x 64 pixel ▪ Analog outputs: 4 x 4-20 mA, programmable, active ▪ Analog inputs: 2 x 4-20 mA, programmable, active/passive ▪ Relay outputs: 2 x relay outputs programmable: 60 V AC/60 V DC, max. 120 mA, NO (normally open) ▪ Relay inputs: 2 x relay inputs programmable: min. 16 V DC, max. 60 V DC, NO (normally open) ▪ Digital interfaces: CAN (connection to laser head)
SU EL10	Supply unit with 24 V DC including: 2 x cable glands (5-14 mm) for connecting laser head and HMI, 5 x cable glands (4-11 mm) for power supply, analog signals and status signals; interfaces: RJ45 for Modbus TCP/IP; operating elements: mains switch and maintenance switch; protection class: IP65
SU EP10	Supply unit incl. 24 V DC power supply unit with 50 W for supply voltage 100-240 V AC including: 2 x cable glands (5-14 mm) for connecting laser head and HMI, 5 x cable glands (4-11 mm) for power supply, analog signals and status signals; interfaces: RJ45 for Modbus TCP/IP; operating elements: mains switch and maintenance switch; protection class: IP65
SU EP10 EX	EX supply unit incl. 24 V DC power supply unit with 50 W for supply voltage 100-240 V AC including: 2 x cable glands (5-14 mm) for connecting laser head and HMI, 5 x cable glands (4-11 mm) for power supply, analog signals and status signals; interfaces: RJ45 for Modbus TCP/IP; operating elements: mains switch and maintenance switch; protection class: IP65
SU G10	Supply unit for purge gas including: 1 x purge gas IN (pressure: 3-8 bar) for nitrogen (N_2), 1 x gas path with flow meter to purge measuring section (gas flow: 0-13 Nl/min), 1 x gas path with pressure regulator (0-0.7 bar) for pressurized laser head enclosure (0.1 bar above ambient pressure), 1 x gas path with pressure regulator (0-6.8 bar) for pressurized buffer zone enclosure (1 bar above process pressure); protection class: IP65

Options for ILA1-X000-EX:	
SU G10 EX	EX supply unit for purge gas including: 1 x purge gas IN for nitrogen (pressure: 3-8 bar), 1 x gas path with flow meter to purge measuring section (gas flow: 0-13 Nl/min), 1 x gas path with pressure regulator (0-0.7 bar) for pressurized laser head enclosure (0.1 bar above ambient pressure), 1 x gas path with pressure regulator (0-6.8 bar) for pressurized buffer zone enclosure (1 bar above process pressure); protection class: IP65
ILA cable, 10 m, 10 x 2 x 0.25 mm	Pre-assembled ILA cable 10 x 2 x 0.25 mm, length: 10 m, for connecting laser head and electrical supply unit
ILA HMI, cable, 10 m, 12 x 2 x 0.25 mm	Pre-assembled ILA cable, 12 x 2 x 0.25 mm, length: 10 m, for connecting HMI and electrical supply unit
EX ILA power supply	ILA power supply TR TSPC050-124 24VDC EX
ILA cellular VPN router RO1520-4L	The cellular router enables remote access to the ILA laser analyzer. A SIM card for operating the router must be provided by the customer.
PS KE10-80R EX	EX piezoresistive pressure transmitter, 0-10 bar abs., pressure connection: G 1/2", complete temp. range: -10 to +80 °C [-40 to 1112 °F]
PS KE10-80R	Piezoresistive pressure transmitter, 0-10 bar abs., pressure connection: G 1/2", complete temp. range: -10 to +80 °C [-40 to 1112 °F]
TS JU600-400A EX	EX screw-in resistance thermometer with end-to-end protection tube, -40 to +600 °C, connect.: G 1/2" threaded
TS JU600-400A	Screw-in resistance thermometer with end-to-end protection tube, -40 to +600 °C, connection: G 1/2" threaded
Probe extension	Various lengths up to 500 mm available
In-situ filter	Filter to protect the measuring section against high dust concentrations

6.9 Technical Drawings

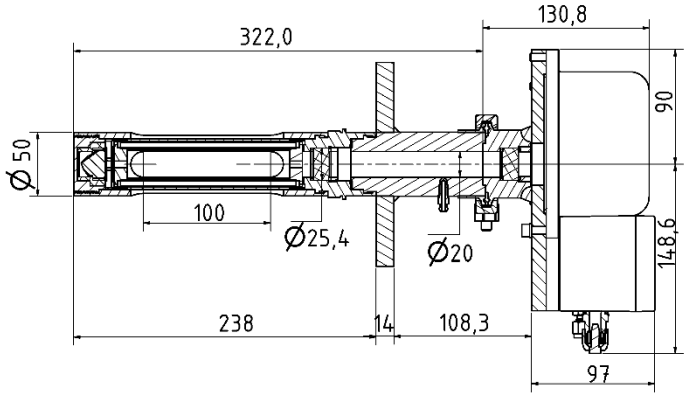


Figure 7 Technical drawing ILA1-B000-EX-PXX20

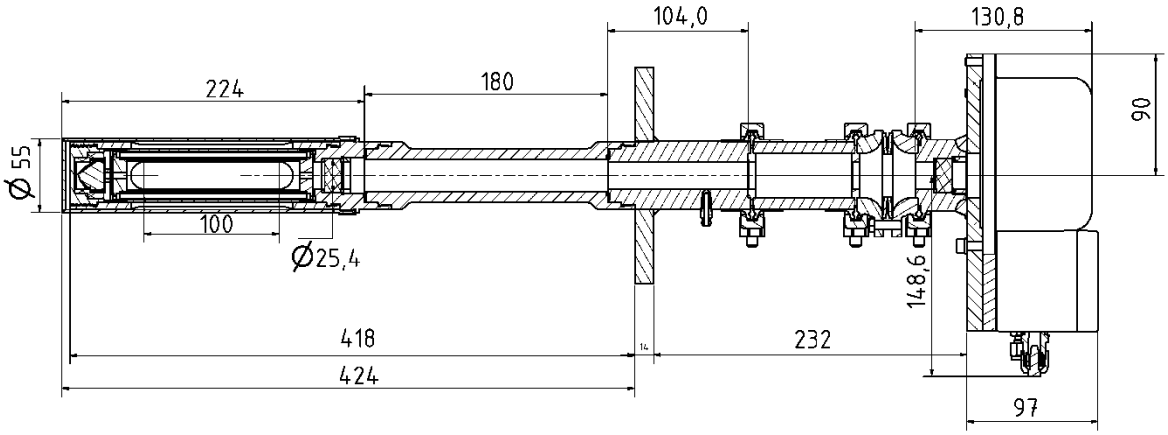


Figure 8 Technical drawing ILA1-B000-EX-PXX20 with alignment and insulation unit, filter and extension

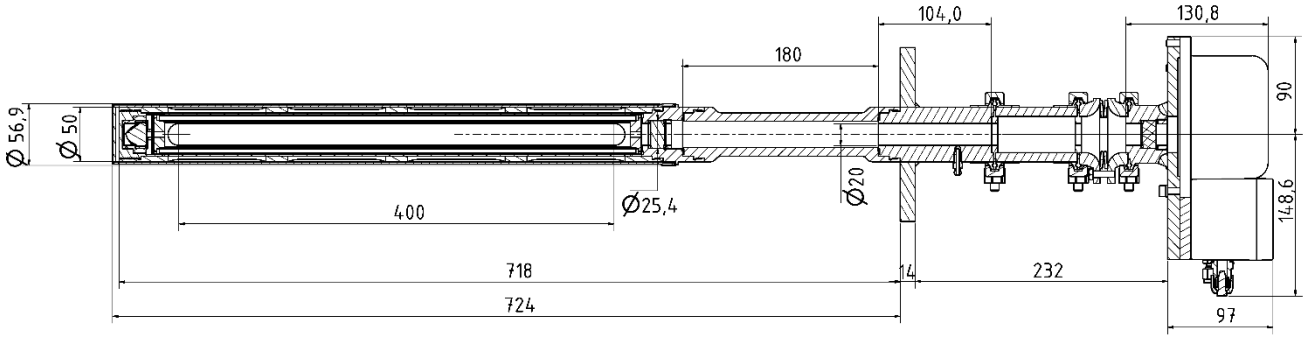


Figure 9 Technical drawing ILA1-A000-EX-PXX80 with alignment and insulation unit, filter and extension

All dimensions are in mm

7 Receiving the In-situ Laser Analyzer

Please remove the In-situ Laser Analyzer carefully from the packaging. Check the scope of the delivery specified on the delivery note. Please make sure that you have received all items stated on the delivery note.

Please check the unit for any transport damage after receipt and report any complaints to the transport company immediately.

Caution Condensation impairs laser function!
Condensate on the surfaces of the In-situ Laser Analyzer might affect commissioning of the device. Allow the analyzer to stand for a few hours in the same environmental conditions in which it will be installed.

7.1 Scope of Delivery

The scope of delivery contains the following items:

- Laser head with probe in optical path length 20/40/60/80 cm (completely assembled, according to order):
    - Probe extension (optionally)

  - Alignment unit for alignment correction (if this is part of the application and order)
  - Insulation unit (optionally)
  - Graphite gasket (1 x) for mounting flange
- External HMI (optionally)
- Pressure and temperature sensors (optionally)
- Unheated calibration cap (optionally)
- Instruction manual

7.2 Type Designation

Due to the different requirements of the process, there are different versions of the In-situ Laser Analyzer (ILA). The respective versions can be seen in the following table.

ILA1	-X	000	-XX	-P	XX	XX	-XXX	-X	X	Type designation
										Gas measured
	-A									O_2
	-B									SO_2
										Approvals
			-EX							EX approval
										Probe extension
					00					No extension
					20					20 cm
					45					45 cm
										Path length
						20				20 cm
						40				40 cm
						60				60 cm
						80				80 cm
										Flange version
							-A01			2" Class 150
							-A02			2.5" Class 150
							-A03			2.5" Class 300
							-A04			3" Class 150
							-A05			3.5" Class 150
							-D01			DN 65 PN 6
							-D02			DN 80 PN 40
										Material
								-S		1.4571 (**s**tandard)
								-R		1.4462 (corrosion **r**esistant)
								-V		1.4539 (**v**ery corrosion resistant)
								-T		1.4878 (**t**emperature range increased)
								-H		Nickel-based alloy, e.g. Hastelloy® (**h**igh temperature)
										Temperatur package
									N	Gylon gaskets, **N**o insulation unit
									D	Gylon gaskets, **D**urobest insulation unit
									Z	ThermA-Pur gaskets, **Z**rO2 insulation unit

Table 1 Type designation

7.3 Product Label, Serial Number and Laser Label

On the TDL laser head there is a nameplate used for device identification. A nameplate overview is shown below.

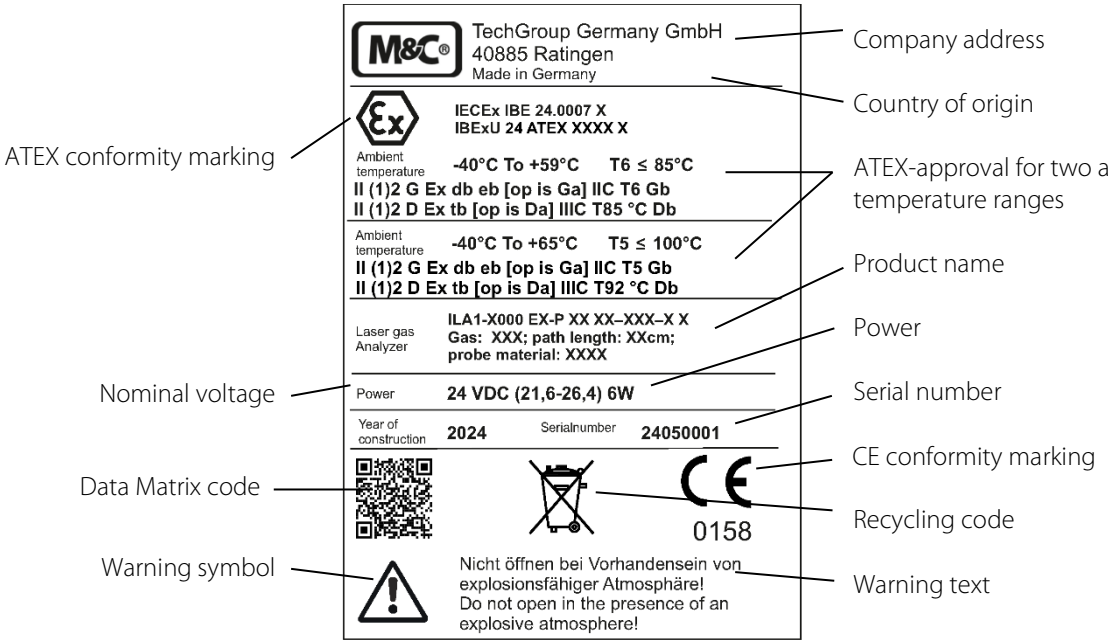


Figure 10 Product label for ATEX version

The serial number of the laser has the following structure:

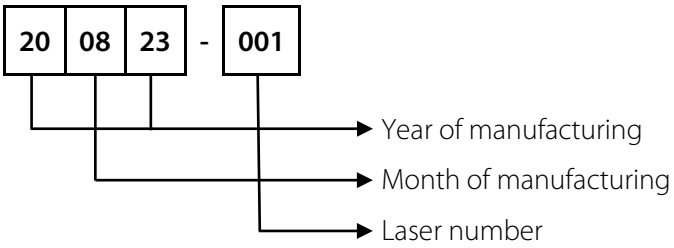


Figure 11 Serial number structure of the In-situ Laser Analyzer

The following laser label is placed on the In-situ Laser Analyzer:

Figure 12 Laser label

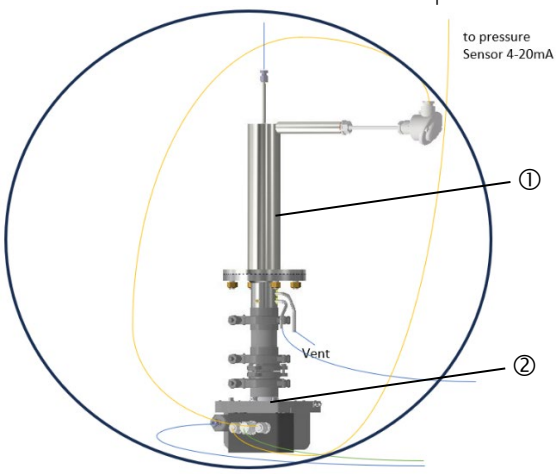
Danger due to laser radiation!
Laser class of the laser head without probe:
O_2 laser: Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam
SO_2 laser: Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments.
Switch off the power supply before any assembly, maintenance or disassembly.

7.4 About the Calibration of the In-situ Laser Analyzer

The In-situ Laser Analyzer is calibrated at the factory with certified gas mixtures. A reference gas cell inside the In-situ Laser Analyzer makes sure that the calibration status of the analyzer stays in working condition. However, we recommend a one-year calibration period by M&C or any certified service company.

7.5 Unheated Calibration Cap

A calibration cap is used for checking and adjusting the in-situ laser measuring device at regular intervals. There are different versions of calibration caps, heated and unheated ones. The heated ones are only used, when there is a risk of condensation at lower temperatures. In all other cases, an unheated calibration cap is used.



① Unheated calibration cap
② In-situ Laser Analyzer

Figure 13 Calibration setup with unheated calibration cap

The temperature sensor of the process (zone separation with sleeve) is also screwed into this calibration cap in order to minimize compensation errors caused by temperature deviations during the measurement.

Since the adjustment is made under atmospheric pressure, atmospheric pressure is also compensated for during the adjustment.

7.5.1 Pressure Sensor

The influences of temperature, pressure, dust load and other gases are normally compensated by the HMI. However, typical constraints at the pressure sensor are:

Influence of the sample gas pressure: ±0.4 % of range

e.g. max process gas pressure: 5 bar(a) but pressure under normal conditions 1 bar(a)

- 10 mbar are equal to a deviation of 0.25 % at the TDL at 1 bar (a)
- => Min. quality: ± 16 mbar at 5 bar (a)

  ⇒ ±0.32 % at a 5 bar (a) sensor;

Usually, the tolerance is given by a percentage of full scale; in case pressure gradation is e.g. 10 bar (a), it will halve the allowable tolerance of the pressure sensor

⇒ ±0.16 % at a 10 bar(a) sensor

The deviation in the concentration measurement of the gas in terms of imprecision of the pressure sensor is smaller at higher pressures (e.g. 6 bar (a)) but the imprecision due to a wider specification is limiting the measurement.

- 10 mbar are equal to a deviation of 0.11 % at the TDL

7.5.2 Performance of a Typical Pressure Sensor

The following table shows the performance of a typical pressure sensor used for this kind of application.

Pressure sensor performance		
Digital non linearity	≤ ±0.02 % FS	Best fitted straight line (BFSL)
Accuracy @ RT (20 to 25 °C)	≤ ±0.05 % FS	Nonlinearity (best fitted straight line BFSL), pressure hysteresis, non-repeatability, zero point deviation and amplification deviation
Total Error Band (-10 to 80 °C)	≤ ±0.1 % FS	Max. deviation within the compensated pressure and temperature range. Experience shows that, outside the compensated temperature range, the total error band in the ambient temperature range is expanded by 0.1 %FS
Compensated temperature ranges	-10 to 80 °C	Optional other compensated temperature ranges within -40 to 125 °C are possible
Analog interface additional deviation	≤ ±0.05 % FS	With reference to accuracy @ RT and the total error band
Long-term stability	≤ ±0.1 % FS	Per year under reference conditions, yearly recalibration recommended
Position dependency	≤ ±2 mbar	Calibrated in vertical installation position with pressure connection facing downwards
Resolution	0.0005 % FS	Digital
Signal stability	0.0025 % FS	Digital noise-free
Internal measurement rate	≥ 1800 Hz	For version «3-wire + digital (0 to 10 V, 0 to 5 V)» > 6000 Hz
Pressure range reserve	±10 %	Outside the pressure range reserve, +Inf / -Inf is displayed If there is an error in the device, NaN is displayed
Vacuum resistance	For operating pressures ≤ 0.1 bar abs., a vacuum-optimized version is recommended	
Note	For pressure ranges < 1 bar, all data apply with reference to a full-range signal (FS) of 1 bar	

Table 2 Data of Keller 35X-series

Typical constraints at the temperature sensor are:

Influence of the sample gas temperature:

T (°C)	Intensity	Slope (U.A)	Slope [%/°C]		Temperature	25
15	2.42E-03	-4,00E-06	-0.17 %		Class A	**0,2**
20	2.40E-03		**Precision [°C]**		Class B	0.425
25	2.38E-03		**0.2**		Class C	0.85
30	2.36E-03		**Precision [%]**			
35	2.34E-03		**-0.03%**			

T (°C)	Intensity	Slope (U.A)	Slope [%/°C]		Temperature	300
290	1.76E-03	-1.40E-06	-0.08 %		Class A	0.75
295	1.75E-03		**Precision [°C]**		Class B	**1.8**
300	1.74E-03		**1.8**		Class C	3.6
305	1.74E-03		**Precision [%]**			
310	1.73E-03		**-0.14 %**			

T (°C)	Intensity	Slope (U.A)	Slope [%/°C]		Temperature	600
580	1.39E-03	-1.00E-06	-0.07 %		Class A	1.35
590	1.38E-03		**Precision [°C]**		Class B	3.3
600	1.37E-03		**3.3**		Class C	**6.6**
610	1.36E-03		**Precision [%]**			
620	1.35E-03		**-0.24 %**			

7.5.3 Performance of a Typical Temperature Sensor

The following table shows the performance of a typical temperature sensor used for this kind of application.

Data sheet	**902820**
Basic type	Screw-in resistance thermometer for process technology with continuous protective tube
Operating temperature in °C	-50 to +600 °C (thin film temperature sensor)
Measuring insert	1x Pt100 in 4-wire circuit
Tolerance class according to DIN EN 60751:2009 / IEC 60751:2008	B
Protection tube diameter D in mm	9.00 mm
Insert length	400.00 mm
Process connection	G 1/2
Protection tube material	Stainless steel 316Ti (material. no. 1.4571)
Extra codes laser head	Connection head Ex d IIC and Ex tb IIIC made of die-cast aluminum (only in connection with extra code 362)
Extra codes transducer	1x transducer (Ex) programmable, output 4 to 20 mA/20 to 4 mA, data sheet 707010
Measuring range transducer	-40 to +600 °C
Transducer output	4 to 20 mA
Type suffix explosion protection	Explosion protection according to 2014/34/EU (ATEX)
Extra code 292	Separating element according to IEC 60079
EX approval	ATEX approval according to SEV 15 ATEX 0118
IECEx-approval	EX-approval according to IECEx SEV 15.0006
ATEX pressure/gas	II 1/2 G Ex d IIC T6...T1 Ga/Gb
Ex marking for pressure/gas	Ex d IIC T6...T1 Ga/Gb
ATEX pressure/dust	II_1/2_D_Ex_tb_IIIC_T80-400
IECEx marking pressure/dust	Ex tb IIIC T80...400°C Da/Db

The following table shows the typical technical specifications of a transducer for a temperature sensor for this kind of application.

Data sheet	**707010**
Measuring input	Measuring range limits
Pt100 DIN EN 60751	-200 to +850 °C
Measuring range -100 to +200°C	Accuracy* of the transmitter: ±0.2 K
Measuring range -200 to +850°C	Accuracy* of the transmitter: ±0.4 K
Connection type	2-wire-, 3-wire- or 4-wire-connection
Minimum measuring range	10 K

Data sheet	707010
Sensor cable resistance - with 3-wire- and 4-wire-connection - with 2-wire-connection	 ≤ 11 Ω per line Measuring resistor + ≤ 22 Ω internal line resistance
Sensor current	< 0.6 mA
Measuring rate	> 1 measurement per second

*The accuracy refers to the maximum measuring range.

8 Installation

8.1 Safety Information

The infrared laser inside the In-situ Laser Analyzer is classified as a Class 1 laser according to IEC 60825-1:2014. A Class 1 laser is safe under all conditions during normal use.
The following laser label is placed on the In-situ Laser Analyzer:

Danger due to laser radiation!
Laser class of the laser head without probe:
O_2 laser: Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam
SO_2 laser: Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments.
Switch off the power supply before any assembly, maintenance or disassembly.

Toxic gas is present!
Probably dead or serious injury will occur if inhaled or come into contact with.
Use gas detector to detect toxic gases. Wear appropriate personal protective equipment (PPE) in accordance with the risk assessment.

Hot metal parts!
Probably death or severe burns could occur if you come in contact with heated metal parts.
Wear appropriate personal protective equipment (PPE) in accordance with the risk assessment. If possible, shield the hot part with appropriate insulation material.

Warning

High pressure present during mounting!
Probably death or serious injury could occur if you mount the In-situ Laser Analyzer to a flange leading to a high-pressure process.
Define a safety factor for mounting the In-situ Laser Analyzer. The window of the process interface is burst-tested up to 4 MPa (40 bar).
The specified range of the operating pressure deviates from this and is described in the data sheet.

Warning

Contact with live parts!
Probably death or serious injury could occur if you come in contact with live parts during installation or de-installation of the In-situ Laser Analyzer.
Make sure that the power supply is disconnected during installation and de-installation.
The housing may only be opened after a waiting period of 4 seconds after the power supply has been disconnected.

8.2 Information about ATEX Installation

Qualified personnel

The In-situ Laser Analyzer may only be installed by qualified personnel. Qualified personnel must have at least the following knowledge:

- Instruction in EX-protection
- Training in the electrotechnical field
- Detailed knowledge of the operating instructions and the applicable safety regulations.

Do not install, maintain, or repair the In-situ Laser Analyzer while explosive atmosphere is present.

Do not open the terminal box and the HMI in hazardous areas.

Warning

Do not open the aluminum enclosure of the sensor-head in a hazardous area. The capacitors are discharged after 4 s but there is a battery powering the RTC, which is loaded for several years!

An easily accessible main switch with appropriate labeling must be provided externally.

If the standard configuration is changed by using components or parts not specified and not authorized by M&C, the type examination certificate will no longer be valid. Repair and services with parts not specified by M&C will also lead to the cancellation of the ATEX certificate.

Caution

Installation in a zone not according to the ATEX certificate:
The ATEX certificate is not valid if the In-situ Laser Analyzer is installed in a zone not stated in the ATEX certificate.
Follow the information in the ATEX certificate closely.

Electrostatic discharges can act as an ignition spark in hazardous areas. Do not use the device in areas where:

- mechanical friction and separation processes occur,
- spraying of electrons takes place (e.g. in the vicinity of electrostatic painting systems), or
- pneumatically conveyed dusts are present.

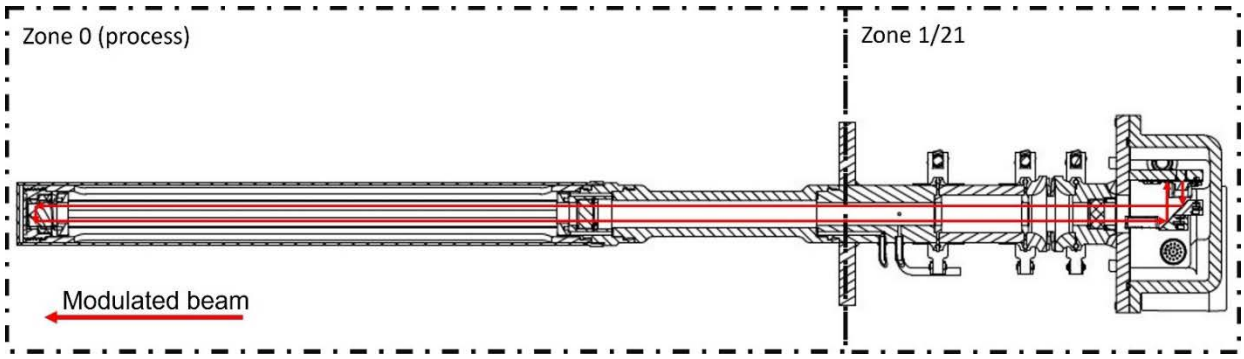


Figure 14 In-situ Laser Analyzer installation in Ex zones

8.3 Flameproof joints at the Ex d enclosure, clearance and creepage distances at the Ex e terminal box

The flameproof joints of the flameproof Ex d enclosure must not be reworked or repaired.

The clearance and creepage distances acc. to IEC 60079-7, table 1, must be maintained for all connections to the terminals inside the Ex e terminal box.
For the nominal 24 V DC (< 32 V DC), a min. creep distance of 1.8 mm must be observed when connecting the individual wires to the terminal blocks.

In order to maintain the ignition protection type, the wire connection must be carried out with extreme care. The insulation of the wires must reach as far as the terminal. The wire itself must not be damaged. Pay attention to the minimum and maximum connectable wire cross-sections.

8.4 Ambient Temperature Requirements for Commissioning

The ILA1-X000-EX may only be operated in the ambient temperature range stated in the technical data. If there is the possibility of exceeding the permitted ambient conditions, for example due to direct sun light, the unit needs to be shielded from the source of heating. Contact M&C or the M&C representative for further information or assistance.

Caution

Heating due to direct sun light is not permitted!
Do not exceed the ambient temperature stated in the technical data.
If you are unsure about the handling and commissioning of the system, contact M&C or the M&C representative for further information or assistance.

Condensation impairs laser function!
Condensate on the surfaces of the In-situ Laser Analyzer might affect the operation of the device. Allow the analyzer to stand for a few hours in the same environmental conditions in which it will be installed and commissioned.

8.5 Selecting the Measuring Point

For selecting the measuring point for the ILA1-X000-EX, we recommend a straight section of the tube in which the process gas flows. As a rule of thumb, the straight section needs to be at least 5 times of the process tubes diameter before the measuring point and at least 3 times of the process tubes diameter behind the measuring point. Selecting this straight section of the process tube results in nearly steady flow conditions, which are important for stable measurements.

8.6 Process Flange Installation by Customer

Caution

The limitation of the maximum ambient temperature is also important for the process flange.
The usage of an insulating flange drastically reduces heat conduction from the process to the connection point of the laser head.

Note

There is only one process flange needed for mounting the laser analyzer. The process flange needs to be installed by the customer.

The process flange needs to be installed at the appropriate measuring point by the customer. The dimensions for the standard process flange are:

- DN 65/PN 6 with the minimum inner diameter of 60 mm

The process flange should protrude as little as possible in order to measure as centrally as possible in the process. Ideally, the process flange should protrude less than 60 mm. If the process flange protrudes further, an extension piece inserted into the probe will be needed. See the following figure for details.

To be able to remove the probe, dimension "B" needs to be a little longer than A+PL.

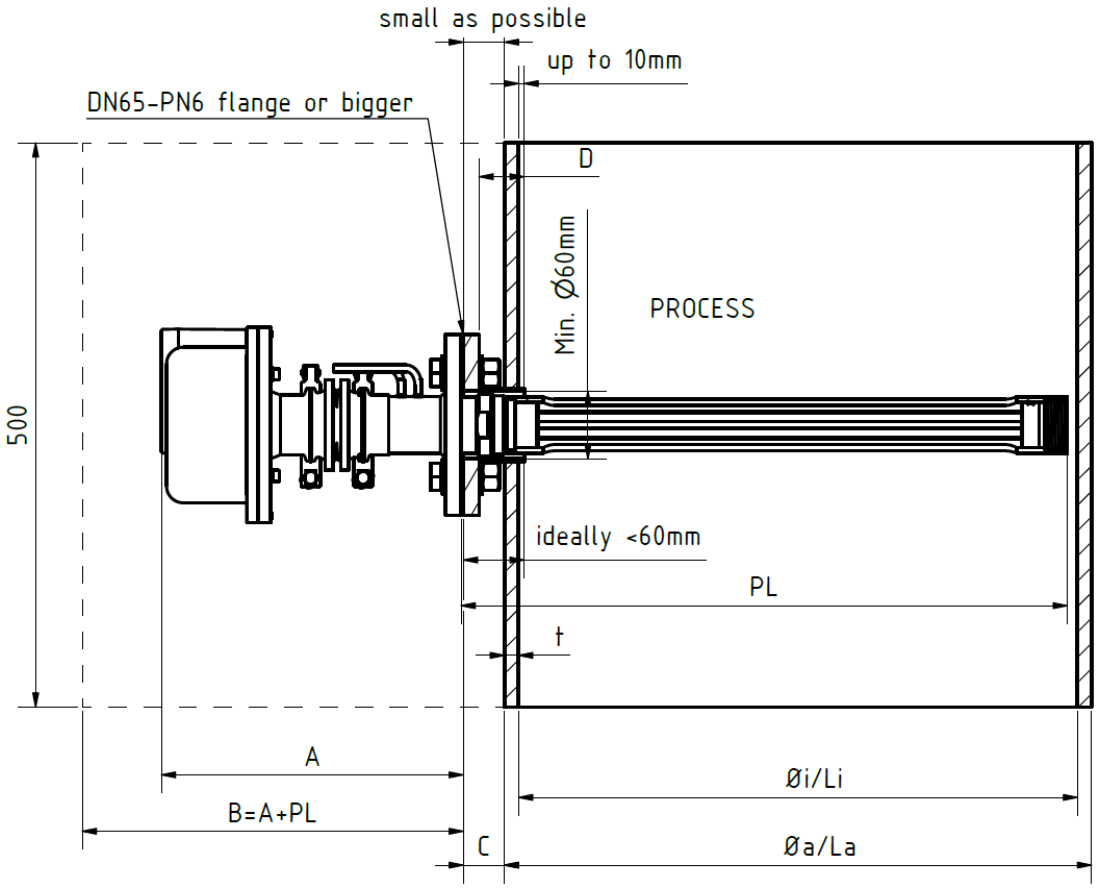


Figure 15 Schematic drawing of the standard process flange installation

Insulation unit for up to 280 °C	Insulation unit for up to 900 °C	Alignment unit	Dimension A, approx. [mm]
-	-	-	222
-	-	x	268
x	-	x	345
-	x	x	370

Alignment unit is needed for long probes (e.g. 400 mm); Insulation unit is needed for high temperature

Table 3 Typical lengths of dimension A (In-situ Laser-Analyzer head)

Probe type [cm]	Filter	Body extension	D [mm]	Øi [mm] or Li [mm]	Standard tube Ø a x t for reference [mm x mm]	Probe length PL [approx. mm]
40	-	-	40	496	521 x 12.5	538
40	x	-	40	517.6	546 x 14.2	544
40	x	x	200	534	559 x 12.5	724
10	-	-	30	201.8	216 x 7.1	238
10	x	-	30	214.8	229 x 7.1	244
10	x	x	190	231.3	245 x 7.1	424

A filter is needed for dusty process gas. Body extension is used to measure in a more centered manner in case of large tube diameters.

Table 4 Typical minimum diameters for the probe

8.7 Information on Optical Path Length

The optical path length is determined by the length of the slotted hole inside the probe. The gas to be measured flows through this opening and crosses the path of the laser beam. The length of the slotted hole is factory-set. The optical path length is two times the length of the slotted hole since the laser beam is passing the slotted hole twice.

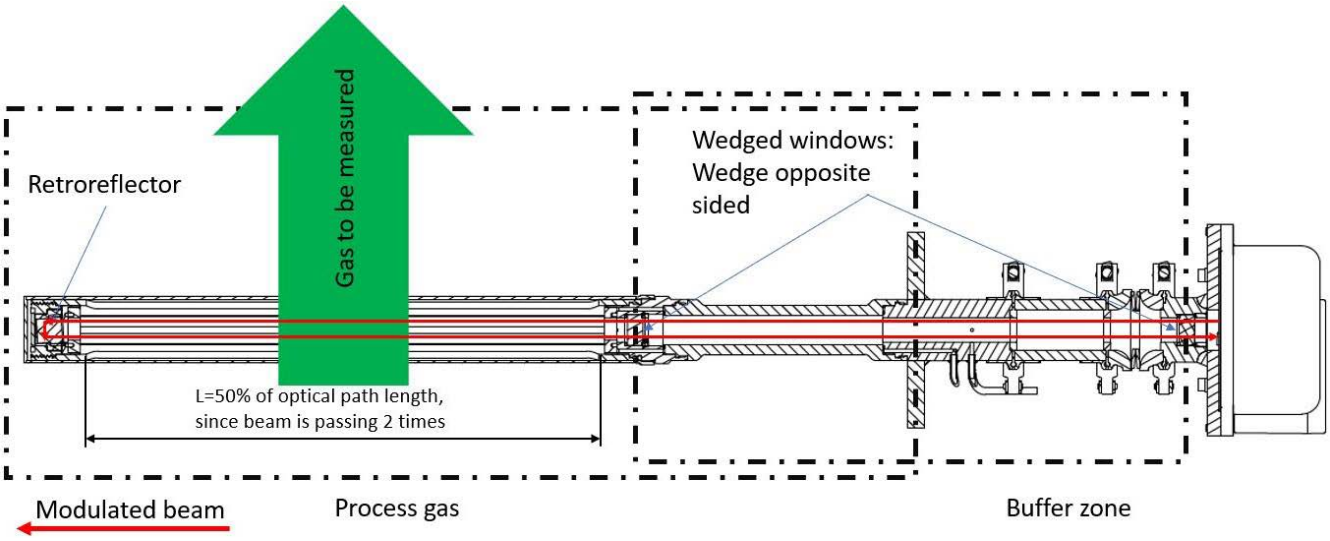


Figure 16 Schematic drawing of the optical path length

8.8 Mounting of the In-situ Laser Analyzer

The In-situ Laser Analyzer is usually pre-assembled. During installation it might be necessary to open a safety clamp to add an alignment or insulation unit. To maximize the laser transmission, it might be also necessary to open one of the clamps.

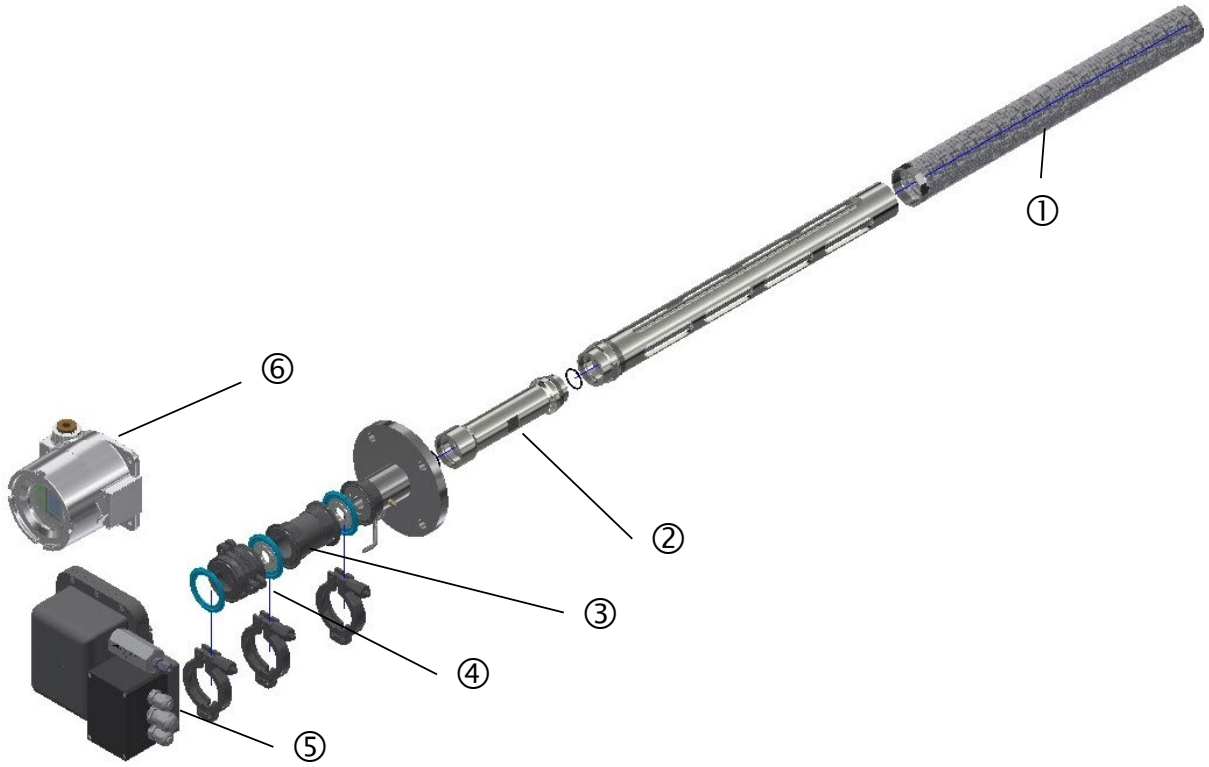
Note

Make sure that the flanges and gaskets are clean prior to installation. If necessary, clean surfaces with a dry cloth.

Use gaskets with center rings on the sealing surfaces of the alignment and insulation unit.

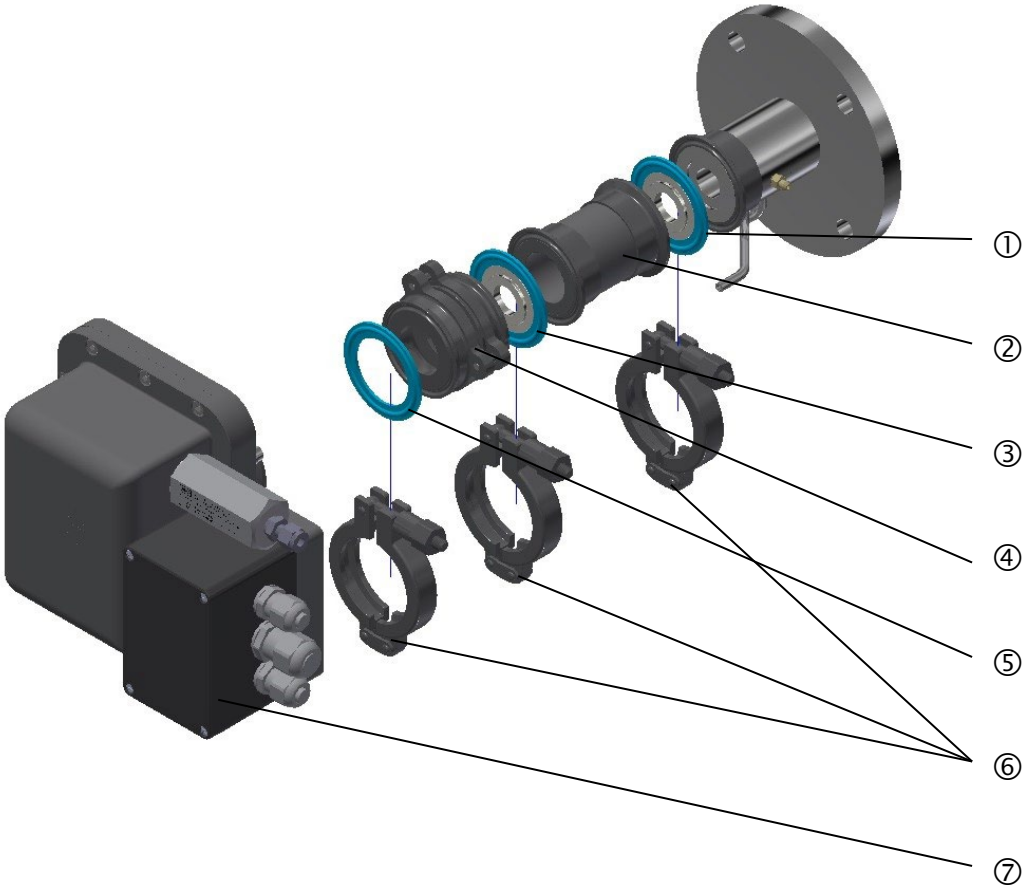
Use only a gasket on the sealing surface of the mounting flange of the laser head. There is no center ring needed since the laser head is already equipped with a center ring.

The clamps used to secure the flanges are safety clamps. The clamps do not drop down, when opened slightly.



① Dust filter (optionally)
② Extension (optionally)
③ Insulation unit (optionally)
④ Alignment unit
⑤ Laser head including terminal box
⑥ HMI (optionally)

Figure 17 Exploded view of the complete laser analyzer



① Gasket and center ring for insulation unit; for temp. above 280 °C, this gasket is in graphite or mica

② Insulation unit; for temp. above 280 °C, the HT-version is used (metallized ZrO_2)

③ Gasket and center ring for alignment unit

④ Alignment unit, used for long probes

⑤ Mounting flange gasket (no center ring)

⑥ Stainless steel safety clamps

⑦ Laser head including terminal box

Figure 18 Exploded view of the front part outside of the process

Follow these steps to install the unit:

1. If not pre-assembled, start assembling the front part outside of the process. Follow the detailed drawing in Figure 18. Tighten the clamps with a (torque of

Note

Hold the laser head horizontally, while tightening the clamp.

In a later step, this clamp can be opened slightly to rotate the laser head. Rotating the laser head is necessary to align the laser and to obtain maximum transmission.

2. Attach the process flange gasket to the process flange of the In-situ Laser Analyzer.
3. Mount the flange of the In-situ Laser Analyzer onto the process flange using the supplied bolts and nuts.
4. The system is now prepared for connecting the purging tubes.

9 Connecting the Purging Tubes

The ATEX version of the laser head is equipped with a breathing and draining device to fulfill the ATEX requirements.

Caution

Use nitrogen or instrument air for SO_2 measurements. For O_2 measurements, use nitrogen only.

Use only high-quality purging gas. Contamination may damage the In-situ Laser Analyzer.

Note

If you are using compressed air for purging the ILA1-B000-EX, make sure to use only dry, dust and oil-free compressed air.

The In-situ Laser Analyzer has three different kinds of purging: laser head, buffer zone and window purging.

9.1 Laser head Purging

The connections for the laser head purging are directly at the laser head housing. This type of purging is to free the laser head from any gas, which might interfere with the measurement.

Note

For connecting the purge in- and outlets, use tubing with an outer diameter of 6 mm. Connect the tubing with a support sleeve to prevent the tubing from being crushed.
Purging gas flow for the laser head: only slight overpressure of 100 mbar needed; flow approx. 5 ml/min

You will need the following tools:

- A 3 mm hex screwdriver to close the locking screw with a torque of 1.4 N m.
- A torque wrench size 8 mm to close the bleed screw with a torque of 7 N m.

Follow these steps to purge the laser head:

1. Set the pressure of the laser head while laser head bleed screw is still locked. Only slight overpressure of 100 mbar is needed.
2. Use the 3-mm hex screwdriver to unscrew the locking screw. Remove the locking screw and the locking plate holding the laser head bleed screw. Set locking screw and holding plate aside.
3. Slightly open the laser head bleed screw so that you can hear gas flowing through the bleed screw.
4. **For O_2 sensor:** Purge laser head with N_2. The Oxygen concentration inside the laser head will start to decrease. Wait for at least 10 minutes until the Oxygen concentration does not decrease anymore.

   For SO_2 sensor: Purge laser head with N_2 or instrument air. Purge the laser head for at least 10 minutes.

5. Close the laser head bleed screw with a 7 N m torque.
6. Take the holding plate and slide it over the laser head bleed screw. Make sure that the hole for the locking screw is placed above the threaded hole for the locking screw.
7. Insert the locking screw and use the 3-mm hex screwdriver to fasten the locking screw with a 1.4 N m torque.
8. Check if the pressure in the laser head corresponds to the required value.

Note

During measurement, the laser head does not need to be purged. Each time you interrupt the measurement, and the laser analyzer is turned off, you need to purge the laser head again.

9.2 Purging of the Buffer Zone between Laser head and Process Flange

The buffer zone between the laser head and the process flange needs also be purged to remove any interfering gas. If you are using a heat insulation unit (optionally) and/or an alignment unit, these units will also be purged by this purging option. The purge gas inlet (DN 6 (Swagelok™), stainless steel tube) is located at the side of the flange part. The purge gas outlet is closed by a bleed screw (see Figure 19)

Note

For connecting the purge in- and outlets use tubing with an outer diameter of 6 mm. Connect the tubing with a support sleeve to prevent the tubing from being crushed.

The recommended overpressure is 1 bar above process pressure.

You will need the following tools:

- A torque wrench size 8 mm to close bleed screw with a torque of 7 Nm

Follow these steps to purge the buffer zone:

1. Set the pressure of the buffer zone while buffer zone bleed screw is still locked. The recommended overpressure is 1 bar above process pressure.
2. Slightly open the buffer zone bleed screw so that you can hear gas flowing through the bleed screw.
3. **For O_2 sensor:** Purge buffer zone with N_2. The Oxygen concentration inside the buffer zone will start to decrease. Wait for at least 10 minutes until the Oxygen concentration does not decrease anymore.

   For SO_2 sensor: Purge buffer zone with N_2 or instrument air. Purge the buffer zone for at least 10 minutes.
4. Close the buffer zone bleed screw with a 7 N m torque.
5. Check if the pressure in the buffer zone corresponds to the required value.

Note

During measurement the buffer zone does not need to be purged. Each time you interrupt the measurement, and the laser analyzer is turned off, you need to purge the buffer zone again.

9.3 Purging of the Wedged Windows and Retroreflector Inside the Process

The purging of the wedged windows and retroreflector inside the process is to remove particles which might affect the measurement.

Note

For connecting the purge inlet use tubing with an outer diameter of 6 mm. Connect the tubing with a support sleeve to prevent the tubing from being crushed.

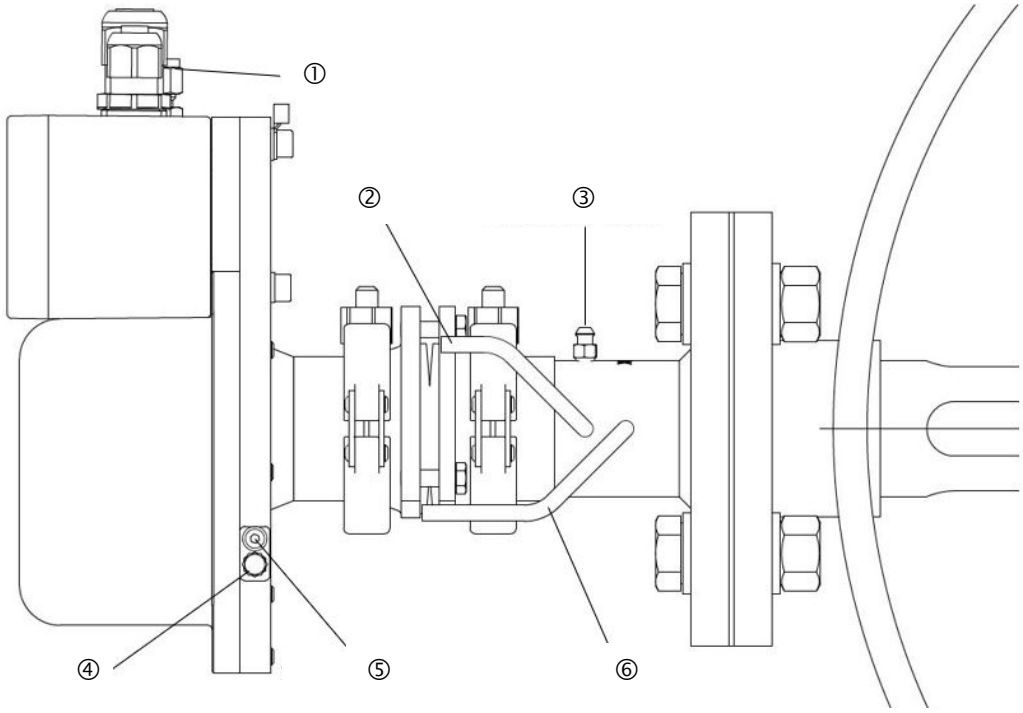
The recommended purging gas flow is 0 – 10 l/min (depending on the application)

The purging gas inlet for the windows (DN 6 (Swagelok™), stainless steel tube) is also located at the side of the flange part. The purging gas flows into the process.

Note

The transmission value can be output via an analog interface and can be provided with an alarm.

Please refer to the following figure for details.



① Purge gas inlet for the laser head

② Purge gas inlet for the buffer zone (shown without Swagelok® connector)

③ Bleed screw at the buffer zone (purge gas outlet)

④ Bleed screw at the laser head (purge gas outlet)

⑤ Screw for locking the bleed screw

⑥ Purge gas inlet for wedged windows in the process (shown without Swagelok® connector)

Figure 19 Schematic drawing of purging tube installation

The flow rate during purging affects the effective length of the optical path and therefore the measured value.

It is recommended to start with a high flow rate of purge gas and decrease it gradually, especially when there is a lot of humidity in the process gas, to avoid condensation on the wedged windows. The reading is initially very small and increases with decreasing purge gas flow. At a certain point, it will level off and remain constant for a while until it starts to increase again. Choose a purge gas flow rate in the middle of this constant period. This effect is more pronounced with short probes than with long probes.

Attention

If the process gas flow remains constant, a good purge gas flow is yielded. However, the effective length of the optical path always remains a function of the process gas flow and must therefore always be taken into account.

9.3.1 Purge Pressure Settings

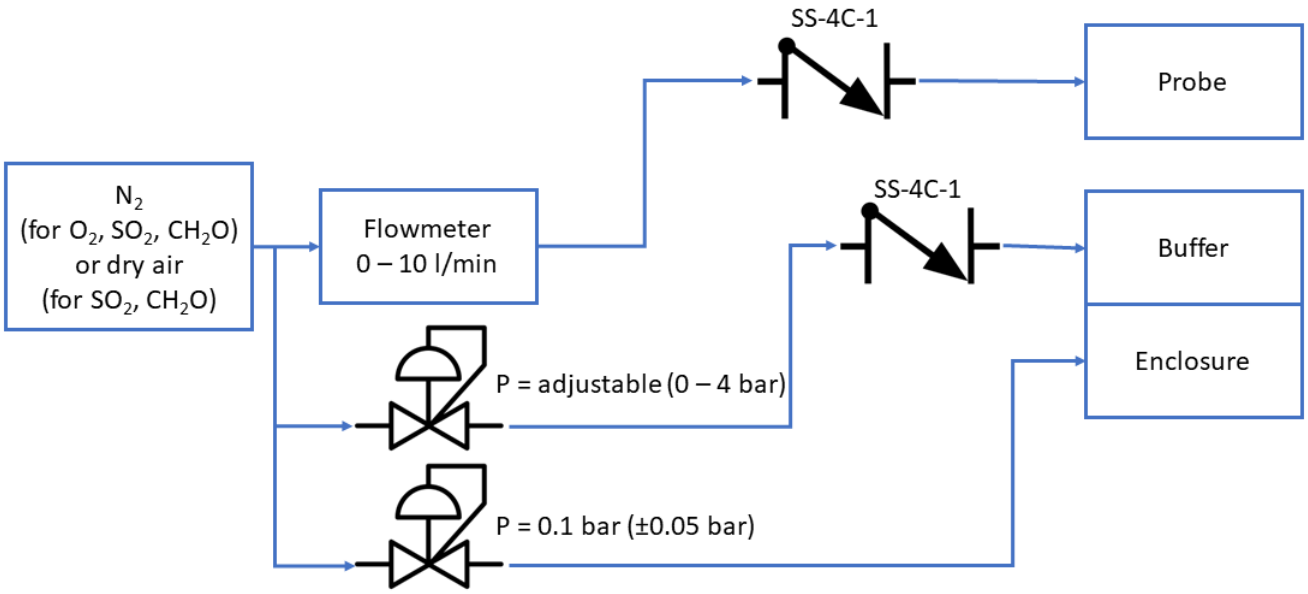


Figure 20 Flow setup for purging

The gases to be measured should stay in the process. For this reason, an overpressure in relation to the process pressure is set in the buffer zone.
In case of a loss of purge-gas pressure, both the buffer zone and the probe have to be equipped with a non-return-valve to prevent process gas from escaping the process. The overpressure in the laser head only has to be greater than the ambient pressure in order to obtain a second sealing barrier here.

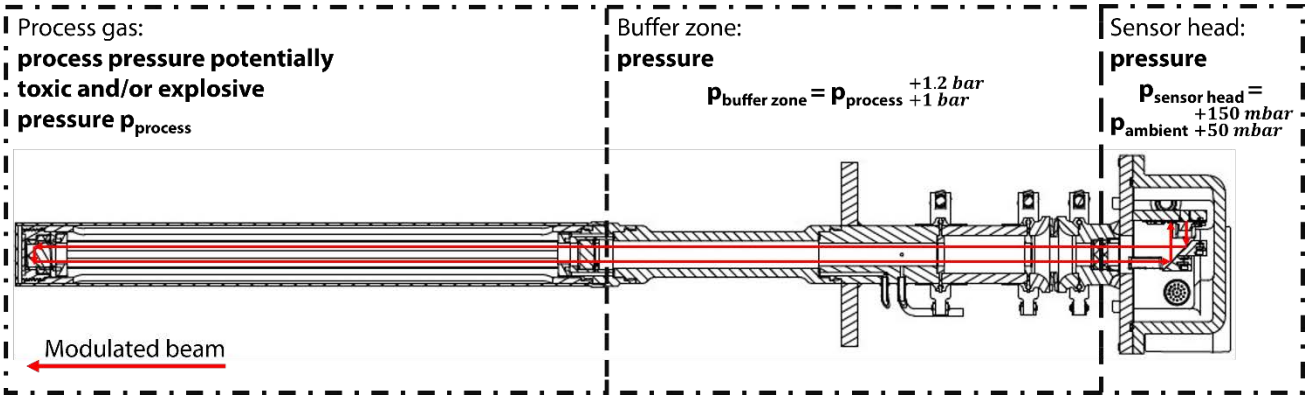


Figure 21 Pressures to be set in the measuring system

10 Electrical Connections

Warning

The relevant IEC standards and national regulations in respect of machine safety codes and also the generally accepted state of the art is obligatory for the setting up and operating processes.

All electrical connection work must only be carried out by suitably qualified electricians (IEC 60079-14).

Check all electrical connections. Only connect the device to the power supply when all connections are correctly connected.

The Ex e terminal box of the In-situ Laser Analyzer is equipped with 2 x M 16 cable glands with seal (O-ring) (for cable Ø 4 to Ø 11 mm) and 1 x M 20 cable gland with seal (O-ring) (for cable Ø 5 to Ø 14 mm). The following cable glands are used:

PFLITSCH_bg216msHTex: torque 8 N m (M16 cable gland); shield of the cable needs to be put on the PE-terminals (square crimp) => grounded on both sides
PFLITSCH_bg220msHTex: torque 10 N m (M20 cable gland); shield of the cable needs to be put on the PE-terminals (square crimp) => grounded on both sides.

Observe the following notes regarding the Ex e terminal box:

- Before delivery, the devices were tested for compliance with the valid Ex regulations for explosion protection.
- Feed in the Ex e terminal box only fixed installed cables and wires with appropriate strain relief.
- Close all unused entry openings with a certified blind plug with seal (O-ring). Since the length of the threads inside the Ex e terminal box have less than 5 thread turns, only cable glands and blind plugs in accordance with IEC 60079-0 annex B with seal (O-Ring) may be used.
- Use only explosion-proof tested cable and metal cable glands and metal blind plugs with a minimum protection class of IP65.
- According to IEC 60079-17, check the tight fit of all cable entries and blind plugs. Refer to the specifications of the cable gland manufacturers for more information. In addition, pay attention to the conditions specified in IEC 60079-14.

- The cable glands must be protected against mechanical damage. Use a suitable impact protection device to protect the cable glands.
- Do not damage the Ex e terminal box. The tested technical characteristics cannot be maintained, if the terminal box is damaged.

10.1 Electrical Cable Used for Connections

Use the following cables to connect signals, power supply and ground:

	LiYCY (TP)-10 x 2 x 0.25 **BK** (Ø a = 11.0) for transferring all signals from the Ex e terminal box of the In-situ Laser Analyzer to a cabinet (incl. power supply). Optional connections for analog or digital signals are available in the EX e housing depending on the customer requirement. Optionally: LiYCY (TP)-12 x 2 x 0.25 BK (Ø a = 11.3) for transferring all signals from the HMI to a cabinet (incl. power supply)
Shielded TP cables with min. cross section of 0.25 mm^2 (AWG24) for pressure sensor and/or thermometer; max. cable length of pressure and temperature sensor is 3 m.	

10.2 Alternative Cable Choice

The "LiYCY (TP) 12x2x0.25 **BK**" cable is hardly available on the market. There is an alternative cable available, which does not comply with the IEC 60079-14 regarding UV protection. To use this cable, it must be fully protected from any UV exposure. The "LiYCY (TP) 12x2x0.25" cable can be used only if these requirements are fulfilled:

- The cable must be routed in a suitable cable duct or must be covered with suitable shrink tubing and optionally covered with a suitable braided hose.
- Suitable shrink tubing must be used to cover the cable entry on the terminal box of the ILA1-X000-EX In-situ Laser-Analyzer and on the HMI.
- In addition, pay attention to the conditions specified in IEC 60079-14.

Contact M&C for more information on cable alternatives.

10.3 Connecting the Terminals Inside the Ex e Terminal Box

The fitted standard terminal is designed for the direct connection of copper wires. Only tested and certified cable in accordance with IEC 60079-0 annex B may be used.

Inside the terminal box are MTP1.5/S and MTP2.5-PE terminals. The MTP2.5-PE terminals are for connecting the shield of the cables to the ground terminal block. The MTP1.5/S terminals are for signal and power supply connections.

Required tools and accessories for opening the Ex e terminal box and connecting the wires:

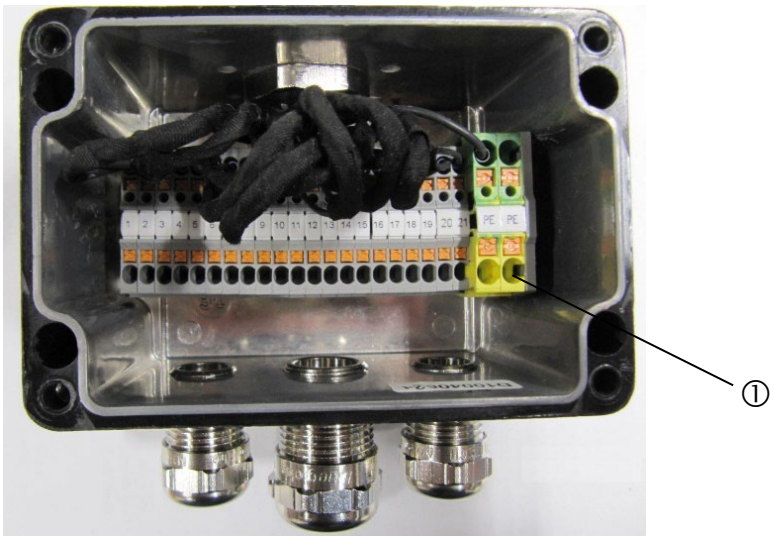
- wire stripping tool
- Insulated ferrules for stranded copper wire with a cross section of 0.25 mm^2, ferrule pin length 8 mm
- Insulated ferrules for twisted shield of the cables (cross section: 4 mm^2); ferrule pin length 10 mm

- Square crimp tool for insulated ferrules
- shrink tubing for shield of the cables
- torque screwdriver for the four screws securing the lid (torque 1.3 N m)
- slotted screwdriver (size 0.4 x 2.5 mm) to open the terminals
- slotted screwdriver (size 1.2 x 8 mm) for connecting inner grounding

For connecting the signal, power supply and ground wires to the Ex e terminal box follow these steps:

1. Open the Ex e terminal box cautiously by unscrewing each of the four screws. To re-fasten the screws use a torque screwdriver for a torque of 1.3 N m.

Figure 22 Lid of Ex terminal box



① Ground terminals, MTP2.5-PE

Figure 23 Terminals inside terminal box: MTP1.5/S; MTP2.5-PE

2. Feed the cables through the appropriate cable glands. See the following communication schematic for information.

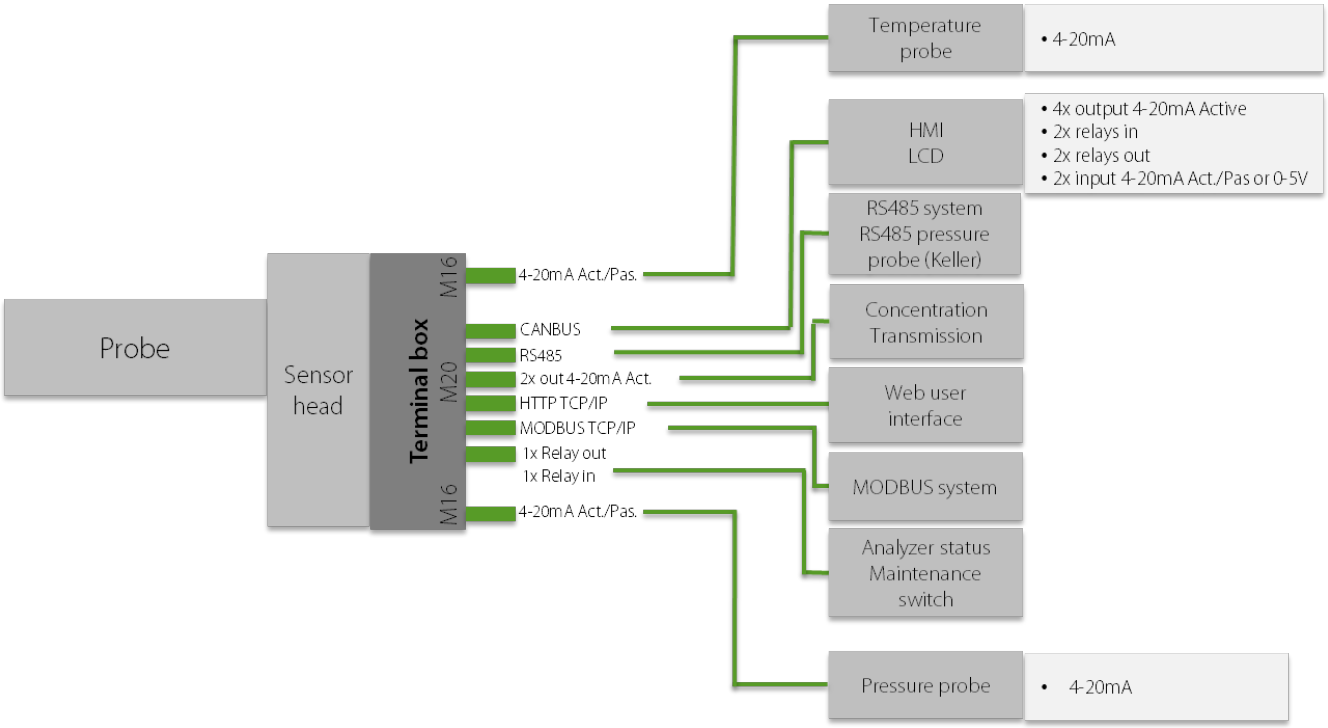


Figure 24 Communication schematic of the ILA1-X000-EX

Prepare and connect the wires for signals and power supply:

1. Use a wire stripping tool to strip the insulation of the wires to a length of 8 mm.
2. Slide an insulated ferrule over each stripped wire and use the crimp tool to fasten it. The test requirements according to DIN 46228 Part 4 need to be met.
3. See the following table for PIN assignments.
   Push the slotted screwdriver (size 0.4 x 2.5 mm) down on the integrated actuating push button to open the terminals. Insert the wires as far as possible into the connection opening of the terminal block.

Connect the signal and power supply wires to the terminals according to the following table:

Pin	Electronic board connection	Description	Specification
1	Ground power supply		
2	+24 V	Power supply 24 V ±10 %; 10 W	
3	T_EXT +15V/GND		Active temperature probe: +15 V; passive temperature probe: GND; signal range: 2.4 to 21.6 mA DC; max. load resistance 500 Ω
4	T_EXT OUT		active temperature probe: Measure; passive temperature probe: Measure;
5	P_EXT +15V/GND		Active pressure probe: +15 V; passive pressure probe: GND; signal range: 2.4 to 21.6 mA DC; max. load resistance 500 Ω
6	P_EXT OUT		active pressure probe: Measure; passive pressure probe: Measure;

Pin	Electronic board connection	Description	Specification
7	4-20 mA I- Transmission	Analog output concentration; 4-20mA Active	Load resistance 200 - 500 Ω including cable resistance
8	4-20 mA I+ Transmission		
9	4-20 mA I- Concentration	Analog output transmission; 4-20 mA Active	Load resistance 200 - 500 Ω including cable resistance
10	4-20 mA I+ Concentration		
11	CANH	CAN Bus Communication	
12	CANL		
13	RS485 B		
14	RS485 A		
15	TX- (11) - J1 - White/Orange	Ethernet Connec-tion 100 Mbps;	Modbus TCP/IP; Webservice
16	TX+ (10) - J2 - Orange		
17	RX- (4) - J3 - White/Green		
18	RX+ (5) - J6 - Green		
19	Relay OUT	Relay output	Open signal: 1 MΩ or more, close signal: 2.5 Ω or less; 24 V DC; 120 mA max.; 1.5 kV isolation; NO; 230 V AC or 60 V DC (120 mA);
20	Relay Vsupply +		
21	Relay IN	Relay input	Max. 150 V DC min. 6 V; contact specification: resistance 3.3 kΩ
22	Earth		

Table 5 Description of the electrical terminals inside the terminal box

Prepare the shield of the cables and connect to the ground terminals:

1. Unravel the braided shield of a cable and pull it to a single core. The minimum cross section of this wire is AWG 12 (4 mm^2).
2. Use suitable heat shrink tubing for the braiding except the last 10 mm.
3. Slide a suitable insulated ferrule on the last 10 mm of this contracted braiding AWG12 (4 mm^2) and use a square crimp tool to fasten it. The test requirements according to DIN 46228 Part 4 need to be met.
4. Push the slotted screwdriver (size 0.4 x 2.5 mm) down on the integrated actuating push button to open the PE-terminals. Insert the wire as far as possible into the connection opening of the ground terminal block.

The cables need to be grounded on both sides.

Closing the Ex e terminal box:

1. Remove all foreign bodies from the device.
2. To fasten the screws use a torque screwdriver for a torque of 1.3 N m.
   Tightening the lid screws with a torque of 1.3 N m provides the necessary minimum type of protection. Do not over-tighten the screws, this may impair the degree of protection.

Incorrect installation and operation of the housing may result in the warranty becoming invalid.

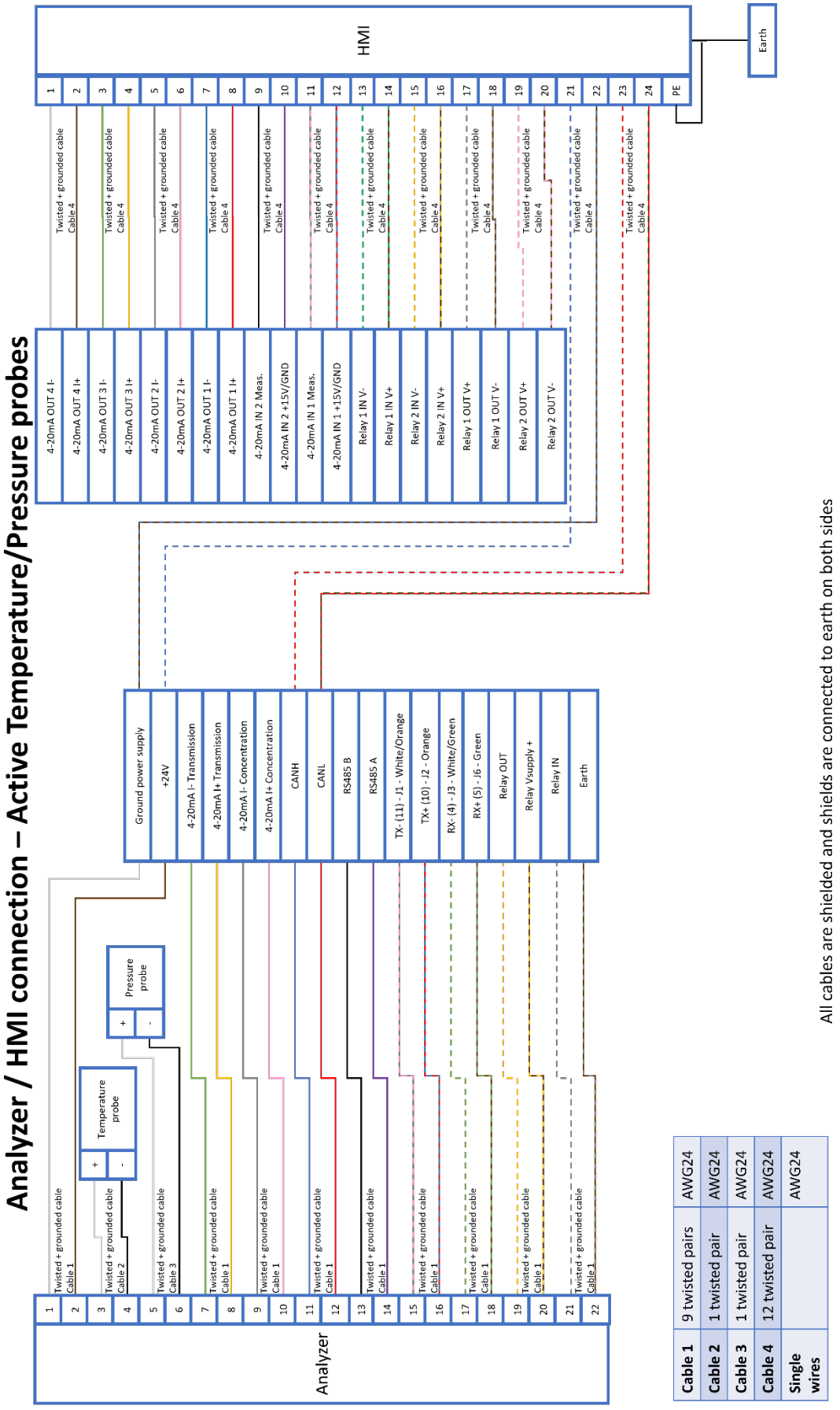


Figure 25 Analyzer/HMI connection – active temperature/pressure probes

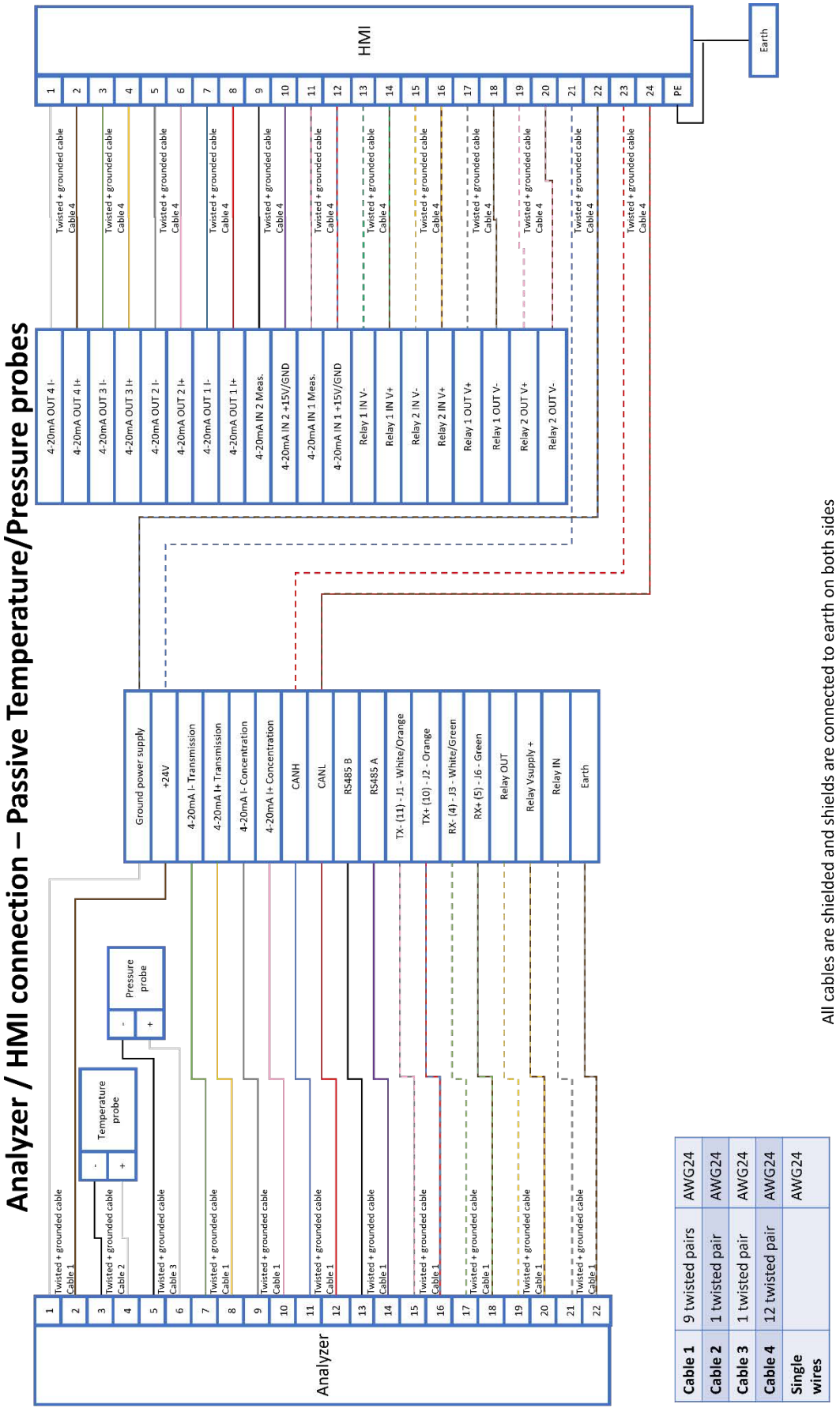


Figure 26 Analyzer/HMI connection – passive temperature/pressure probes

10.3.1 Active Analog Outputs

Active analog outputs need no external powering of the output terminal. Please refer to Figure 26 for output signal connection. For the active analog outputs, there is a 15 V DC voltage supply. This output must not be short-circuited for a long time, as this leads to a very strong heating of the resistors on the board, which leads to their failure after a certain time.

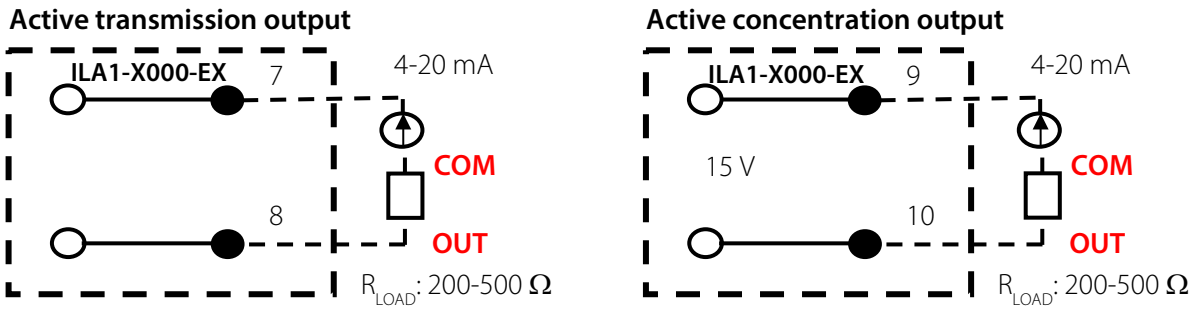


Figure 27 Exemplary usage of active analog output

Warning

Active analog inputs **do not need** an external power supply.

10.3.2 Active or Passive Analog Inputs

Passive analog inputs require external powering for operation. Active analog inputs need no external powering of the input terminal. For the active analog inputs, there is a 15 V DC voltage supply. This input must not be short-circuited for a long time, as this leads to a very strong heating of the resistors on the board, which leads to their failure after a certain time.

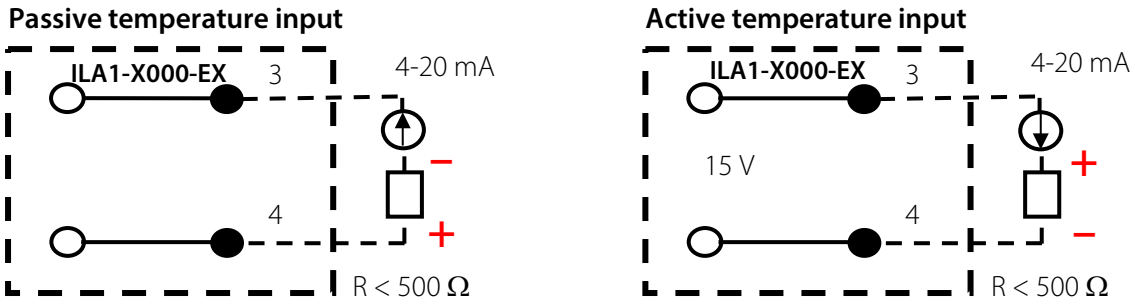


Figure 28 Usage of active or passive analog temperature input by opposite polarization

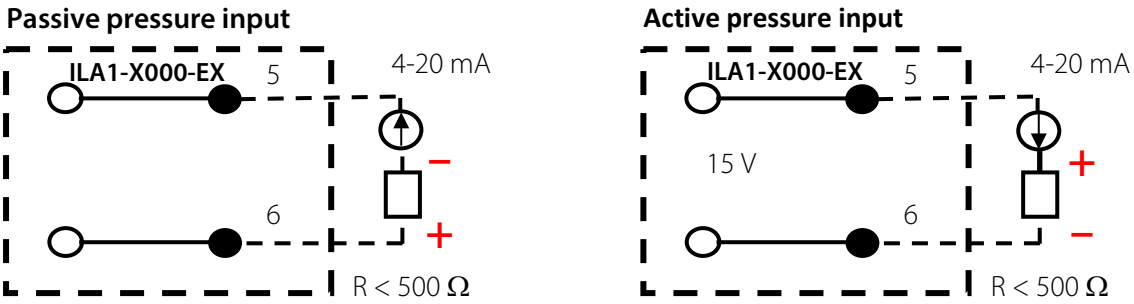


Figure 29 Usage of active or passive analog pressure input by opposite polarization

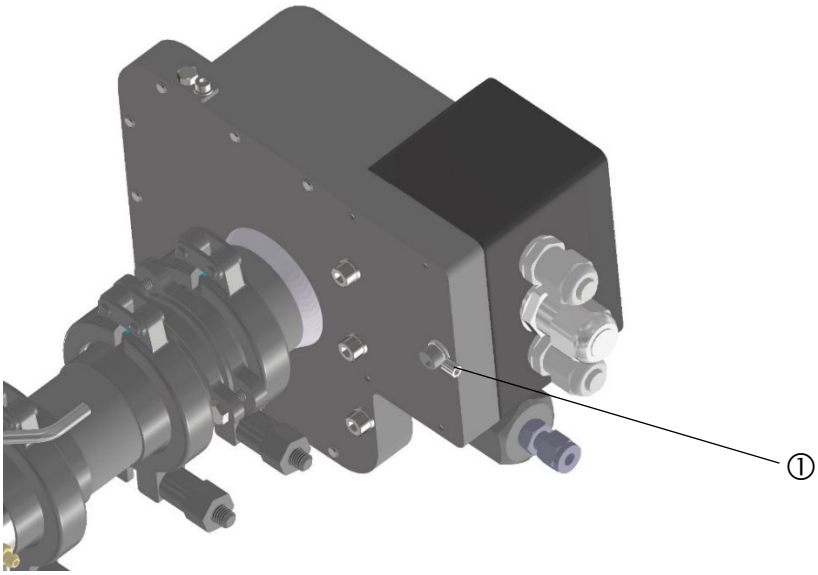
Warning

Passive analog outputs **need** an external power supply.

Active analog inputs **do not need** an external power supply.

10.4 Connecting the Potential Equalization to the Housing

Protective and potential equalization wire connection of the explosion-proof enclosure of the In-situ Laser Analyzer must be earthed in accordance with the requirements of IEC 60079 ff., IEC 61439 ff. and IEC 60364-5-54.
The connector of the potential equalization is located on the underside of the main baseplate of the laser head. The potential equalization connector is a crimp-on ring terminal with a contact washer Ø 6.4 mm.



① Connector for potential equalization with crimp-on ring terminal and contact washer Ø 6.4 mm

Figure 30 Connector for potential equalization

The following tools are required:

- slotted torque screwdriver
- crimp tool

To connect the earth wire, follow these steps:

1. Loosen the screw holding the crimp-on ring and the contact washer.

2. The cross-section of the earth wire must have a cross-section of at least 4 mm^2. Fit the earth wire into the crimp-on ring and use a crimp tool to fasten it.
3. Screw the crimp-on ring with the wire attached and the contact washer back onto the main baseplate of the laser head. The torque of the screw (ISO 4762 M6 x 10 - A4) is 5 N m.

11 Battery-powered Real-time Clock (RTC)

The real-time clock (RTC) maintains the time in the analyzer even when power supply is shut down. In order to continue operating the real-time clock (RTC) in the event of disconnection of the system, it is powered with a high-temperature-resistant ceramic battery. The battery is directly connected to the power management integrated circuit (PMIC). There will be no power forwarded to the Ex e-housing, since only the RTC-system is powered.

Battery classification and model: Rechargeable lithium-ion battery (high temperature resistant)

Battery information	
Manufacturer:	NGK
Model	ET2016C-H
Positive Electrode	LiCoO2
Negative Electrode	Li4Ti5O12 (LTO)
Electrolyt	Li[BF4] (lithium tetrafluoroborate) with organic solvent (non-aqueous)
Design	Hermetically closed
Battery life-time	Approximately 10 years
Powering of the RTC	Approximately 5 years (e.g. for a stored backup-system at 25 °C)

Note

Battery type is also included in release list table 14 (secondary cells) of EN60079-0.
Detailed parameters of the ET2016C-H can be seen in the appendix.

12 Alignment of the In-situ Laser Analyzer

Warning

Note

Danger due to laser radiation!
Laser class of the laser head without probe:
O_2 laser: Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam
SO_2 laser: Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments.
Switch off the power supply before any assembly, maintenance or disassembly.

Purge the laser head, the buffer zone between laser head and process flange, and the wedged windows and retroreflector inside the process before aligning.
The alignment procedure must be performed with great care to ensure that the instrument performs the measurements correctly.

The laser head and the probe are pre-aligned at the factory. To obtain the maximum laser transmission, it might be necessary to rotate the laser head. To rotate the laser head the clamp holding the laser head needs to be opened slightly.

The transmission can be seen in the HMI (optionally) by going to **Main screen -> Alignment** where the transmission will be shown in **%**. Alternatively, a PC can be connected to the service interface, which displays the transmission using the service software. The description of the software and the handling is described in chapter 13.

Note

The transmission value can be output via an analog interface and can be provided with an alarm.

Another alternative is to use a multimeter set to amperemeter with a 200 Ω to 500 Ω resistor.

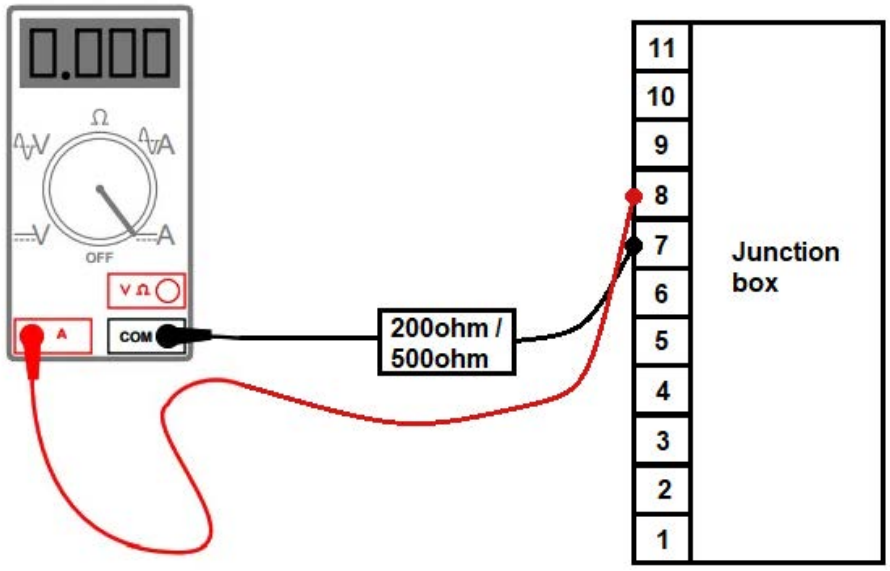


Figure 31 Transmission measurement with a multimeter

12.1 Laser Head Orientation for Analyzer Pre-alignment

- Reset the trimming flange to its default setting.
- Unscrew the head clamp.
- Be careful when doing so not to touch the head side window or let dust in the buffer zone.
- Be careful not to let the laser head fall down.

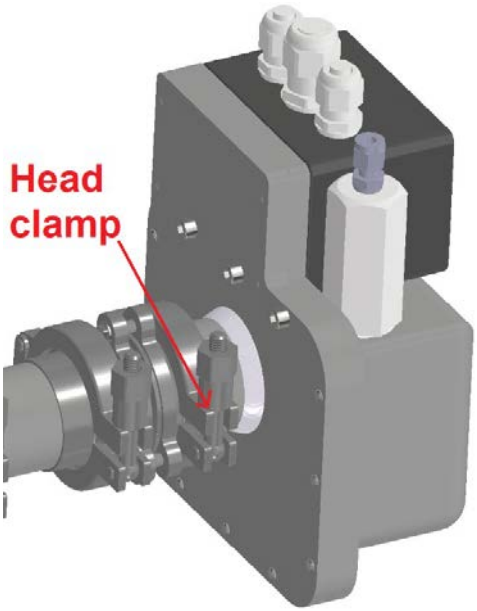


Figure 32 Clamp at the laser head

Start at an angle where the arrows of the windows on the laser head and on the probe side are on opposite directions. While looking at the analyzer's transmission, find an angle around this position that gives the highest transmission possible. Start closing the head clamp. The transmission can start to go down when the head clamp starts to be screwed. In such case, find the optimum alignment back using the trimming flange screws and start tightening the head clamp screw again.

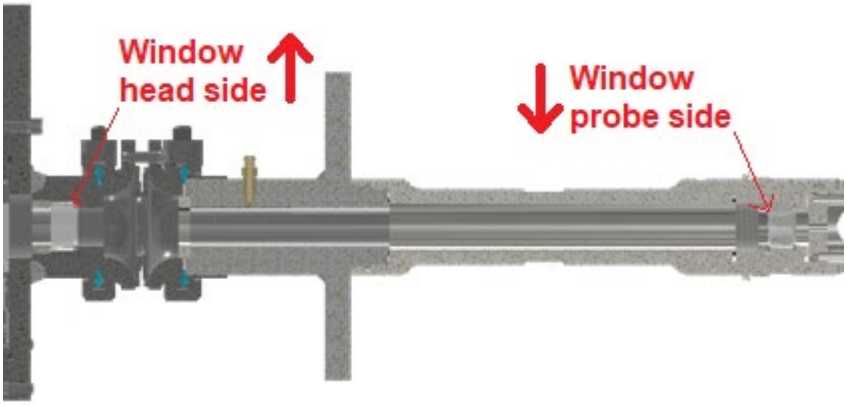


Figure 33 Window orientation

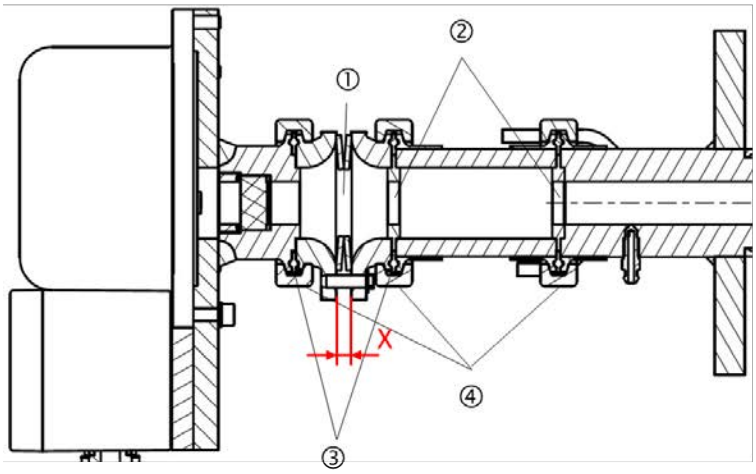
Continue doing the clamp screw tightening/trimming flange alignment cycle until the head clamp screw has been closed with a 10 N m torque.

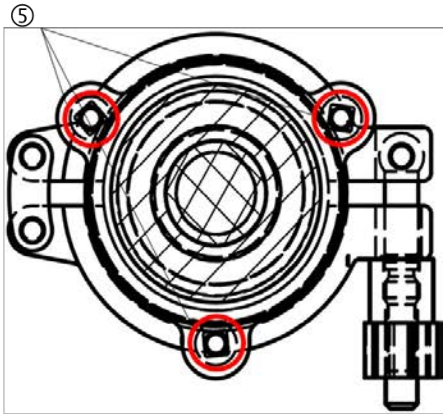
12.2 Alignment of the In-situ Laser Analyzer Using the Alignment Unit

Note

Purge the laser head, the buffer zone between laser head and process flange, and the wedged windows and retroreflector inside the process before aligning.
The alignment procedure must be performed with great care to ensure that the instrument performs the measurements correctly.

The laser head and the probe are pre-aligned at the factory. Due to assembly tolerances for additional components (insulating flange, alignment unit, etc.), it may be necessary to correct this alignment slightly.





① Seal-welded disc springs
② Center rings
③ Gylon®-gaskets, max. temp. 260 °C
④ Safety clamps
⑤ Square head screws for adjusting the alignment

Figure 34 Adjusting with the alignment unit

Follow this procedure to align the In-situ Laser Analyzer using the alignment unit:

1. Check and write down dimension X for all three hex screws (see Figure 34). X should be in the range of 5.5 mm to 6 mm (default 6 mm).
2. Check and write down the laser transmission using the HMI, a PC or a multimeter.
3. Choose one screw. Write down which screw you have chosen. Tighten this screw slightly. Dimension X must not be less than 5.5 mm.
4. Check and write down the laser the transmission using the HMI, a PC or a multimeter.
5. If the **transmission becomes higher** when tightening the screw, it can be tightened a little bit further (dimension X must not be less than 5.5 mm), but not so far that the transmission decreases again.
6. If the **transmission decreases** right at the beginning, the screw must be brought back to its original position and another screw needs to be selected.
7. Repeat this procedure with the second and third screw.

13 User Interface (HMI)

The external HMI (product name: ILA HMI DCU10 EX) can be used to operate, configure or perform diagnostics on the ILA1-X000-EX In-situ Laser Analyzer.

It can be connected directly to the terminal box of the Laser Analyzer or to another location where the Laser Analyzer signals are available (e.g. control cabinet or terminal box). The power supply can be supplied via the analyzer cable or via a suitable separate power supply with a suitable supply line (usage of the second cable entry).

The HMI is equipped with a 128 x 64 dot LCD-display (equivalent to 8 x 21 characters). The HMI allows monitoring of pre-defined measurements and editing of essential parameters. The user can access and toggle between the menu positions using the buttons that are placed above and below the display by capacitive touch functionality.

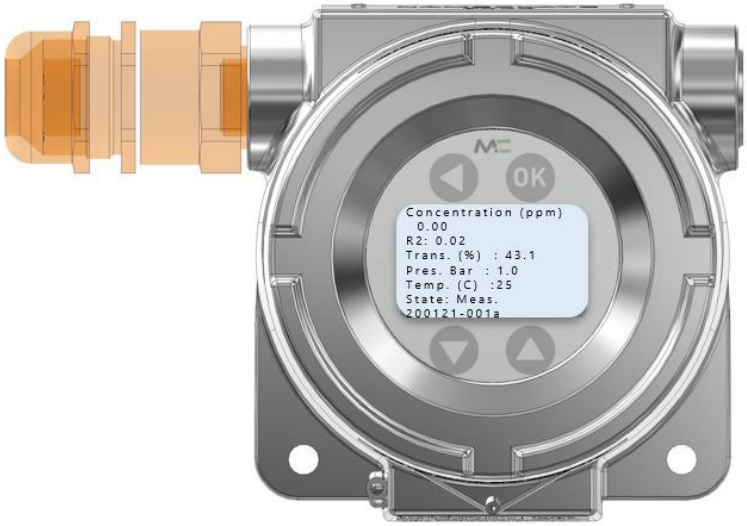


Figure 35 HMI display with standard process parameters

13.1 Installation

Warning

Contact with live parts!
Probably death or serious injury could occur if you come in contact with live parts during installation or de-installation of the HMI.
Make sure that the power supply is disconnected during installation and de-installation.
The housing may only be opened after a waiting period of 4 seconds after the power supply has been disconnected.

13.2 Information about ATEX Installation

Qualified personnel

The ILA HMI DCU10 EX may only be installed by qualified personnel.
Qualified personnel must have at least the following knowledge:

- Instruction in EX protection
- Training in the electrotechnical field
- Detailed knowledge of the operating instructions and the applicable safety regulations.

Do not install, maintain, or repair the ILA HMI DCU10 EX while explosive atmosphere is present.
Do not open the terminal box of the In-situ Laser Analyzer and the HMI in hazardous areas.

Warning

An easily accessible main switch with appropriate labeling must be provided externally.
If the standard configuration is changed by using components or parts not specified and not authorized by M&C, the type examination certificate will no longer be valid. Repair and services with parts not specified by M&C will also lead to the cancellation of the ATEX certificate.

Installation in a zone not according to the ATEX certificate
The ATEX certificate is not valid if the ILA HMI DCU10 EX is installed in a zone not stated in the ATEX certificate.
Follow the information in the ATEX certificate closely.

Caution

Electrostatic discharges can act as an ignition spark in hazardous areas. Do not use the device in areas where:

- mechanical friction and separation processes occur,
- spraying of electrons takes place (e.g. in the vicinity of electrostatic painting systems), or
- pneumatically conveyed dusts are present.

13.3 Ignition Paths at the Flameproof Joints of the Ex d housing

Do not rework or repair of the flameproof joints.

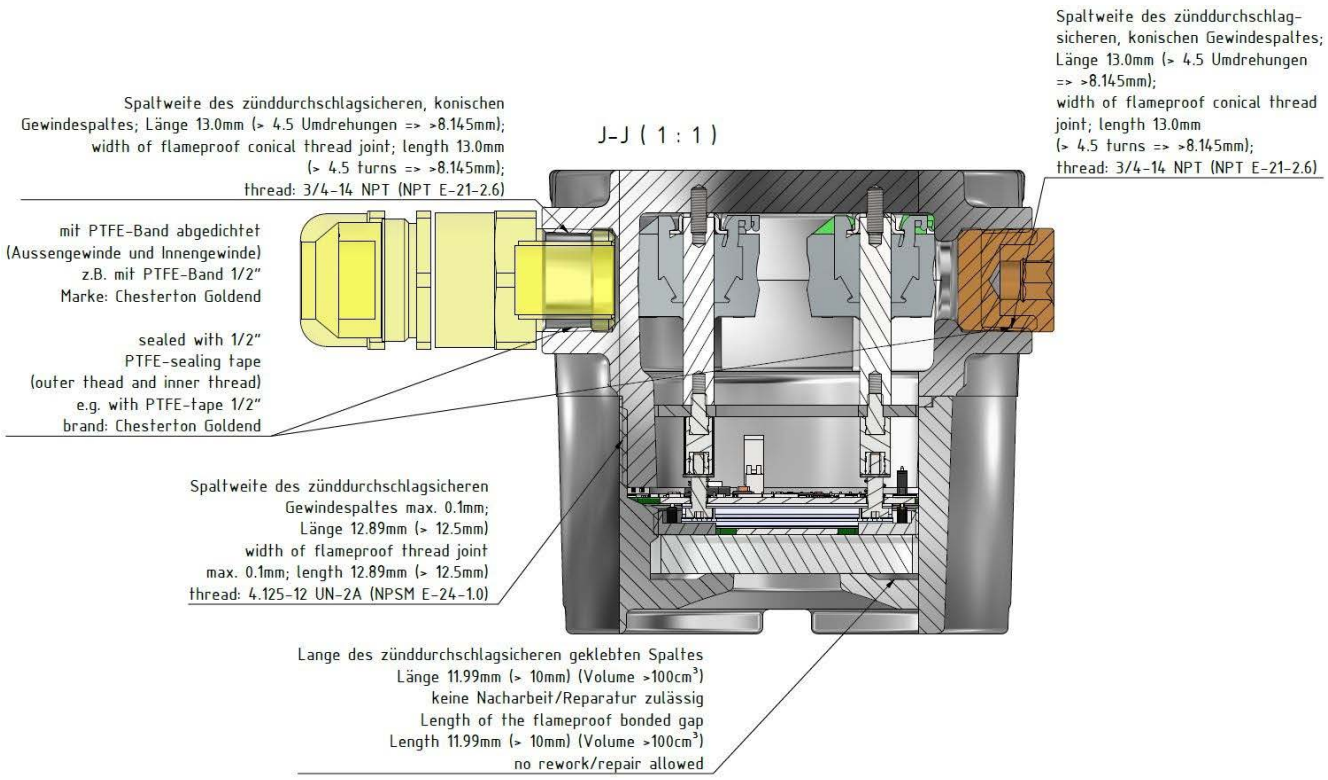


Figure 36 Flameproof joints at the HMI

13.4 Connecting the HMI to the In-situ Laser-Analyzer

Warning

The relevant IEC standards and national regulations in respect of machine safety codes and also the generally accepted state of the art is obligatory for the setting up and operating processes.

All electrical connection work must only be carried out by suitably qualified electricians (IEC 60079-14).

Check all electrical connections. Only connect the device to the power supply when all connections are correctly connected.

The In-situ Laser-Analyzer has a terminal box to connect to the terminals inside the HMI housing.
The housing of the terminal box of the ILA1-X000-EX In-situ Laser-Analyzer is certified as an Ex e terminal box. This terminal box is equipped with 2 x M 16 cable glands with seal (O-ring) (for cable Ø 4 to Ø 11 mm) and 1 x M 20 cable gland with seal (O-ring) (for cable Ø 5 to Ø 14 mm). The cable glands at the terminal box have an ingress protection (IP) rating higher than IP54 for explosive gas atmospheres.

The housing of the HMI with the electrical terminals inside, is certified as an Ex d housing. The cable gland of the HMI housing must have an IP6X for explosive dust atmospheres. Therefore the cable gland of the HMI housing must be sealed by epoxy to achieve an IP6X and tightness better than EN60079-14 appendix E / IEC 60079-14 appendix E.

13.4.1 Electrical Cables for Connecting the HMI to the In-situ Laser-Analyzer

Use the following cables to connect the HMI to the In-situ Laser-Analyzer:

Ex	LiYCY (TP)-12 x 2 x 0.25 **BK** (Ø a = 11.3) for transferring all signals from the HMI to a cabinet (incl. power supply) Minimum bending radius: fixed installation: 6 x outer diameter Temperature range: fixed installation: - 40 °C to +80 °C

13.4.2 Alternative Cable Choice

The "LiYCY (TP) 12x2x0.25 **BK**" cable is hardly available on the market. There is an alternative cable available, which does not comply with the IEC 60079-14 regarding UV protection. To use this cable, it must be fully protected from any UV exposure. The "LiYCY (TP) 12x2x0.25" cable can be used only if these requirements are fulfilled:

- The cable must be routed in a suitable cable duct or must be covered with suitable shrink tubing and optionally covered with a suitable braided hose
- Suitable shrink tubing must be used to cover the cable entry on the terminal box of the ILA1-X000-EX In-situ Laser-Analyzer and on the HMI.
- In addition, pay attention to the conditions specified in IEC 60079-14.

Contact M&C for more information on cable alternatives.

13.5 Cable Gland, Ex d Certified with Epoxy for Longitudinal Tightness

The housing of the HMI with the electrical terminals inside, is certified as an Ex d housing. The cable gland of the HMI housing must be sealed by epoxy to achieve an IP6X for explosive dust atmospheres and must prevent gas or vapor from migrating through the gaps between the individual wires of the connecting cable (non-longitudinally sealed cable).
Only cable glands certified to EN60079-1/IEC60079-1 fulfilling the tightness according EN60079-14 appendix E/ IEC60079-14 appendix E for non-longitudinally sealed cable may be used. For longitudinally sealed cable, tested according EN60079-14 cable glands certified to EN60079-1 (db) are sufficient.

A maximum of one reducer certified for use in hazardous areas may be used with any single cable entry on the EX d housing. All conduit sealing fittings must be certified as flameproof "db" or "Db", dust ignition protection "tb" and have a minimum IP66 rating equal to the marking on the HMI housing.

All unused device openings must be fitted with a certified blind plug rated equivalent or greater to the marking on the HMI housing. Possibly used plastic thread protection plugs (shipping plugs) shipped with the unit must be replaced during installation.

Example cable glands are:

PXSS2K-REX from CMP Products:

- Size 25, 3/4" NPT, part No. 25PXSS2KREX1RA532, for an outside overall cable diameter of 11.1 mm to 20 mm
- In combination with a reducer type 737 (3/4" NPT to M 20) only: size 20, M 20, part No. 20PXSS2KREX1EX5) for an outside overall cable diameter of 6.5 mm to 14 mm.

Contact M&C for more information on suitable cable glands.

13.5.1 Installation Information for Type PXSS2K-REX

Note

The PXSS2K-REX cable gland is suitable for fixed installations only. Make sure that the cable is securely fastened in the cable gland so that it cannot be pulled out or twisted.

The PXSS2K-REX cable gland is certified for explosive dust atmospheres. The cable gland must be sealed by an epoxy to achieve an IP6X and tightness better than EN60079-14 appendix E / IEC 60079-14 appendix E.

Usually the PXSS2K-REX cable gland is pre-assembled and part of the delivery.

Warning

Not pre-assembled PXSS2K-REX cable gland:

Read and follow closely the instructions in the original manufacturer manual to assembly the PXSS2K-REX cable gland. The original manufacturer manual is supplied with the PXSS2K-REX cable gland.

Note

Make sure that the wires are long enough to connect to the terminals inside the HMI housing.

The braided shield of the cable must be unraveled and pulled to a single core. Use suitable heat shrink tubing for the braiding except the last 10 mm, but leave 9 mm space between the outer sheat of the cable and where the heat shrink tubing starts to allow the epoxy resin to penetrate into the mesh of the braiding.

13.6 Connecting the Terminals Inside the HMI

Warning

Do not install, maintain or repair the ILA HMI DCU10 EX while explosive atmosphere is present.
Do not open the terminal box of the In-situ Laser Analyzer and the HMI housing in hazardous areas.

If the standard configuration is changed by using components or parts that are not specified and not approved by M&C, the type examination certificate loses its validity. Repairs and services with parts that are not specified by M&C will also invalidate the EX certificate.

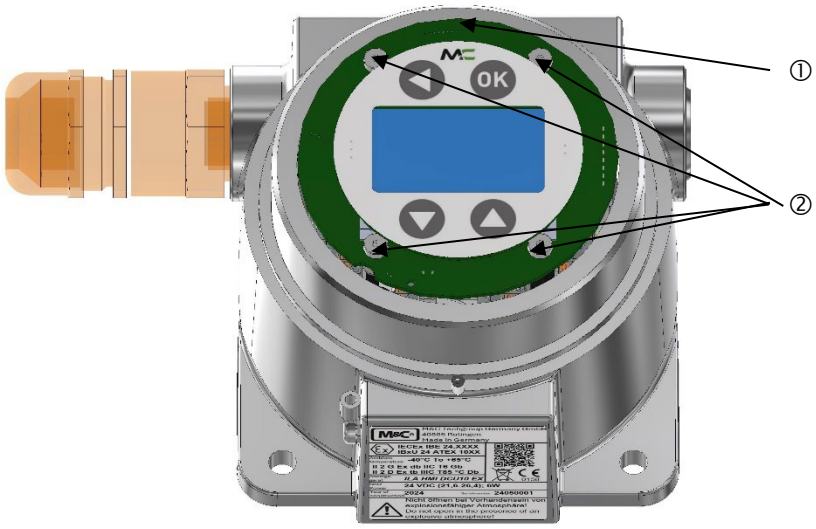
The terminals for connecting the HMI to the power supply, the inner ground and the terminal box of the In-situ Laser-Analyzer are located inside the HMI. All wiring necessary for connecting needs to be ordered separately.

Required tools and accessories for opening the HMI housing and connecting the wires:

- wire stripping tool
- Insulated ferrules for stranded copper wire with a cross section of 0.25 mm^2, ferrule pin length 8 mm
- Crimp-on ring terminal with a cross section of 4 mm^2 M5 or N10-24 UNC
- shrink tubing for shielding of the cable
- crimp tool for insulated ferrules
- crimping pliers for ring terminals
- hex key (size 1.5) for the set screw securing the lid of the housing
- hex key (size 2) to unscrew fitting screws
- slotted screwdriver (size 0.4 x 2.5 mm) to open the terminals
- slotted screwdriver (size 1.2 x 8 mm) for connecting inner grounding

To open the HMI housing follow these steps:

1. Use a hex key (size 1.5) to release the set screw on the front of the HMI housing securing the lid. There is no need to remove the set screw.
2. Unscrew the lid counterclockwise and remove it from the HMI housing. Inside the HMI housing there is the display with the circuit board. The circuit board is connected to the HMI housing by four fitting screws.



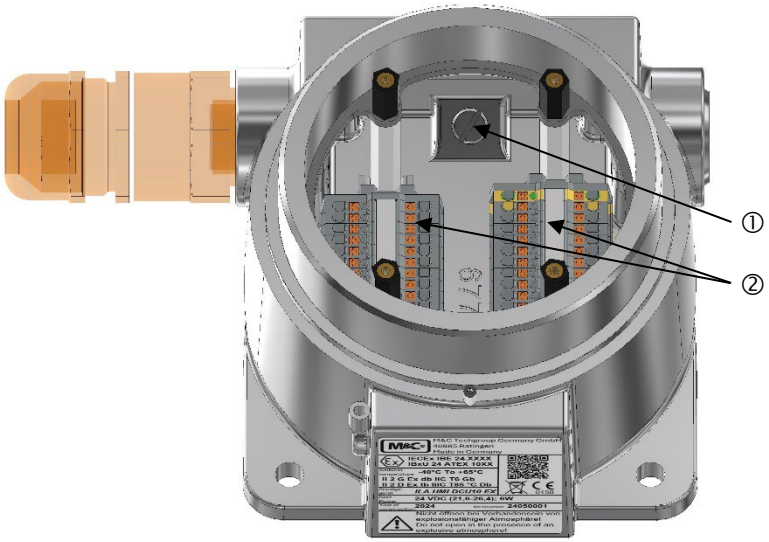
① Circuit board with display
② Fixing screws to hold the circuit board (tightening torque: 0.65 N m)

Figure 37 Circuit board and display inside HMI housing

Note

The circuit board with the display can be rotated by 180°.
Note the orientation of your display. Insert the display in the same position in which you removed it.

3. Unscrew the four fitting screws by using a hex key (size 2). To refasten the fitting screws, you need a tightening torque of 0.65 N m. Remove the fitting screws and set them aside. The circuit board is wired to the electrical terminals. Flip the circuit board with the display upwards or sidewards. Inside the HMI housing there are the electrical terminals.



① Connector for connecting to ground (to connect two ring terminals)
② Terminals for electrical connections: MTP1.5/S; MTP1.5/S-PE

Figure 38 Connections inside the HMI housing (circuit board not shown)

Prepare and connect the wires:

1. Use a wire stripping tool to strip the insulation of the wires to a length of 8 mm
2. Slide an insulated ferrule over each stripped wire and use the crimp tool to fasten it. The test requirements according to DIN 46228 Part 4 need to be met.
3. Twist the corresponding pairs again (1&2; 3&4; 5&6 etc.)
4. See the following table for PIN assignments.
   Push the slotted screwdriver (size 0.4 x 2.5 mm) down on the integrated actuating push button to open the terminals. Insert the wires as far as possible into the connection opening of the terminal block.

   Connect the wires to the terminals according to the following table:

PIN	Colour	Function
1	white	4-20mA OUT 4 I-
2	brown	4-20mA OUT 4 I+
3	green	4-20mA OUT 3 I-
4	yellow	4-20mA OUT 3 I+
5	grey	4-20mA OUT 2 I-
6	pink	4-20mA OUT 2 I+
7	blue	4-20mA OUT 1 I-
8	red	4-20mA OUT 1 I+
9	black	4-20mA IN 2 Meas.
10	violet	4-20mA IN 2 +15V/GND
11	grey-pink	4-20mA IN 1 Meas.
12	red-blue	4-20mA IN 1 +15V/GND
13	white-green	Relay 1 IN V-
14	brown-green	Relay 1 IN V+
15	white-yellow	Relay 2 IN V-
16	yellow-brown	Relay 2 IN V+
17	white-grey	Relay 1 OUT V+
18	grey-brown	Relay 1 OUT V-

PIN	Colour	Function
19	white-pink	Relay 2 OUT V+
20	pink-brown	Relay 2 OUT V-
21	white-blue	+24 V
22	brown-blue	Ground power supply
23	white-red	CANH
24	brown-red	CANL

Table 6 Electrical terminals inside the HMI housing

Connect the shielding of the cable to ground (see Figure 38):
The ground connector connects two ring terminals to ground. The first ring terminal is already attached.

1. The cross section of the ground connection wire is AWG 12 (4 mm^2).
2. Slide an AWG12 crimp-on ring terminal M5 or N10-24 UNC over the single core and use the crimping pliers for ring terminals to fasten it. The test requirements according to DIN 46228 Part 4 need to be met.
3. Use a slotted screwdriver (size 1.2 x 8 mm) to loosen the screw for connecting to ground. This loosens the first ring terminal.
4. Insert the first ring terminal and the new ring terminal.
5. Use a slotted screwdriver (size 1.2 x 8 mm) to fasten the screw for connecting to ground (4.5 Nm).

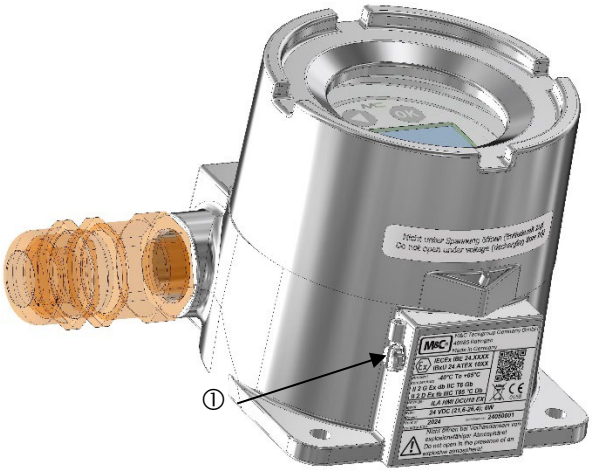
The shield of the cable has to be connected on both sides of the cable (EMC requirement).

Close the HMI housing:

1. Flip the circuit board with the display back onto the electrical terminals. Use a hex key (size 2) to fasten the four fitting screws. To fasten the fitting screws, you need a tightening torque of 0.65 N m.
2. Screw the lid back on to the HMI housing (clockwise).
3. Use a hex key (size 1.5) to fasten the set screw on the front of the HMI housing securing the lid.

13.7 Connecting the Potential Equalization to the HMI Housing

Protective and potential equalization wire connection of the HMI must be earthed in accordance with the requirements of IEC 60079 ff., IEC 61439 ff. and IEC 60364-5-54.
The potential equalization connector is located on the side of the HMI housing. The connector is a crimp-on ring terminal with a lock washer.



① Connector for potential equalization with crimp-on ring terminal and lock washer

Figure 39 Connector for potential equalization

The following tools are required:

- slotted torque screw driver
- crimping pliers for ring terminals

To connect the earth wire follow these steps:

4. Loosen the screw holding the crimp-on ring and the lock washer.
5. The cross-section of the earth wire must have a cross-section of at least 4 mm^2. Fit the earth wire into the crimp-on ring terminal and use crimping pliers for ring terminals to fasten it.
6. Screw the crimp-on ring with the wire attached and the lock washer back onto the HMI housing. The torque of the screw (N10-24 UNC – length 0.25") is 4.5 N m.

13.8 Starting up the HMI

The start-up procedure takes about 3 minutes. When starting up, "initialization" is displayed first. Then, the system performs a self-check. After this, the system goes into the "Idle" state. When the system is set to automatically measuring, it is starting the measurement directly after it is in idle state.

When the system has an error or warning, the screensaver will be disabled.
The word "Measurement" displayed at a certain interval indicates a proper operation. In this case the system is running without any warning or error.

13.9 Menu Navigation

The HMI has two different authorization levels (=> three levels in total). In the administrator menu (User), trained employees of the customer can access display measurements, parameters and IOs (Inputs/Outputs) using a password.

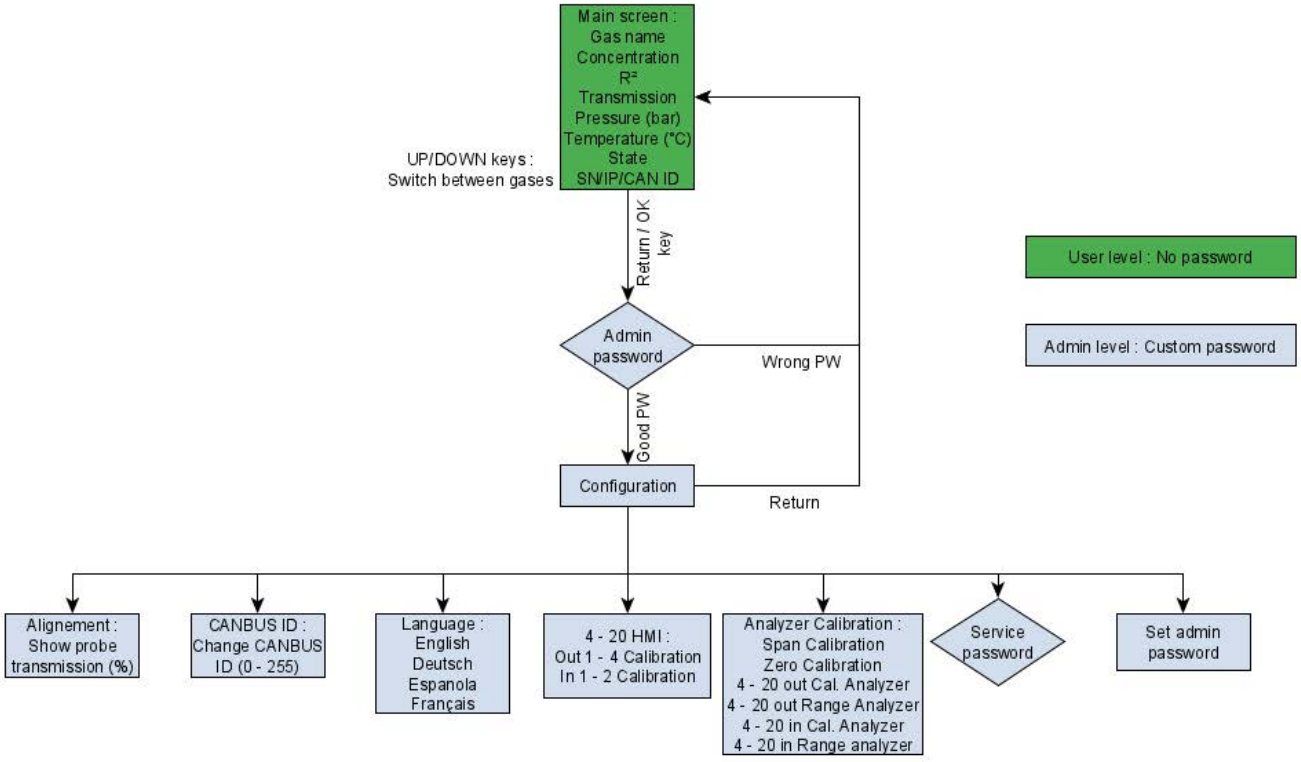


Figure 40 HMI access structure

The user has access to the menu from the HMI level. The menu structure is as following (English).

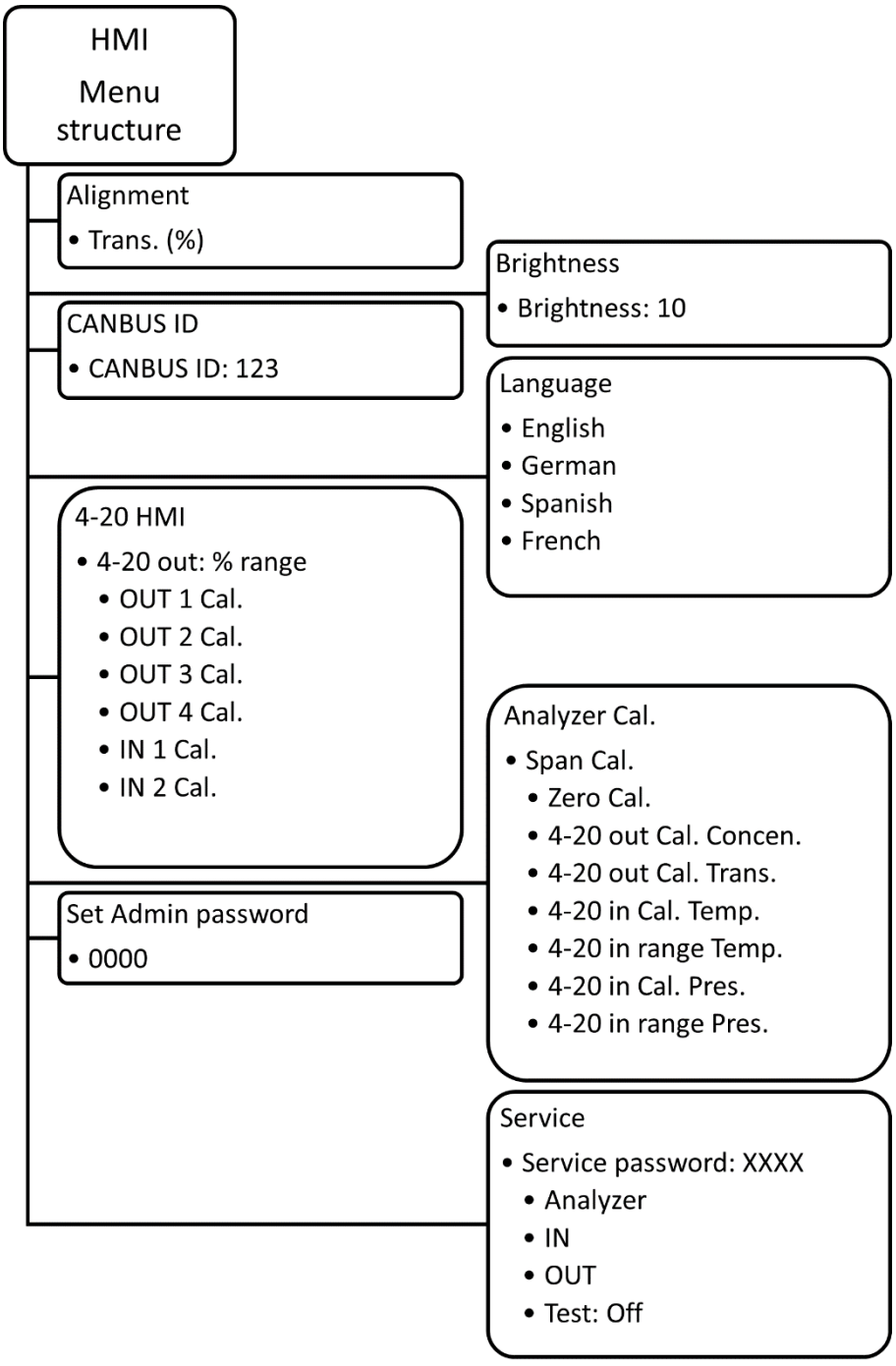


Figure 41 HMI menu structure - English

13.9.1 Measurements

The measurements in the standard view are displayed in the following figure.

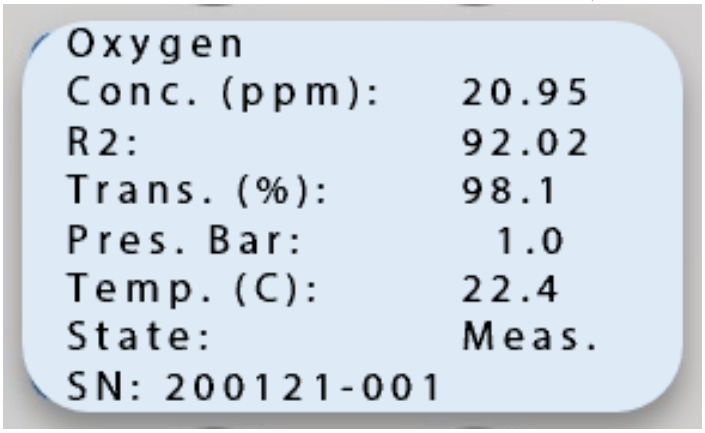


Figure 42 HMI display: measurements

Note Items in this category are read-only.

MEASUREMENTS	
Display	**Description**
ALIAS (e.g.: SO2) Conc. (ppm)	Displays the concentration value (can be only a few ALIAS items)
R2	The R^2 is a linear regression figure of merit. It shows the quality of the measurement (R^2) and should be > 0.9. It´s maximum is 1.0
Trans. (%)	Displays the transmission value in %
Pres. Bar	Displays the pressure value of the process gas
Temp. (C)	Displays the temperature value of the process gas
State	Shows the current status of the ILA1-B000-EX (measuring, warm-up, malfunction, maintenance etc.); see detailed explanation in chapter 12.2
SN/IP/CAN Bus ID	The display switches between Serial number, IP and CAN Bus ID of the analyzer

Table 7 Description of HMI display – measurements

ALIGNMENT	
Display	**Description**
Alignment	The transmission is a measure of the amount of light that returns from the transmitter (usually a laser diode) through the sample gas to the receiver. Therefore, effects such as dust exposure, contamination with dirt or dust of the optical elements (e.g. wedge windows) or alignment deviations (alignment accuracy, deviation due to asymmetrical thermal expansion, etc.) become visible here. The transmission value should be at least 100 % after realignment and cleaning. Since the value is standardized in the factory setting, it can have a value greater than 100 % after realignment and cleaning.

Table 8 Description of HMI display – alignment

Note

The parameter transmission in "Alignment" is read-only.

13.9.2 Parameters

Note

Items in this category can be both read and written.

Settings I		
Display	**Description**	**Allowed range of values**
Brightness	The desired brightness of the LCD display can be entered here.	0…10
CAN Bus-ID	The unique CAN bus ID must be entered here.	1…256
Language	The desired language can be selected here.	

Table 9 Description of settings I in the HMI

13.9.3 Analog Inputs and Outputs (IOs)

Note

Sub-elements from "AIN x" or "AOUT x" can be edited.

Settings Outputs "4-20 HMI"		
Display	**Description**	**Allowed range of values**
OUT 1 Cal.	Calibration of Output 1	0.00….99.99
OUT 2 Cal.	Calibration of Output 2	0.00….99.99
OUT 3 Cal.	Calibration of Output 3	0.00….99.99
OUT 4 Cal.	Calibration of Output 4	0.00….99.99
IN 1 Cal.	Calibration of Input 1	0.00….99.99
IN 2 Cal.	Calibration of Input 2	0.00….99.99

Table 10 Description of the "4-20 HMI" panel in the HMI

Settings Inputs "Analyzer Cal."		
Display	**Description**	**Allowed range of values**
Span Cal.	Calibration of the span point of the gas-measuring signal. Span gas has to be provided at least 5 min before starting span calibration. Concentration of the span gas has to be provided in the same unit as the one displayed in the main screen (ppm or %).	0.0…999.9
Zero Cal.	Calibration of the zero point of the gas-measuring signal. Zero gas has to be provided at least 5 min before starting zero calibration.	
4-20 out Cal. Concen.	Calibration of the 4-20 mA output for the analyzer's gas-measuring signal. The value is to be given in mA.	0.0…99.99
4-20 in Cal. Temp.	Calibration of the analyzer's temperature input signal. The value is to be given in Kelvin.	0…9999
4-20 in range Temp.	Scaling of the output signal for the analyzer's temperature input signal. The values are to be given in Kelvin. A minimum (4 mA) and a maximum (20 mA) are asked.	0…9999
4-20 in Cal. Pres.	Calibration of the analyzer's pressure input signal. The value is in bar. A minimum (4 mA) and a maximum (20 mA) are asked.	0.00…99.99
4-20 in range Pres.	Scaling of the output signal for the analyzer's pressure input signal. The values are to be given in bar.	0.00…99.99

Table 11 Description of the settings input "Analyzer Cal." in the HMI

Note

X [°C] = Y [Kelvin] + 273.15
X [°F] = ((Y [Kelvin] - 273.15) x 9) / 5 + 32

13.10 State

At the display entry for "State:", the current status of the measuring system is shown. If the measurement is running without any problems, it shows "Meas.". In the event of an error, "Error" is displayed.

When starting up, "Init." is displayed first. Then, the system is performing a self-check. After the self-check, the system goes into the "Idle" state. "Cal." is the output for the calibration mode.
The six possible signals are:

Name shown on the HMI	Status	Description
Init.	Initialisation	System is starting up
Check	Check	System is performing a self-check
Idle	Idle	System is ready for measuring
Meas.	Measuring	System is running without any warning or error
Error	Error	Critical error
Cal.	Calibrate	System is in calibration mode

Table 12 Description of the different status of the measuring device

13.11 Buttons on the HMI

There are four buttons on the lid of the HMI. Each button has a function depending on the mode. There are two modes "Normal input" and "Editing".

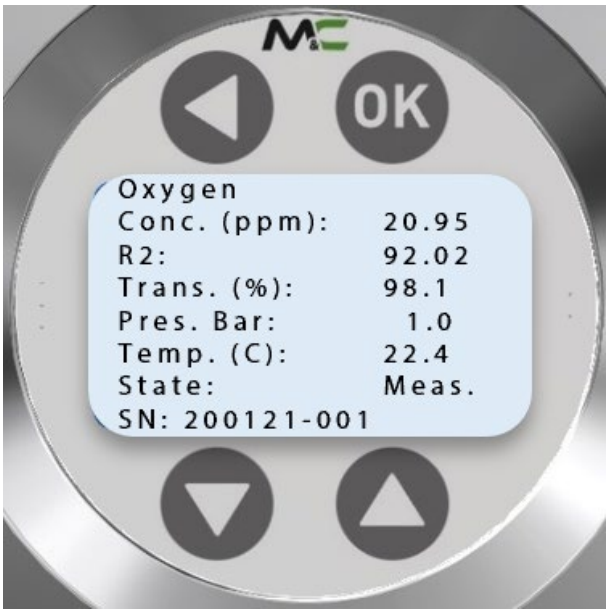


Figure 43 HMI buttons

HMI buttons		Normal input	Editing
	Up	Move up	Increment digit
	Down	Move down	Decrement digit
	Left/return	Return to last menu	Go left
OK	Enter	Select item	Confirm changes/value

Table 13 Description of the button functionality

13.12 Admin Password

A password is required to change parameters, settings, offsets or the scale of AINx/AOUTx.

The following password is case sensitiv: **XXXX**

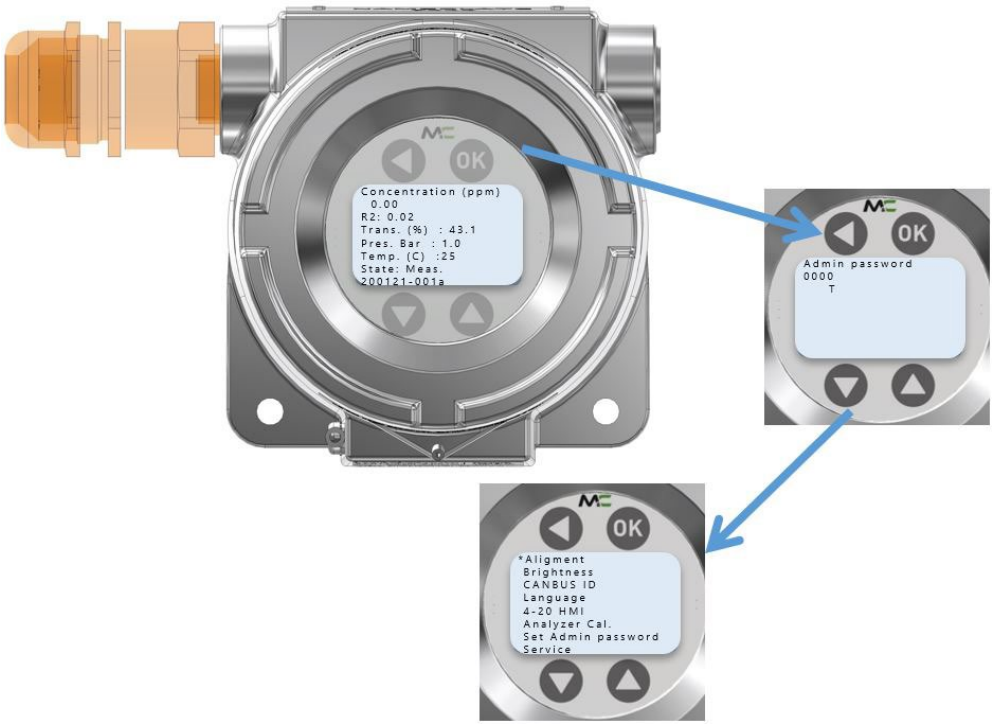


Figure 44 HMI admin password – enter XXXX to access admin menu

To enter the admin-password, press the or OK key. Type password XXXX by increasing or decreasing the specific digit and moving left to adapt the next digit. Finally press the OK key to confirm. After confirmation of the correct password, the Admin menu opens. In case the wrong password has been confirmed, the main menu is shown. Default admin password is: **0000**.

13.13 Service Menu Navigation

The service menu, which can be called up using a different password, is reserved for M&C TechGroup and has more extensive access and setting options, as well as diagnosis values (e.g. temperatures).

14 WebServer Application

The WebServer application allows to monitor the In-situ Laser Analyzer parameters i.e. transmission value or scaling of input and output parameters which are necessary to properly adjust the instrument. These parameters are available in the Analyzer configuration.

14.1 Establishing Communication with the ILA1-X000-EX

Note

A router with integrated DHCP server has to be connected for the communication between the ILA analyzer and the computer to work properly. By default the ILA analyzer has a auto ip configuration and needs the DHCP server to provide it with an IP address.

Note

Do not use any other browser than **Firefox** to establish communication.
To download the latest version of the Firefox browser, visit the Mozilla homepage at: https://www.mozilla.org/de/firefox/new/

Note

Check with your IT department if the use of an automatic IP addressing (DHCP) is compatible with the computer that you are using.

The communication is based on the Microsoft Windows 10 operating system. Follow these steps to establish communication between the computer and the In-situ Laser Analyzer:

Use the right mouse button on "Start"-symbol (1) and open "Network Connections" (2)

Figure 45 Webserver configuration I

Select "Ethernet" (3) with the left mouse button, double-click to "Change adapter options" (4) and click with the right button on "Ethernet" (5). To check/modify the properties of this Ethernet connection, select "Properties".

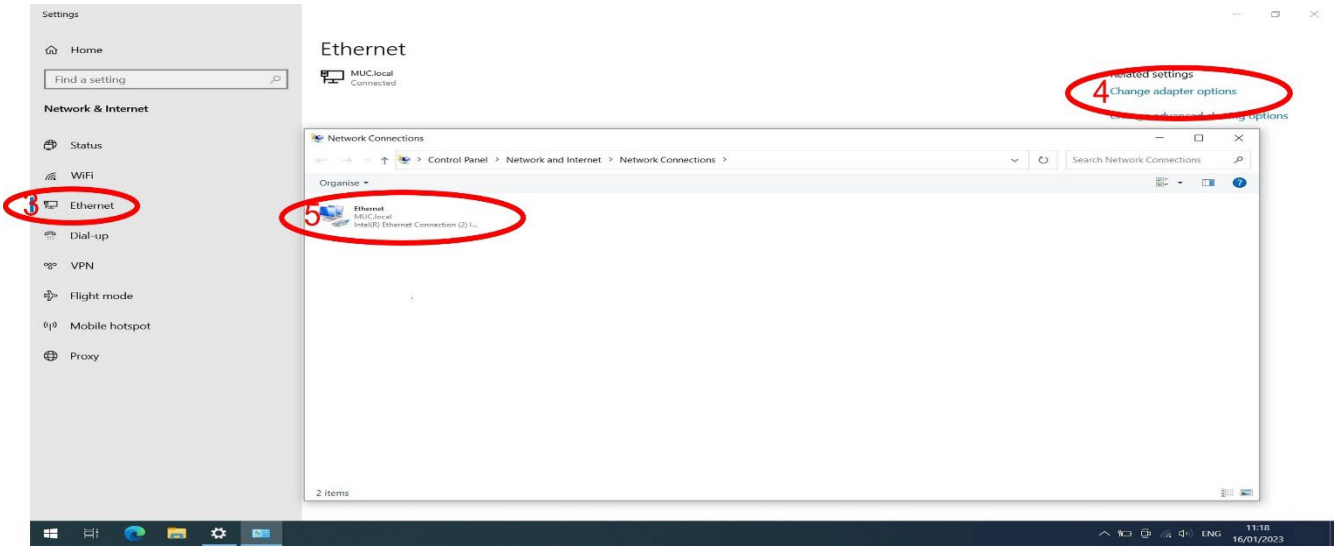


Figure 46 Webserver configuration II

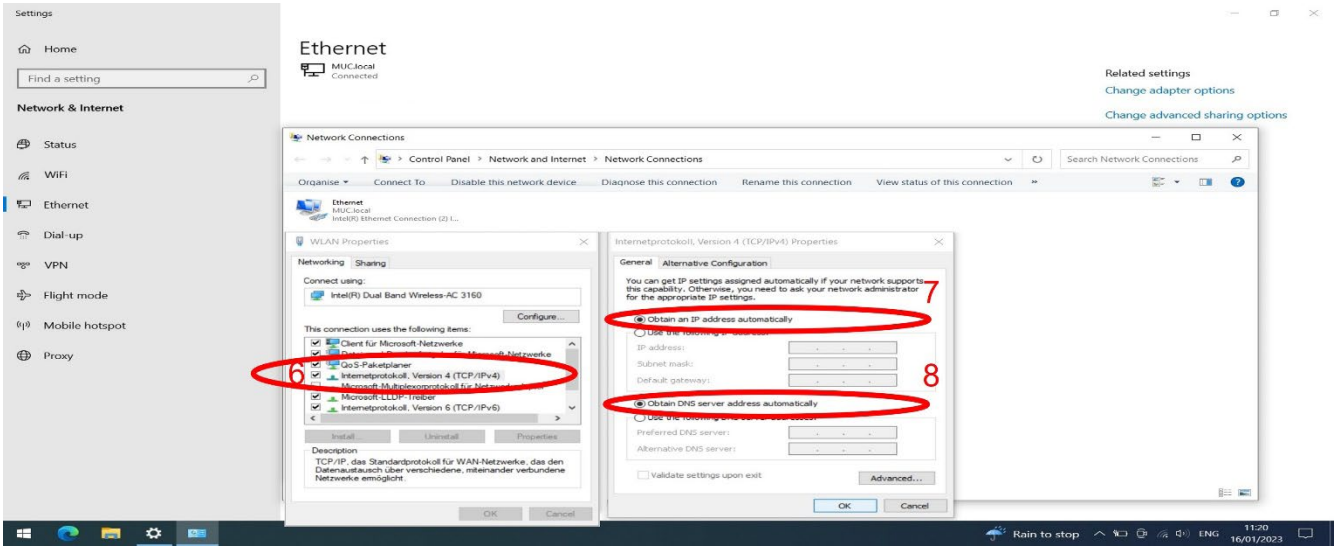


Figure 47 Webserver configuration III

Select "Internet Protocol, Version 4 (TCP/IPv4)" (6) and go to "Properties". Check, that the settings are "Obtain an IP address automatically" (7) and "Obtain DNS server address automatically" and apply changes in case you had to modify it.

After that, you can start the Webserver:

1. Open Mozilla Firefox as your internet browser.
2. Type in the IP-address of the device (XXX.XXX.XXX.XXX) (the IP address depends on the assignment by the DHCP server and can be read, for example, on the HMI in the bottom line)
3. The WebServer application opens when the Ethernet connection is established.

14.2 Webserver - Measurement Window

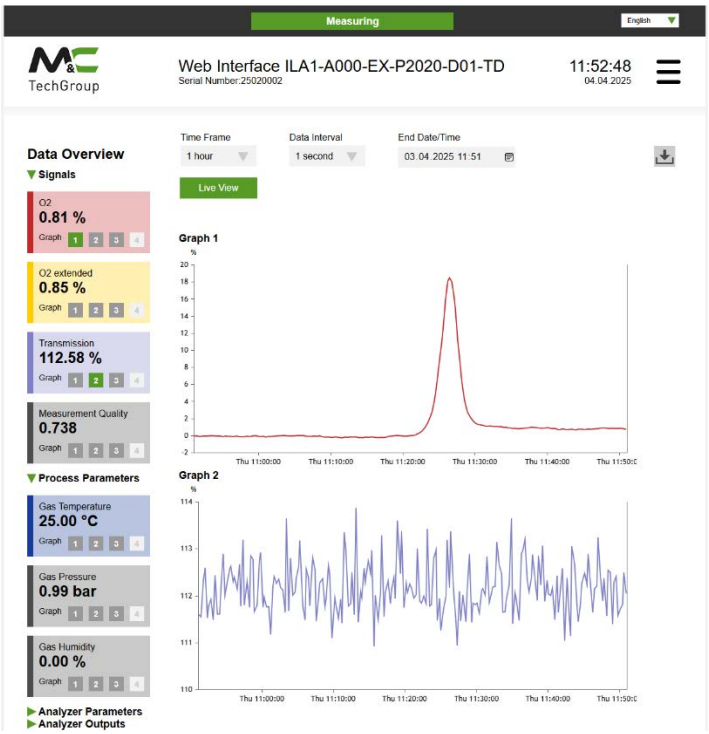


Figure 48 Webservice user access level - measurement window

The following functions are on the right side of the measurement window:

Measurement window functions	
Functions	**Description**
Time Frame	The length of the time interval to be displayed graphically can be set here.
Data Interval	The web server collects the data from the analyzer in the set time interval.
End Date/Time	When a time is entered and confirmed, past measurement data up to the set time is displayed.
Live View	Pressing the button switches from the display of past measured values to the current measured values.
Data Export	By pressing the button, measurement data from the laser can be exported as a CSV file.

Table 14 Measurement window functions

14.3 Configuration Menu Access

The analyzer configuration access is restricted. To obtain the password to this part of the Webservice please contact M&C service.

Figure 49 Webservice login window

After logging in the configuration window, the Webservice window will appear.

You can go back to the measurement window by clicking the return button.

14.4 Webservice - Configuration Menu

The following settings can be made in the configuration menu:

Analyzer configuration:

- Calibration of the analyzer (multi-point calibration) for two measuring ranges
- Configuration and calibration of the analog outputs
- Adjusting the CAN Bus-ID

Settings of the temperature probe

- Temperature probe mode (4-20 mA / Constant)
- Scale minimum of the 4-20 mA input for temperature
- Scale maximum of the 4-20 mA input for temperature
- Temperature probe calibration

Settings of the pressure probe

- Pressure probe mode (RS485 / 4-20 mA / Constant)
- Scale minimum of the 4-20 mA input for pressure
- Scale maximum of the 4-20 mA input for pressure
- pressure probe calibration

HMI configuration:

- Configuration and calibration of the analog outputs

15 Start-up of the In-situ Laser Analyzer

After calibration, installation (mechanical and electrical) and alignment according to the technical specifications, the In-situ Laser Analyzer is ready for the start-up procedure.

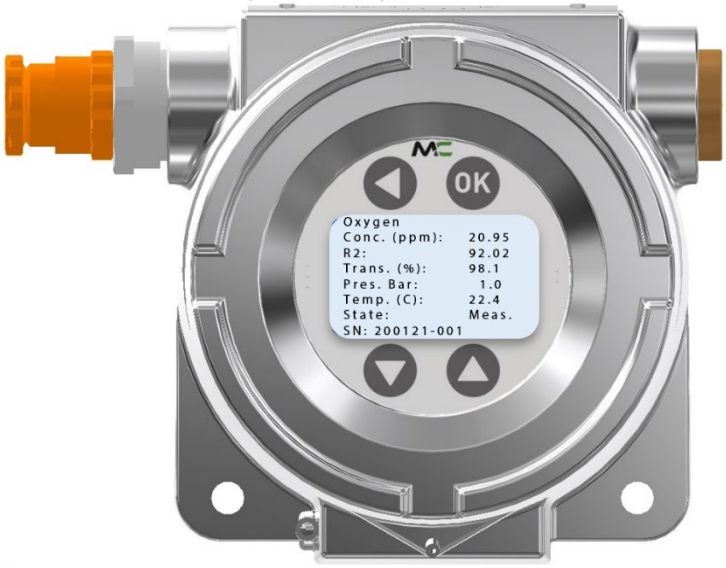


Figure 50 HMI display with standard process parameters

The start-up procedure takes about 3 minutes. When starting up, "initialization" is displayed first. Then, the system is performing a self-check. After this, the system goes into the "Idle" state. When the system is set to automatically measuring, it is starting the measurement directly after it is in idle state.
When the system has an error or warning, the screensaver will be disabled.
The word "Measurement" displayed at a certain interval indicates a proper operation. In this case the system is running without any warning or error.
In case of operation without HMI, the system starts as soon as the power supply is activated and the computer system, which is located in the TDL head, boots.

The proper function can be seen with the WebServer application (see chapter 14 "WebServer application").

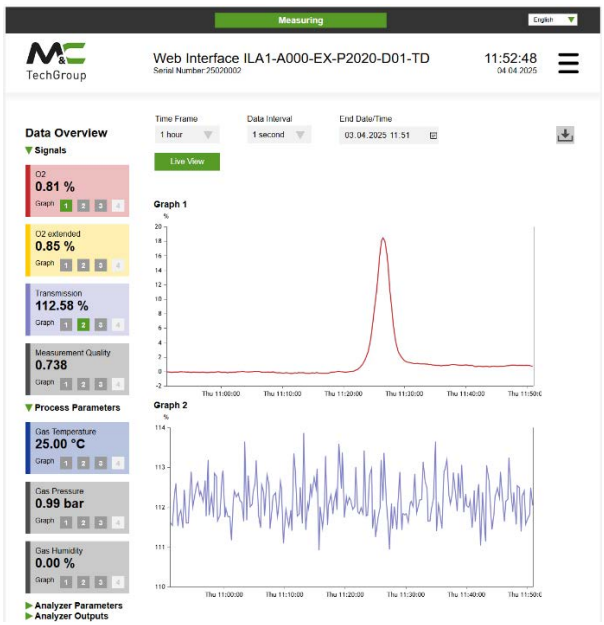


Figure 51 Webservice user access level - measurement window

16 Decommissioning

Purge the In-situ Laser Analyzer with instrument air (for SO_2 only) or inert gas.

Aggressive condensate possible!
Chemical burns caused by aggressive media possible!

For general electrical and mechanical work on the analyzer, wear personal protective equipment (PPE) in accordance with the risk assessment.

17 Maintenance

Note

We recommend a visual inspection of the system every 6 months and annual maintenance.

The intervals between servicing are dependent on the process and system conditions in your facility. The facility QA/QC plan should address the frequency for maintenance and should be updated based on your operations.

Danger

Maintenance work on equipment for use in potentially explosive areas needs to comply with the corresponding national standards regarding 'regulations of electrical systems in potentially explosive areas'. It also needs to follow all safety notes and descriptions stated in this manual.

There may be harmful sample gases in the analyzer. Prevent potentially harmful gases from escaping the open probe maintenance and mounting flange. Purge this area with inert gas or air before servicing or wear appropriate personal protective equipment.

Warning

Danger due to laser radiation!
Laser class of the laser head without probe:
O_2 laser: Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam
SO_2 laser: Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments.
Switch off the power supply before any assembly, maintenance or disassembly.

Aggressive condensate possible!
Chemical burns caused by aggressive media possible!

For general electrical and mechanical work on the analyzer, wear personal protective equipment (PPE) in accordance with the risk assessment.

Caution

Electrostatic discharges can act as an ignition spark in hazardous areas. Avoid electrostatic charging of the housing surface due to friction. Do not clean the device with a dry cloth.

Please refer to the spare parts list for our recommended spare parts.

Warning

Explosion hazard due to wear and tear!

A periodical inspection of all analyzer parts based on the following servicing plan is necessary.

Inspect the following analyzer components	**Action**
Realigning the beam	When the transmission is getting lower than 30 %, the aligning of the beam needs to be checked according to chapter 12.
Cleaning of optics	If the transmission is still poor after realigning the beam, the optics might be dirty, and they should be cleaned (wedged window and retroreflector) according to chapter 17.2.

Table 15 Maintenance on the system

Warning

Components like cable glands and protective plugs can only be replaced by equal parts with a type examination certificate.

17.1 Cleaning the Laser Housing

The housing of the **In-situ Laser Analyzer** should be checked in suitable time intervals. Dust layers of more than 5 mm [approx. 0.2"] must be removed immediately.

Warning

To avoid static charges, always clean with a damp cloth.

17.2 Cleaning of the Optics

Warning

Danger due to laser radiation!
Laser class of the laser head without probe:
O_2 laser: Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam
SO_2 laser: Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments.
Switch off the power supply before any assembly, maintenance or disassembly.

The optical components, such as wedge windows and retroreflectors can be cleaned with pure isopropanol. If the dirt is organic, it can also be burned off by heating it up to 900 °C (pyrolytic cleaning), since the coating is designed for this temperature. No scouring agents may be used for cleaning.

If the wedge windows are removed from the probe, they must be installed in exactly the same rotational position and installation direction. The wedge angle on the wedge windows is very small and not perceptible to the eye. The orientation of the wedged window is marked with an arrow on the outer diameter.

When cleaning the optical components, care must be taken not to scratch the anti-reflection coating.

18 Disassembling the In-situ Laser Analyzer

Purge the analyzer with instrument air (for SO_2 only) or inert gas.

Aggressive condensate possible!
Chemical burns caused by aggressive media possible!

For general electrical and mechanical work on the analyzer, wear personal protective equipment (PPE) in accordance with the risk assessment.

Follow these warnings and safety instructions before disassembly:

Danger due to laser radiation!
Laser class of the laser head without probe:
O_2 laser: Laser class 3B in accordance with IEC 60825-1, avoid exposure to beam
SO_2 laser: Laser class 1M according to IEC 60825-1, do not view laser radiation directly with optical instruments.
Switch off the power supply before any assembly, maintenance or disassembly.

There may be harmful sample gases in the analyzer. Prevent potentially harmful gases from escaping the probe during disassembly.

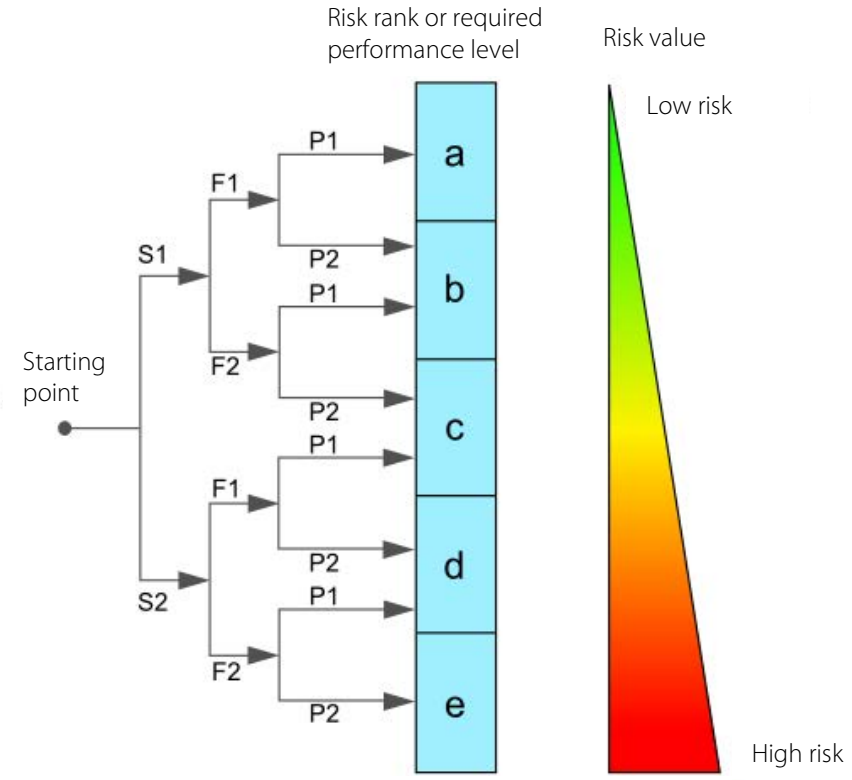
19 Proper Disposal of the Device

At the end of the life cycle of our products, it is important to take care of the appropriate disposal of obsolete electrical and non-electrical devices. To help protect our environment, please follow the rules and regulations of your country regarding recycling and waste management.

20 Risk Assessment

The risk assessment provided in this chapter is intended for all work activities on the product. The hazards can occur in the work steps of assembly, commissioning, maintenance, disassembly and in the event of a product fault. During normal operation, the product is protected by a system cabinet or appropriate covers.
Only qualified personnel is permitted to perform the work. The following minimum knowledge is required for the work:
Employee instruction provided in process engineering
Employee instruction provided in electrical engineering
Detailed knowledge of the instruction manual and the applicable safety regulations

The product complies with the current regulations according to state-of-the-art science and technology. Nevertheless, not all sources of danger can be eliminated while observing technical protective measures. Therefore, the following risk assessment and the description of exposure hazards refer to the work steps mentioned above.



Severity of injury:
S1 = 1 = minor (reversible injury)
S2 = 2 = serious (irreversible injury, death)

Frequency and duration:
F1 = 1 = infrequent or short exposure to hazard
F2 = 2 = frequent (more than once per hour/shift)

Possibility of preventing or limiting the damage:
P1 = 1 = possible
P2 = 2 = hardly possible

Figure 52: Overview risk assessment

Caution electric shock Supply unit

Risik rank group B-C
When installing high-power systems with nominal voltages of up to 1000 V, the requirements of VDE 0100 and their relevant standards and regulations must be observed!
This also applies to any connected alarm and control circuits. Before opening the products, they must always be disconnected from the power supply.

Gas hazard

Risk rank group C
The purging unit can be operated with nitrogen. In the event of a leak, the cabinet may be exposed to a nitrogen atmosphere. Observe the appropriate personal protective equipment (PPE).

Gas hazard

Risk rank group A-B-C
The hazard potential mainly depends on the gas to be extracted.
If toxic gases, oxygen displacing or explosive gases are conveyed with the product, an additional risk assessment by the operator is mandatory.
In principle, the gas paths must be purged with inert gas or air before opening the gas-carrying parts.
The escape of potentially harmful gas from the open process connections must be prevented.
The relevant safety regulations must be observed for the media to be conveyed. If necessary, flush the gas-carrying parts with a suitable inert gas. In the event of a gas leakage, the product may only be opened with suitable PPE or with a monitoring system.
Furthermore, the work safety regulations of the operator must be observed.

Danger from laser radiation

Risk rank group B
Trained personnel only
When installed, the laser is declared as class 1. Work on the laser analyzer and the clamps may only be carried out after the laser has been switched off, otherwise laser class 3B applies.

Caution crushing hazard

Risk rank group A
The work must be performed by trained personnel only.
This applies to products weighing less than < 40 kg [≈ 88.2 lbs]:
The product can be transported by 1 to 2 person(s). The instructions for appropriate personal protective equipment (PPE) must be observed.
The weight specifications are contained in the technical data of this product.
Furthermore, the work safety regulations of the operator must be observed.

21 Trouble Shooting

Problem/Indication	Possible cause	Error code	Check/Action	M&C service needed
Laser head (TDL-System) is not starting at all	No main supply		Check power supply; Check power cable for proper connection.	
Laser head (TDL-System) is not starting completely	Parameters file unreadable	40	Impossible to read the parameters file. Call M&C-service to connect to the file server to investigate.	x
	Database unreadable	41	Impossible to read the database. Call M&C-service to connect to the file server to investigate.	x
	FPGA problem	50	The FPGA is not working properly. Shutdown the laser head for at least 1 minute and restart it.	
	FPGA communication problem	51	The FPGA is not communicating properly. Shutdown the laser head for at least 1 minute and restart it.	
	FPGA acquisition timeout occured	54	The acquisition took more than 30 s. Check the analyzer parameters.	
	CAN Bus controller not working	62	The CAN Bus is not working properly. Shutdown the laser head for at least 1 minute and restart it.	
			Use right CAN-Bus ID	
System is starting, but TDL is not measuring	Laser thermalization problem	1	The laser diode temperature stabilization is impossible. Call M&C-service to connect to the maintenance interface and/or open laser head to investigate.	x
	Laser temperature incorrect	4	The laser diode temperature is incorrect. Call M&C-service to open laser head and check the laser diode thermistor connection.	x
	Laser emission too high	11	The laser diode is emitting too much power or the reference photodiode is having a problem. Call M&C-service to connect to the maintenance interface and/or open laser head to investigate.	x
	Laser temperature too low	2	The laser diode temperature is too low (T < 10 °C) to thermalize properly. Check probe temperature.	
	FPGA temperature too low	52	The FPGA temperature is too low (T < 0 °C). Check laser head temperature	
	PCB temperature too low	55	The PCB temperature is too low (T < -10 °C). Check laser head temperature	

Problem/Indication	Possible cause	Error code	Check/Action	M&C service needed
	Laser head temperature too low	60	The laser head temperature is too low (T < -40 °C). Check laser head temperature.	
	Laser temperature too high	3	The laser diode temperature is too high (T > 80 °C) to thermalize properly. Check probe temperature.	
	FPGA temperature too high	53	The FPGA temperature is too high (T > 120 °C). Check laser head temperature.	
	PCB temperature too high	56	The PCB temperature is too high (T > 85 °C). Call M&C-service to check laser head temperature.	x
	Laser head temperature too high	61	The laser head temperature is too high (T > 80 °C). Call M&C-service to check laser head temperature.	
HMI not working	Wrong CAN-Bus ID		Use right CAN-Bus ID	
Low transmission	Sun heats up the laser head on one side		Protect laser head from asymmetric sun radiation	
	Poor alignment of laser beam	10	Realignment of beam	
	No purge gas => optics got dirty	10	Clean optics	
	Dirty optics due to dust	10	Clean optics and call M&C-service for a dust filter on the probe	
	Laser emission is too low	10	The laser diode is not emitting enough power or the reference photodiode is having a problem. Connect to the maintenance interface and/or open laser head to investigate.	
Measurement signal too high	System has been calibrated with purge gas flow and purge gas flow has been stopped		Calibrate system without purge gas flow	
	Leakage between buffer zone and process zone with additional too low pressure in the buffer zone		Check pressure in buffer zone and replace gasket between process zone and buffer zone	
	Process gas pressure not correct		Use proper pressure probe to have more precise compensation of the measuring signal	
	Process gas pressure too low	120	Adapt process gas temperature	
	Process gas pressure too high	121	Adapt process gas temperature	

Problem/Indication	Possible cause	Error code	Check/Action	M&C service needed
	Process gas temperature is not correct	-/112	Use proper temperature probe to have more precise compensation of the measuring signal	
	Process gas temperature too low	110	Adapt process gas temperature	
	Process gas temperature too high	111	Adapt process gas temperature	
	Process gas temperature out of range		Adapt process gas pressure	
Measurement signal too low	Purge gas flow is too high and displaces the gas to be measured from the measuring zone		Adjust the purge gas flow as described in the manual	
	Leakage between buffer zone and process zone		Replace gasket between buffer zone and process zone	
	Process gas pressure not correct		Use proper pressure probe to have more precise compensation of the measuring signal	
	Process gas pressure too low	120	Adapt process gas temperature	
	Process gas pressure too high	121	Adapt process gas temperature	
	Process gas temperature is not correct	-/112	Use proper temperature probe to have more precise compensation of the measuring signal	
	Process gas temperature too low	110	Adapt process gas temperature	
	Process gas temperature too high	111	Adapt process gas temperature	
	Process gas temperature out of range		Adapt process gas pressure	
Purge gas demand too high	Usage of wrong pressure regulator (with bleeding instead of without bleeding)		Use correct pressure regulator without bleeding	
	Leakage on the laser head		Call M&C-service to replace O-Ring	x

Table 16 Trouble shooting on the system

In the case of unexpected operating states, a distinction is made between critical errors, which do not allow measurement, and warnings, where measurement continues.

ID (0-255)	Name	Description
1	Laser thermalization problem	The laser diode temperature stabilization is impossible. Connect to the maintenance interface and/or open laser head to investigate.
2	Laser temperature too low	The laser diode temperature is too low (T < 10 °C) to thermalize properly. Check probe temperature.
3	Laser temperature too high	The laser diode temperature is too high (T > 80 °C) to thermalize properly. Check probe temperature.
4	Laser temperature incorrect	The laser diode temperature is incorrect. Open laser head and check the laser diode thermistor connection.
10	Laser emission too low	The laser diode is not emitting enough power or the reference photodiode is having a problem. Connect to the maintenance interface and/or open laser head to investigate.
11	Laser emission too high	The laser diode is emitting too much power or the reference photodiode is having a problem. Connect to the maintenance interface and/or open laser head to investigate.
40	Parameters file unreadable	Impossible to read the parameters file. Connect to the file server to investigate.
41	Database unreadable	Impossible to read the database. Connect to the file server to investigate.
50	FPGA problem	The FPGA is not working properly. Shutdown the laser head for at least 1 minute and restart it.
51	FPGA communication problem	The FPGA is not communicating properly. Shutdown the laser head for at least 1 minute and restart it.
52	FPGA temperature too low	The FPGA temperature is too low (T < 0 °C). Check laser head temperature.
53	FPGA temperature too high	The FPGA temperature is too high (T > 120 °C). Check laser head temperature.
54	FPGA acquisition timeout occured	The acquisition took more than 30 sec. Check the analyzer parameters.
55	PCB temperature too low	The PCB temperature is too low (T < -10 °C). Check laser head temperature.
56	PCB temperature too high	The PCB temperature is too high (T > 85 °C). Check laser head temperature.
60	Laser head temperature too low	The laser head temperature is too low (T < -40 °C). Check laser head temperature.
61	Laser head temperature too high	The laser head temperature is too high (T > 80 °C). Check laser head temperature.
62	CAN Bus controller not working	The CAN Bus is not working properly. Shutdown the laser head for at least 1 minute and restart it.

Table 17 Trouble shooting – error code list

ID (0-255)	Name	Description
100	Transmission too low	The measurement channel is not receiving enough power. The probe is either not transmitting enough (dust/fouling) or is misaligned. Realign the probe and/or check for window/retroreflector fouling.
101	Measure channel saturation	The measurement channel is saturated. It either receive too much optical power or the channel is having a problem. Connect to the maintenance interface and/or open laser head to investigate.
102	Quality of measurement too low	The quality of measurement is too low. Connect to the maintenance interface and check the spectrum.
110	Gas temperature too low	The gas temperature is too low (T < -40 °C). The measurement can be inaccurate. Increase the gas temperature.
111	Gas temperature too high	The gas temperature is too high (T > 600 °C). The measurement can be inaccurate. Reduce the gas temperature.
112	Gas temperature probe not connected	The gas temperature probe is not connected. A default 20 °C temperature is selected.
120	Gas pressure too low	The gas pressure is too low (P < 0 bar). The measurement can be inaccurate. Increase gas pressure.
121	Gas pressure too high	The gas pressure is too high (P > 5 bar). The measurement can be inaccurate. Reduce gas pressure.
122	Gas pressure probe not connected	The gas pressure probe is not connected. A default pressure of 1 bar is selected.
150	CAN Bus device not connected	No CAN Bus device is connected to the laser head. Connect a CAN Bus device to the laser head.

Table 18 Trouble shooting – warning code list

22 Appendix 1: Modbus TCP Configuration

Information about the Modbus TCP configuration: IP address:
DHCP defined; TCP port number: 502

Description	Type	Read/ Write	Unit	Format	Func-tion	Address (HEX)	Address w/o offset (DEC)	Column 1
Error	Coil	R		boolean	2	2711	1	0
Relay_in	Coil	R		boolean	2	2719	2	1
Relay_out	Coil	R		boolean	2	2721	3	2
Heater_1	Coil	R		boolean	2	2729	4	3
Heater_2	Coil	R		boolean	2	2731	5	4
GPIO_0	Coil	R		boolean	2	2739	6	5
GPIO_1	Coil	R		boolean	2	2741	7	6
GPIO_2	Coil	R		boolean	2	2749	8	7
G0	Coil	R		boolean	2	2751	9	8
G1	Coil	R		boolean	2	2759	10	9
Laser_ON	Coil	R		boolean	2	2761	11	10
PID_regulation_ON	Coil	R		boolean	2	2769	12	11
Diode_temperature_stabilization	Coil	R		boolean	2	2771	13	12
Gas concentration 1	Input register	R	ppb	uint32	3	9C41	1	0
Gas concentration 2	Input register	R	ppb	uint32	3	9C43	3	2
Gas concentration 3	Input register	R	ppb	uint32	3	9C45	5	4
Gas concentration 4	Input register	R	ppb	uint32	3	9C47	7	6
Gas concentration 5	Input register	R	ppb	uint32	3	9C49	9	8
Confidence index gas	Input register	R		uint16	3	9C4B	11	10
Transmission	Input register	R	%	uint16	3	9C4C	12	11
Diode temperature setpoint	Input register	R	0.01 °C	uint16	3	9C4D	13	12
Diode temperature	Input register	R	0.01 °C	uint16	3	9C4E	14	13
Diode temperature output	Input register	R	mV	uint16	3	9C4F	15	14
Gas temperature	Input register	R	0.01 °C	uint16	3	9C50	16	15
Gas pressure	Input register	R	mbar	uint16	3	9C51	17	16
Analyzer temperature	Input register	R	0.01 °C	uint16	3	9C52	18	17

Description	Type	Read/ Write	Unit	Format	Func-tion	Address (HEX)	Address w/o offset (DEC)	Column 1
Processor temperature	Input register	R	0.01 °C	uint16	3	9C53	19	18
PCB temperature	Input register	R	0.01 °C	uint16	3	9C54	20	19
Analyzer pressure	Input register	R	mbar	uint16	3	9C55	21	20
Analyzer state	Input register	R		uint16	3	9C56	22	21
Analyzer error code	Input register	R		uint16	3	9C57	23	22
FPGA version	Input register	R		String (20 bytes)	3	9C69	41	40
Firmware version	Input register	R		String (20 bytes)	3	9C73	51	50
Serial number	Input register	R		String (20 bytes)	3	9C7D	61	60

Table 19 Modbus TCP register map

Scaling to integer value (0 - 27648) at max. failure current 22 mA

System		Gas Concentration	Transmission	AI	AO	Description
Integer	**Hexadecimal**	**0 to 10 [ppm]**	**0 to 100 [%]**	**4 to 20 [mA]**	**4 to 20 [mA]**	
32767	7FFF	11.250	118.51	22.00	22.00	Overflow
32512	7F00					
32502	7EF6	11.159	117.59	21.85	21.85	Overshoot range
27649	6C01					
29126	71C6	10	100	20	20	Nominal range
21845	5555	7,5	75	16.00	16.00	
1	1	0.00034	0.0034	4 + 549.34 nA	4 + 549.34 nA	
0	0	0	0	4	4	
-1	FFFF					Undershoot range
-5124	EBFC	-1.759		1.185	1.185	
-5125	EBFB					Underflow
-32768	8000					

Table 20 Scaling to integer value (0 - 27648) at max. failure current 22 mA

23 Appendix 2: Modbus RTU Configuration

The RS-485 communication with modbus RTU is prepared for communicating with a Keller pressure sensor.

RS-485 communication settings:

Band rate:	9600 bps
Data bits:	8
Parity:	No parity
Start bits:	1
Stop bits:	1
Flow control:	None
Modbus RTU slave address:	245 (default)

Table 21 RS-485 communication settings (Modbus RTU)

Modbus RTU module responses on "Read Input Register" request function, any other request end with "Illegal function" response.

Description	Type	Read / Write	Unit	Format	Func - tion	Address (HEX)	Address w/o offset (DEC)	Column 1
Error	Coil	R		boolean	2	2711	1	0
Relay_in	Coil	R		boolean	2	2719	2	1
Relay_out	Coil	R		boolean	2	2721	3	2
Heater_1	Coil	R		boolean	2	2729	4	3
Heater_2	Coil	R		boolean	2	2731	5	4
GPIO_0	Coil	R		boolean	2	2739	6	5
GPIO_1	Coil	R		boolean	2	2741	7	6
GPIO_2	Coil	R		boolean	2	2749	8	7
G0	Coil	R		boolean	2	2751	9	8
G1	Coil	R		boolean	2	2759	10	9
Laser_ON	Coil	R		boolean	2	2761	11	10
PID_regulation_ON	Coil	R		boolean	2	2769	12	11
Diode_temperature_stabilization	Coil	R		boolean	2	2771	13	12
Gas concentration 1	Input register	R	ppb	uint32	3	9C41	1	0
Gas concentration 2	Input register	R	ppb	uint32	3	9C43	3	2
Gas concentration 3	Input register	R	ppb	uint32	3	9C45	5	4
Gas concentration 4	Input register	R	ppb	uint32	3	9C47	7	6
Gas concentration 5	Input register	R	ppb	uint32	3	9C49	9	8
Confidence index gas	Input register	R		uint16	3	9C4B	11	10

Description	Type	Read / Write	Unit	Format	Func - tion	Addres s (HEX)	Addres s w/o offset (DEC)	Column 1
Transmission	Input register	R	%	uint16	3	9C4C	12	11
Diode temperature setpoint	Input register	R	0.01 °C	uint16	3	9C4D	13	12
Diode temperature	Input register	R	0.01 °C	uint16	3	9C4E	14	13
Diode temperature output	Input register	R	mV	uint16	3	9C4F	15	14
Gas temperature	Input register	R	0.01 °C	uint16	3	9C50	16	15
Gas pressure	Input register	R	mbar	uint16	3	9C51	17	16
Analyzer temperature	Input register	R	0.01 °C	uint16	3	9C52	18	17
Processor temperature	Input register	R	0.01 °C	uint16	3	9C53	19	18
PCB temperature	Input register	R	0.01 °C	uint16	3	9C54	20	19
Analyzer pressure	Input register	R	mbar	uint16	3	9C55	21	20
Analyzer state	Input register	R		uint16	3	9C56	22	21
Analyzer error code	Input register	R		uint16	3	9C57	23	22
FPGA version	Input register	R		String (20 bytes)	3	9C69	41	40
Firmware version	Input register	R		String (20 bytes)	3	9C73	51	50
Serial number	Input register	R		String (20 bytes)	3	9C7D	61	60

Table 22 Modbus RTU input register map

Note

See electrical connections in chapter 10.

24 Appendix 3: Battery Details

Battery Model: ET2016C-H

No	Parameter	Value
3.1	Operating Voltage	2.7 ~ 1.5 V
3.2	Nominal Capacity (Standard Charge/Discharge)	20.0 mAh
3.3	Minimum Capacity (Standard Charge/Discharge)	Min 18.0 mAh
3.4	Nominal Voltage	2.3 V
3.5	1CmA	20 mA
3.6	Standard Charge	CV (Constant Voltage); Voltage: 2.7 V Cut-off current : 0.02 CmA (@ 25 ±2 °C, 65 ±20 % RH)
3.7	Max. Charge Current	No limit
3.8	Standard Discharge	CC (Constant Current); Current: 0.1 CmA Cut-off Voltage : 1.5 V (@ 25 ±2 °C, 65 ±20 % RH)
3.9	Peak Discharge Current *	45 mA
3.10	Cell Weight	Less than 3 g
3.11	Cell Diameter	20.0 ±0.2 mm (not including terminals)
3.12	Cell thickness	1.95 +0.2/-0.1 mm (including terminals)
3.13	Open Circuit Voltage	2.35 ±0.05 V
3.14	Technology	Positive electrode: $LiCoO_2$ ceramic plate with high-speed Li ion conductivity by crystal orientation. Negative electrode: $Li_4Ti_5O_{12}$ (LTO) electrolyte: Li[BF4] (lithiumtetrafluorborate) with organic solvent
3.15	Semi-Solid State Battery (EnerCera® Coin)	The battery is packaged with all-ceramic stacked monolithic body with a minimal amount of liquid electrolyte.
3.16	Constant Voltage Charging	OK
3.17	Internal Resistance (Ω)	10
3.18	Operating Temp. (recommended)	-40 to 105 °C
3.19	Mounting Method	Reflow soldering
3.20	Features	High Heat Resistance

*Voltage drop is 0.5 V within 1 sec.
EnerCera® is a registered trademark for a rechargeable li-ion battery by NGK Insulators LTD., Japan

Table 23 Battery model: ET2016C-H

25 Appendix 4: ATEX Details

Parameter	Size/properties
Width of flameproof joint at protection niveau "db" (enclosure)	
Gas-group IIC, dust group IIIC	
Flat gap (also according to 5.2.7) for a volume V ≤ 500 cm^3	≥ 9.5 mm
Restriction due to acetylene/air mixtures	Max. gap width 0.04 mm
Minimum length of the flameproof gap according to the documentation (technical drawing)	≥ 9.5 mm
Maximum gap width of the flameproof gap according to documentation (technical drawing)	≤ 0.04 mm
Thread gaps	
Minimum number of engaged threads according to documentation (technical drawing)	≥ 5 mm
Screw-in depth with a cylindrical thread gap (volume > 100 cm^3)	≥ 8 mm
Thread pitch	≥ 0.7 mm
Thread form and grade	Medium, tolerances according to ISO 965-1 and ISO 965-3
Conical thread pitch	
Tapered male thread (Swagelok SS 6M0):	At least 4.5 full threads engaged (see table 5)

Table 24 Atex details of laser head

Com-ponent	Manu-facturer	Type	ATEX	ATEX certificate	Date	IECEx	Ambient temperature range	IP-class
Complete unit	M&C Techgroup Germany GmbH	ILA1-X000-EX					$T_{ambient}$ -40 °C to +59 °C: T6 ≤ 85 °C $T_{ambient}$ -40 °C to +65 °C: T5 ≤ 100 °C	IP65
Breathing and draining device	M&C Techgroup Germany GmbH	MC95A	II 2 G Ex db IIC Gb	IBEXU 15 ATEX1028 U	04.05.2015	IECEX IBE 15.0013U	Tamb -20 °C to +80 °C	n.a.
Single wire feedthrough	Quintex	LBSM24122/ MCRA	II 2G Ex db IIC T4/T5/T6 Gb II 2G Ex eb IIC T4/T5/T6 Gb II 2 D Ex tb IIIC T135 °C, T100 °C, T135 °C, T85 °C Db IP66 I M2 Ex db I Mb	EPS 11 ATEX 1342 X	17.05.2021	IECEX EPS 11.0004X	-55 °C to +115 °C; due to the o-ring limitation of the upper ambient temperature +70°C	IP66/ IP68
Ex e-housing	Rose Systemtechnik	06.08 11 088 (Ex Polyester standard) mit HF-Dichtung	II 2 G Ex db eb ia [ia] mb IIC T4, T5, T6 Gb II 2 D Ex tb IIIC T85 °C, T100 °C, T135 °C Db	PTB 00 ATEX 1002	26.03.2018		-40 °C to +90 °C	IP66/ IP68
Cable gland M16	Pflitsch	bg216msHTex	II 2G Ex eb IIC Gb II 2D Ex tb IIIC Db	PTB 11 ATEX 1007X xx C 0102	22.04.2020	IEC 60079-0:2017, IEC 60079-7:2017 IEC 60079-31:2013	-55 °C to +160 °C	IP66/ IP68
Cable gland M20	Pflitsch	bg220msHTex	II 2G Ex eb IIC Gb II 2D Ex tb IIIC Db	PTB 11 ATEX 1007X xx C 0102	22.04.2020	IEC 60079-0:2017, IEC 60079-7:2017 IEC 60079-31:2013	-55 °C to +160 °C	IP66/ IP68

Table 25 Atex details of components used in the system

26 Appendix 5: Certificates

IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[1] **EU-BAUMUSTERPRÜFBESCHEINIGUNG**

[2] Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen, Richtlinie 2014/34/EU

[3] EU-Baumusterprüfbescheinigung Nummer **IBExU24ATEX1007 X** | Ausgabe 0

[4] Produkt: **In-situ Laser Analysator**
Typ: ILA1-X000-EX

[5] Hersteller: M&C TechGroup Germany GmbH

[6] Anschrift: Rehhecke 79
40885 Ratingen
GERMANY

[7] Dieses Produkt sowie die verschiedenen zulässigen Ausführungen sind in der Anlage zu dieser Bescheinigung sowie den darin aufgeführten Unterlagen festgelegt.

[8] IBExU Institut für Sicherheitstechnik GmbH, notifizierte Stelle mit der Nummer 0637 in Übereinstimmung mit Artikel 17 der Richtlinie 2014/34/EU des Europäischen Parlaments und des Rates vom 26. Februar 2014, bestätigt, dass dieses Produkt die wesentlichen Sicherheits- und Gesundheitsanforderungen für die Konzeption und den Bau von Produkten zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen aus Anhang II der Richtlinie erfüllt.

Die Untersuchungs- und Prüfergebnisse werden in dem vertraulichen Prüfbericht IB-23-3-0085 festgehalten.

[9] Die Beachtung der wesentlichen Sicherheits- und Gesundheitsanforderungen wurde in Übereinstimmung mit folgenden Normen gewährleistet:
EN IEC 60079-0:2018 EN 60079-1:2014 EN IEC 60079-7:2015/A1:2018 EN 60079-28:2015
EN 60079-31:2014

Hiervon ausgenommen sind jene Anforderungen, die unter Punkt [18] der Anlage aufgelistet werden.

[10] Ein „X" hinter der Bescheinigungsnummer weist darauf hin, dass das Produkt den besonderen Bedingungen für die Verwendung unterliegt, die in der Anlage zu dieser Bescheinigung festgehalten sind.

[11] Diese EU-Baumusterprüfbescheinigung bezieht sich ausschließlich auf die Konzeption und den Bau des angegebenen Produktes. Für den Fertigungsprozess und die Bereitstellung dieses Produkts gelten weitere Anforderungen der Richtlinie. Diese fallen jedoch nicht in den Anwendungsbereich dieser Bescheinigung.

[12] Die Kennzeichnung des Produktes muss Folgendes beinhalten:

Ex II (1)2 G Ex db eb [op is Ga] IIC T6 Gb | **Ex II (1)2 G Ex db eb [op is Ga] IIC T5 Gb**
Ex II (1)2 D Ex tb [op is Da] IIIC T85 °C Db | **Ex II (1)2 D Ex tb [op is Da] IIIC T92 °C Db**
T_a -40 °C ... +59 °C | T_a -40 °C ... +65 °C

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
09599 Freiberg, GERMANY

Tel.: +49 (0)3731 3805-0
Fax: +49 (0)3731 3805-10

Im Auftrag

Dipl.-Ing. K. Willamowski

- Siegel -
(notifizierte Stelle Nummer 0637)

Bescheinigungen ohne Siegel und Unterschrift haben keine Gültigkeit. Bescheinigungen dürfen nur vollständig und unverändert vervielfältigt werden.

Freiberg, 04.03.2025

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IBExU24ATEX1007 X | 0

IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[13] **Anlage**

[14] **Bescheinigung Nummer IBExU24ATEX1007 X** | Ausgabe 0

[15] **Beschreibung des Produkts**

Der In-situ Laser Analysator Typ ILA1-X000-EX ist ein Hochleistungsanalysator für industrielle und potenzielle Compliance-Anwendungen. Er besteht aus einer Sonde, die eine Messstrecke, einen Sondenflansch und einen druckfesten Sensorkopf mit separat geprüftem Ex-e-Anschlusskasten umfasst, sowie einer separaten HMI-Einheit (optional). Der Sender und der Empfänger befinden sich im Sensorkopf, der Strahlreflektor ist in der Spitze der Sonde im Messabschnitt untergebracht.

Technische Daten

- Nennspannung:	24 V DC
- Leistungsaufnahme:	max. 6 VA
- Umgebungstemperaturbereich:	-40 °C bis +59 °C bzw. +65 °C
- Schrauben-Festigkeitsklasse:	A4-70 nach ISO 4762

[16] **Prüfbericht**

Die Prüfergebnisse sind im vertraulichen Prüfbericht IB-23-3-0085 vom 27.02.2025 festgehalten.
Die Prüfunterlagen sind Teil des Prüfberichts und werden darin aufgelistet.

Zusammenfassung der Prüfergebnisse

Der In-situ Laser Analysator Typ ILA1-X000-EX genügt den Anforderungen des Explosionsschutzes für Geräte der Gruppe II, Kategorie (1)2 G in Zündschutzart druckfeste Kapselung „db", erhöhte Sicherheit „eb" und inhärent sichere optische Strahlung „op is" sowie Kategorie (1)2 D in Zündschutzart Staubexplosionsschutz durch Gehäuse „tb" in Verbindung mit Schutz durch inhärent sichere optische Strahlung „op is".

[17] **Besondere Bedingungen für die Verwendung**

- Eine Reparatur an den zünddurchschlagsicheren Spalten darf nur entsprechend konstruktiver Vorgaben des Herstellers erfolgen. Die Reparatur entsprechend den Werten der Tabellen 2 und 3 der EN 60079-1 ist nicht zulässig.
- Es dürfen nur die vom Hersteller festgelegten Gehäuseschrauben nach ISO 4762 (Festigkeitsklasse A4-70) verwendet werden.
- Das Typenschild ist gegen intensive elektrostatische Aufladevorgänge zu schützen.
- Es dürfen nur Kabel- und Leitungseinführungen und Blindverschlüsse mit Dichtung verwendet werden.

[18] **Wesentliche Sicherheits- und Gesundheitsanforderungen**

Zusätzlich zu den wesentlichen Sicherheits- und Gesundheitsanforderungen, die in den Anwendungsbereich der unter Punkt [9] genannten Normen fallen, wird Folgendes für dieses Produkt als relevant angesehen und die Konformität wird im Prüfbericht dargelegt:

- nicht zutreffend -

[19] **Zeichnungen und Unterlagen**

Die Dokumente sind im Prüfbericht aufgelistet.

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
09599 Freiberg, GERMANY

Im Auftrag

Dipl.-Ing. K. Willamowski

Freiberg, 04.03.2025

IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[1] **EU-TYPE EXAMINATION CERTIFICATE** - TRANSLATION

[2] Equipment and protective systems intended for use in potentially explosive atmospheres, directive 2014/34/EU

[3] EU-Type Examination Certificate Number **IBExU24ATEX1007 X** | Issue 0

[4] Equipment: **In-situ Laser Analyzer**
Type: ILA1-X000-EX

[5] Manufacturer: M&C TechGroup Germany GmbH

[6] Address: Rehhecke 79
40885 Ratingen
GERMANY

[7] This product and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

[8] IBExU Institut für Sicherheitstechnik GmbH, Notified Body number 0637 in accordance with Article 17 of Directive 2014/34/EU of the European Parliament and of the Council, dated 26 February 2014, certifies that this product has been found to comply with the essential health and safety requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Annex II to the Directive.

The examination and test results are recorded in the confidential test report IB-23-3-0085.

[9] Compliance with the essential health and safety requirements has been assured by compliance with:
EN IEC 60079-0:2018 EN 60079-1:2014 EN IEC 60079-7:2015/A1:2018 EN 60079-28:2015
EN 60079-31:2014

Except in respect of those requirements listed at item [18] of the schedule.

[10] If the sign "X" is placed after the certificate number, it indicates that the product is subject to the specific conditions of use specified in the schedule to this certificate.

[11] This EU-type examination certificate relates only to the design and construction of the specified product. Further requirements of the Directive apply to the manufacturing process and supply of this product. These are not covered by this certificate.

[12] The marking of the product shall include the following:

Ex II (1)2 G Ex db eb [op is Ga] IIC T6 Gb
Ex II (1)2 D Ex tb [op is Da] IIIC T85 °C Db
T_a -40 °C ... +59 °C

Ex II (1)2 G Ex db eb [op is Ga] IIC T5 Gb
Ex II (1)2 D Ex tb [op is Da] IIIC T92 °C Db
T_a -40 °C ... +65 °C

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
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Phone: +49 (0)3731 3805-0
Fax: +49 (0)3731 3805-10

By order

Dipl.-Ing. K. Willamowski

Seal
(Notified Body number 0637)

Certificates without seal and signature are not valid. Certificates may only be duplicated completely and unchanged. In case of dispute, the German text shall prevail.

Freiberg, 2025-03-04

IBExU Institut für Sicherheitstechnik GmbH
An-Institut der TU Bergakademie Freiberg

[13] **Schedule**

[14] **Certificate Number IBExU24ATEX1007 X** | Issue 0

[15] **Description of product**

The In-situ Laser Analyzer type ILA1-X000-EX is a high-performance analyzer for industrial and potential compliance applications. It consists of a probe which includes a measuring section, probe flange and sensor head as well as a separate HMI unit (optionally). The transmitter and receiver are located in the sensor head, the beam reflector is placed inside the tip of the probe in the measuring section.

Technical data

- Nominal voltage:	24 V DC
- Power input:	max. 6 VA
- Ambient temperature range:	-40 °C up to +59 °C or +65 °C
- Property class fastening screws:	A4-70 according to ISO 4762

[16] **Test report**

The test results are recorded in the confidential test report IB-23-3-0085 of 2025-02-27.
The test documents are part of the test report and they are listed there.

Summary of the test results

The In-situ Laser Analyzer type ILA1-X000-EX fulfils the requirements of explosion protection for equipment of Group II, Category 2 G, type of protection flameproof enclosure "db", increased safety "eb"" and inherently safe optical radiation "op is" and Category 2 D, type of protection dust ignition protection by enclosure "tb" and inherently safe optical radiation "op is".

[17] **Special conditions for use**

- Repairs of the flameproof joints must be made in compliance with the constructive specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 2 and 3 of IEC 60079-1.
- Only the fastening screws specified by the manufacturer (strength class min. A4-70) according to ISO 4762 may be used.
- The label of the In-situ Laser Analyzer must be protected against intensive electrostatic charging.
- Only cable glands and plugs with sealing ring must be used.

[18] **Essential health and safety requirements**

In addition to the essential health and safety requirements (EHSRs) covered by the standards listed at item [9], the following are considered relevant to this product, and conformity is demonstrated in the test report:

- not applicable -

[19] **Drawings and documents**

The documents are listed in the test report.

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
09599 Freiberg, GERMANY

By order

Dipl.-Ing. K. Willamowski

Freiberg, 2025-03-04

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification System for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	**IECEx IBE 24.0007X**	Page 1 of 3	Certificate history:
Status:	**Current**	Issue No: 0	
Date of Issue:	2025-03-04		
Applicant:	**M&C TechGroup Germany GmbH** Rehhecke 96 40885 Ratingen **Germany**		
Equipment:	**In-situ Laser Analyzer type ILA1-X000-EX**		
Optional accessory:			
Type of Protection:	**Ex db, Ex eb, Ex op is, Ex tb**		
Marking:	Ex db eb [op is Ga] IIC T6 or T5 Gb Ex tb [op is Da] IIIC T85 °C or T100 °C Db T_a -40 °C ... +59 °C or +65 °C		

Approved for issue on behalf of the IECEx Certification Body: **Kai Willamowski**

Position: **Head of department Certification Body**

Signature: (for printed version)

Date: (for printed version) 04.03.2025

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting www.iecex.com or use of this QR Code.

Certificate issued by:

IBExU Institut für Sicherheitstechnik GmbH
Fuchsmühlenweg 7
09599 Freiberg
Germany

IECEx Certificate of Conformity

Certificate No.: **IECEx IBE 24.0007X** Page 2 of 3

Date of issue: 2025-03-04 Issue No: 0

Manufacturer: **M&C TechGroup Germany GmbH**
Rehhecke 96
40885 Ratingen
Germany

Manufacturing locations:

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements.This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended

STANDARDS :
The equipment and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards

IEC 60079-0:2017 Edition:7.0	Explosive atmospheres - Part 0: Equipment - General requirements
IEC 60079-1:2014 Edition:7.0	Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"
IEC 60079-28:2015 Edition:2	Explosive atmospheres - Part 28: Protection of equipment and transmission systems using optical radiation
IEC 60079-31:2022 Edition:3.0	Explosive atmospheres – Part 31: Equipment dust ignition protection by enclosure "t"
IEC 60079-7:2017 Edition:5.1	Explosive atmospheres - Part 7: Equipment protection by increased safety "e"

This Certificate **does not** indicate compliance with safety and performance requirements other than those expressly included in the Standards listed above.

TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in:

Test Report:

DE/IBE/ExTR24.0002/00

Quality Assessment Report:

DE/BVS/QAR17.0009/07

IECEx Certificate of Conformity

Certificate No.: **IECEx IBE 24.0007X** Page 3 of 3

Date of issue: 2025-03-04 Issue No: 0

EQUIPMENT:
Equipment and systems covered by this Certificate are as follows:

The In-situ Laser Analyzer ILA1-X000-EX is a high-performance analyzer for industrial and potential compliance applications. It consists of a probe which includes a measuring section, probe flange and sensor head as well as a separate HMI unit (optionally). The transmitter and receiver are located in the sensor head, the beam reflector is placed inside the tip of the probe in the measuring section.

Technical Data

- Nominal voltage:	24 V DC
- Power:	max. 6 VA
- Ambient temperature range:	-40 °C up to +59 °C or +65 °C
- Property class fastening screws:	A4-70 according to ISO 4762

SPECIFIC CONDITIONS OF USE: YES as shown below:

- Repairs of the flameproof joints must be made in compliance with the constructive specifications provided by the manufacturer. Repairs must not be made on the basis of values specified in tables 2 and 3 of IEC 60079-1.
- Only the fastening screws specified by the manufacturer (strength class min. A4-70) according to ISO 4762 may be used.
- The In-situ Laser Analyzer must be protected against intensive electrostatic charging.
- Only cable glands and plugs with sealing ring must be used.